

Vol. 4 No. 2  
December 2014  
ISSN 2047-2978

journal of  
**gl****bal**  
health

**Journal of Global Health (JoGH)** is a peer-reviewed general medical journal focusing on issues relevant for global health. The mission of the journal is to serve the community of researchers, funding agencies, international organizations, policy-makers and other stakeholders by providing an independent critical assessment of the key issues that dominated the global health community. **JoGH** publishes original articles, viewpoints, research protocols and other publication items, making them available in full text online as soon as they are ready for publication. The articles are collected in two annual print issues, at the end of June and December. Guidelines for authors are available at <http://jogh.org/contributors.htm>. All submissions and editorial inquiries should be directed to [editor@jogh.org](mailto:editor@jogh.org).

**Publisher:** Edinburgh University Global Health Society (EUGHS).  
The views expressed by the authors do not reflect the views of **JoGH** or its publisher.  
**Creative Commons Licence:** CC BY 4.0 (<http://creativecommons.org/licenses/by/4.0/>).

**Print ISSN:** 2047-2978  
**Online ISSN:** 2047-2986  
Paper version of the journal is printed on acid-free paper.

**JoGH** editors and editorial board members are independent researchers based at academic institutions, thus being well placed to provide professional evaluation of the key topics and ongoing activities and programs.

#### EDITORS-IN-CHIEF

**Professor Ana Marušić** – Chair, Department of Research in Biomedicine and Health; The University of Split School of Medicine, Split, Croatia

**Professor Igor Rudan** – Chair in International Health and Molecular Medicine; Co-Director, WHO Collaborating Centre for Population Health Research and Training; Research Director, Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Edinburgh, Scotland, UK

**Professor Harry Campbell** – Professor of Genetic Epidemiology and Public Health; Co-Director, WHO Collaborating Centre for Population Health Research and Training; Co-Director, Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Edinburgh, Scotland, UK

#### REGIONAL EDITORS

**North America:** **Professor Robert E. Black** – Director for the Institute of International Programs; Johns Hopkins Bloomberg School of Public Health; Johns Hopkins University, Baltimore, MD, USA • **Professor Craig E. Rubens** – Affiliate Professor of Global Health and Affiliate Professor of Pediatrics; Executive Director, Global Alliance to Prevent Prematurity and Stillbirth (GAPPS); Seattle Children's and University of Washington School of Medicine, Seattle, WA, USA

**South America:** **Professor Claudio F. Lanata** – Nutritional Research Institute; Lima, Peru • **Professor Cesar G. Victora** – Professor of Epidemiology; Federal University of Pelotas; Pelotas, Brazil

**Europe:** **Professor Sue C. Welburn** – Assistant Principal Global Health; Professor, Medical and Veterinary Molecular Epidemiology; Director, Global Health Academy; The University of Edinburgh, Edinburgh, Scotland, UK • **Dr Evropi Theodoratou** – Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Edinburgh, Scotland, UK

**Africa:** **Professor Shabir A. Madhi** – Executive Director, National Institute for Communicable Diseases; DST/NRF South African Research Chair in Vaccine Preventable Diseases; University of the Witwatersrand, Johannesburg, South Africa • **Professor Mark R. Tomlinson** – Department of Psychology; Stellenbosch University, Matieland, South Africa

**Asia:** **Professor Zulfiqar A. Bhutta** – The Noordin Noormahomed Sheriff Endowed Professor and Founding Chair, Department of Paediatrics and Child Health; The Aga Khan University, Karachi, Pakistan • **Professor Shams El Arifeen** – Professor of Epidemiology; Director, Centre for Child and Adolescent Health; International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B); James P. Grant School of Public Health, BRAC University, Dhaka, Bangladesh

**China:** **Professor Yan Guo** – Professor of Public Health; Vice President, Peking University Health Science Center; Vice Chairman of the Chinese Rural Health Association; Vice Director of the China Academy of Health Policy (PKU); School of Public Health, Peking University, Beijing, China • **Dr Kit Yee Chan** – Visiting Scholar, School of Public Health, Peking University Health Science Center; Peking University, Beijing, China and Reader, Center for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Scotland, UK

**India:** **Professor K. Srinath Reddy** – President, Public Health Foundation of India; President, World Heart Federation; Chair, Core Advisory Group on Health and Human Rights, National Human Rights Commission, India; President, National Board of Examinations, India; Bernard Lown Visiting Professor of Cardiovascular Health, Harvard School of Public Health, Boston, MA, USA • **Dr Harish Nair** – Public Health Foundation of India; Indian Institute of Public Health, New Delhi, India; Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Scotland, UK

**Australia and Western Pacific:** **Professor Trevor Duke** – Director, Centre for International Child Health; Director, WHO Collaborating Centre for Research and Training in Child and

Neonatal Health; Deputy Director of the Intensive Care Unit and Clinical Director of the General Intensive Care Unit; The University of Melbourne and Royal Children's Hospital, Melbourne, Australia • **Professor Wei Wang** – Professor of Postgraduate Medicine; School of Medical Sciences, Edith Cowan University, Perth, Australia

#### EDITORIAL COUNCIL

**Professor Stephen Hillier** – Vice Principal International; International Strategy and Partnerships, International Office; The University of Edinburgh, Edinburgh, Scotland, UK • **Professor David Weller** – James MacKenzie Professor; Head of General Practice Department; Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Edinburgh, Scotland, UK • **Professor James Smith** – Professor of African and Development Studies; Assistant Principal, Global Development Academy; School of Social and Political Science; The University of Edinburgh, Edinburgh, Scotland, UK • **Jake Broadhurst** – Head, Global Academies Directorate; The University of Edinburgh, Edinburgh, Scotland, UK • **Professor Mickey Chopra** – Honorary Professor of Global Health; Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Edinburgh, Scotland, UK; Chief of Health, UNICEF, New York, NY, USA • **Dr Elizabeth Grant** – Deputy Director, Global Health Academy; Senior Lecturer in Global Health and Development; Programme Director, Distance Learning Masters Programmes; Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Edinburgh, Scotland, UK • **Dr Devi Sridhar** – Senior Lecturer in Global Public Health; Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Edinburgh, Scotland, UK and Co-Director, Centre for AIDS Interdisciplinary Research (CAIRO), Blavatnik School of Government, Oxford University, Oxford, UK

#### EDITORIAL BOARD

**Dr Davies Adeloje** – Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Edinburgh, Scotland, UK • **Professor Abdullah H. Baqui** – Director, International Center for Maternal and Newborn Health; The Johns Hopkins Center for Global Health; Johns Hopkins University, Baltimore, MD, USA • **Dr Luciana Brondi** – Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Edinburgh, Scotland, UK • **Dr W. Abdullah Brooks** – Director, Kamalapur Field Site; Head, Infectious Diseases Unit; The Johns Hopkins Center for Global Health; Johns Hopkins University, Baltimore, MD, USA • **Professor Graham Brown** – Foundation Director; Nossal Institute for Global Health; The University of Melbourne, Melbourne, Australia • **Ruth M. Campbell** – Honorary Associate/Researcher; Harvard Global Equity Initiative, Cambridge, MA, USA • **Associate Professor Josip Car** – Director of Health Services and Outcomes Research Programme; Lee Kong Chian School of Medicine; Imperial College & Nanyang Technological University, Singapore and Director, Global eHealth Unit, School of Public Health, The Imperial College London, London, UK • **Professor Simon Cousens** – Professor of Epidemiology and Medical Statistics; Director of Research Degrees; Department of Infectious Disease Epidemiology; London School of Hygiene and Tropical Medicine, London, UK • **Professor Karen Edmond** – Winthrop Professor; School of Paediatrics and Child Health; The University of Western Australia, Perth, Australia • **Dr Christa L. Fischer Walker** – Associate Scientist; Division of Global Disease Epidemiology and Control; The Johns Hopkins Center for Global Health; Johns Hopkins University, Baltimore, MD, USA • **Professor Wendy J. Graham** – Chair in Obstetrics and Gynaecology; The Institute of Applied Sciences; The University of Aberdeen, Aberdeen, UK • **Dr David B. Hipgrave** – Honorary Senior Researcher; Nossal Institute of Global Health; University of Melbourne, Melbourne, Australia and UNICEF, New York, NY, USA • **Dr Hope L. Johnson** – Center for Global Health; Johns Hopkins University Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA and Head, Programme Outcomes and Impact, GAVI Alliance, Geneva, Switzerland • **Professor Keith P. Klugman** – William H. Foege Chair of Global Health; Hubert Department of Global Health, Rollins School of Public Health; The Emory University, Atlanta, GA,

USA • **Assistant Professor Ivana Kolčić** – Assistant Professor of Epidemiology; Croatian Centre for Global Health; Department of Public Health; The University of Split School of Medicine, Split, Croatia • **Assistant Professor Tomislav Lauc** – Assistant Professor of Orthodontics and Dental Anthropology; Editor-in-Chief, South European Journal of Orthodontics and Dentofacial Research; Department of Anthropology, School of Social Sciences and Humanities; University of Zagreb, Zagreb, Croatia • **Professor Joy E. Lawn** – Director, Global Evidence and Policy, Saving Newborn Lives programme, Save the Children; Director, MARCH Centre; The London School of Hygiene and Tropical Medicine, London, UK • **Clinical Assistant Professor James A. Litch** – Director, Perinatal Interventions Program; Global Alliance to Prevent Prematurity and Stillbirth (GAPPS), Seattle Children's; Department of Global Health and Department of Epidemiology; University of Washington, Seattle, WA, USA • **Dr Li Liu** – Assistant Scientist; Division of Global Disease Epidemiology and Control; The Johns Hopkins Center for Global Health; Johns Hopkins University, Baltimore, MD, USA • **Professor Azeem Majeed** – Head, Department of Primary Care & Public Health; Imperial College London, UK • **Professor Julie Meeks Gardner** – Head, Caribbean Child Development Centre; Consortium for Social Research and Development; The University of the West Indies, Mona, Jamaica • **Professor Katherine L. O'Brien** – Executive Director, The International Vaccine Access Center (IVAC); Global Disease Epidemiology and Control, Center for Global Health; Johns Hopkins University; Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA • **Associate Professor Ozren Polašek** – Associate Professor of Biostatistics; Director, Croatian Centre for Global Health; Department of Public Health; The University of Split School of Medicine, Split, Croatia • **Professor Carine Ronsmans** – Professor of Epidemiology; Head, Department of Infectious Diseases Epidemiology, The London School of Hygiene and Tropical Medicine, London, UK • **Professor Samir K. Saha** – Head, Department of Microbiology; Executive Director, The Child Health Research Foundation; Bangladesh Institute of Child Health, Dhaka Shishu Hospital, Dhaka, Bangladesh • **Professor Joshua A. Salomon** – Professor of Global Health; Department of Global Health and Population; Harvard School of Public Health and Harvard Global Health Institute; Harvard University, Boston, MA, USA • **Dr Giorgio Tamburlini** – Research Director, Institute of Child Health IRCCS Burlo Garofolo; Scientific Director, European School for Maternal, Newborn, Child and Adolescent Health; Director, WHO Collaborating Centre on Maternal and Child Health; The Institute Burlo Garofolo, Trieste, Italy • **Assistant Professor Alexander C. Tsai** – Assistant Professor of Psychiatry; Department of Psychiatry; Massachusetts General Hospital and Harvard Medical School, Boston, USA • **Professor Peter Tugwell** – Professor of Medicine and Epidemiology & Community Medicine; co-Director, WHO Collaborating Centre for Knowledge Translation and Health Technology Assessment in Health Equity; Director, Centre for Global Health; Institute of Population Health and Department of Medicine; Faculty of Medicine, The University of Ottawa, Ottawa, Canada • **Associate Professor Anita K. Zaidi** – Director of Research, Department of Paediatrics and Microbiology; The Aga Khan University, Karachi, Pakistan and Director, Enteric and Diarrheal Diseases, Bill and Melinda Gates Foundation, Seattle, WA, USA • **Associate Professor Lina Zgaga** – Associate Professor of Epidemiology; Department of Public Health and Primary Care; Trinity College Centre for Health Sciences, Dublin, Ireland • **Professor Stanley H. Zlotkin** – Professor, Departments of Paediatrics, Nutritional Sciences and Dalla Lana School of Public Health/Vice President, Medical and Academic Affairs, Department of Pediatrics and Surgery, Division of Clinical Medicine; The Hospital for Sick Children, The University of Toronto, Toronto, Canada

#### NEWS SECTION EDITOR

**Rachael Atherton** – Centre for Population Health Sciences; College of Medicine and Veterinary Medicine; The University of Edinburgh, Edinburgh, Scotland, UK

# Journal of Global Health: The Mission Statement

The *Journal of Global Health* is a peer-reviewed journal published by the Edinburgh University Global Health Society, a not-for-profit organization registered in the UK. The *Journal* publishes editorials, news, viewpoints, original research and review articles in two issues per year.

The *Journal's* mission is to serve the community of researchers, funding agencies, international organizations, policy-makers and other stakeholders in the field of international health by:

- presenting important news from all world regions, key organizations and resources for global health and development;
- providing an independent assessment of the key issues that dominated the previous semester in the field of global health and development;
- publishing high-quality peer-reviewed original research and providing objective reviews of global health and development issues;
- allowing independent authors and stakeholders to voice their personal opinions on issues in global health.

Each issue is dedicated to a specific theme, which is introduced in the editorial and in one or more viewpoints and related articles. The news section brings up to five news items, selected by the *Journal's* editorial team, relevant to seven regions of the world, seven international agencies and seven key resources important to human population health and development.

We particularly welcome submissions addressing persisting inequities in human health and development globally and within regions. We encourage content that could assist international organizations to align their investments in health research and development with objective measurements or estimates the disease burden or health problems that they aim to address. Finally, we promote submissions that highlight or analyse particularly successful or harmful practices in management of the key resources important for human population health and development.

All editors and editorial board members of the *Journal* are independent health professionals based at academic institutions or international public organisations and so are well placed to provide objective professional evaluation of key topics and ongoing activities and programs. We aim to stay true to principles of not-for-profit work, open knowledge and free publishing, and independence of academic thought from commercial or political constraints and influences. Join us in this publishing effort to provide evidence base for global health!

March 7, 2011

The Editors, *Journal of Global Health*



Children in a rural orphanage in Kenya, miles from access to any healthcare centre, competing in a bandage race in their first ever lesson in first aid. Earlier challenges required them to treat burns by compressing dirt into the wound to "dry it out" and attempted to care for snake bites by "sucking the venom out". With mortality rates from simple injuries in the area being very high, they were all eager to learn how to treat themselves and their friends, so they turned out for a lesson early on a Saturday morning

Submitted by: **Kate O'Sullivan**, EUGHS member. The Photo won the 1st Prize in the Journal of Global Health's annual photo competition in 2014.

# Current scientific evidence for integrated community case management (iCCM) in Africa:

## Findings from the iCCM Evidence Symposium

Theresa Diaz<sup>1</sup>, Samira Aboubaker<sup>2</sup>, Mark Young<sup>1</sup>

<sup>1</sup> Health Section, Programme Division, UNICEF, New York, NY, USA

<sup>2</sup> Maternal, Newborn, Child and Adolescent Health and Development, World Health Organization, Geneva, Switzerland

In March 2014, over 400 individuals from 35 countries in sub-Saharan Africa and 59 international partner organizations gathered in Accra, Ghana for an integrated Community Case Management (iCCM) Evidence Review Symposium. The objective was 2-fold: first, to review the current state of the art of iCCM implementation and second, to assist African countries to integrate lessons learned and best practices presented during the symposium into their programmes. Based on the findings from the symposium this supplement includes a comprehensive set of articles that provide the latest evidence for improving iCCM programs and ways to better monitor and evaluate such programs.

Since early 2000 the use of integrated community case management (iCCM) strategy to deliver pneumonia, malaria and diarrhea treatments to children under 5 has dramatically increased. In 2005 there were only 10 countries in sub-Saharan Africa with policies supporting implementation of iCCM of which 7 included pneumonia treatment [1]. This increased to 28 countries by 2013 that now support implementation of iCCM and this includes pneumonia treatment [2].

iCCM, in the hands of well trained, supplied and supervised community health workers can reduce child mortality [3,4]. Recognizing this, in 2012 the World Health Organization and UNICEF released a Joint Statement for iCCM as an equity-focused strategy to improve access to case management, emphasizing important standard practices that should be part of any such programming in countries [5]. However, iCCM implementation has faced challenges considering the poor health care infrastructure in the countries in which this strategy has been introduced.

Since the joint statement was released an increasing amount of evidence has been generated on the strengths and limita-

tions of iCCM, as well as the outcome and impact of iCCM within a variety of different country contexts [6]. A number of key impact and outcome studies were finalized in 2013. New and innovative methods for reporting and supervision have been tested. A comprehensive assessment of cost drivers and cost-effectiveness of this approach is ongoing. Finally, given the acceptance of iCCM as a delivery strategy to reach particularly those with limited access to health services, there has been much interest to add other interventions to the package such as maternal and newborn but these additions are only currently being tested in a few countries.

Between 3 and 5 March 2014, over 400 individuals from 35 countries in sub-Saharan Africa and 59 international partner organizations gathered in Accra, Ghana for an iCCM Evidence Review Symposium. The objective of the symposium was 2-fold: first, to review the current state of the art of iCCM implementation by bringing together researchers, donors, governments, implementers and partners to examine the current iCCM implementation landscape and status of evidence in key programme areas, in order to summarize lessons learned and best practices, and identify priorities and



Photo: Courtesy of UNICEF

gaps in knowledge for improving maternal-newborn and child health. Second, to assist African countries to integrate lessons learned and best practices presented during the evidence symposium into their programmes and identify key actions to include in their national plans.

We conceptualized a theory of change model as to what factors may increase utilization of quality iCCM services (Figure 1). We assumed that this increase in utilization would translate into increased coverage and thus ultimately contribute to decreased child hood mortality.

The symposium and articles in this supplement were organized in thematic areas based on this model. Presentations

were given in each thematic area and tools to support implementation were shared with participants for each of these areas as well as in three additional topic areas (private sector, innovations and newborn interventions). In addition lessons learned were documented in each area. This supplement includes articles, based in part on these experiences and lessons learned. The thematic and additional areas, their relationship to the model, and their associated articles are shown in Box 1.

In regards to policy and scale up Rasanathan et al report on the results of survey on iCCM in sub-Saharan Africa and in a viewpoint summarizing policy issues that impact scale

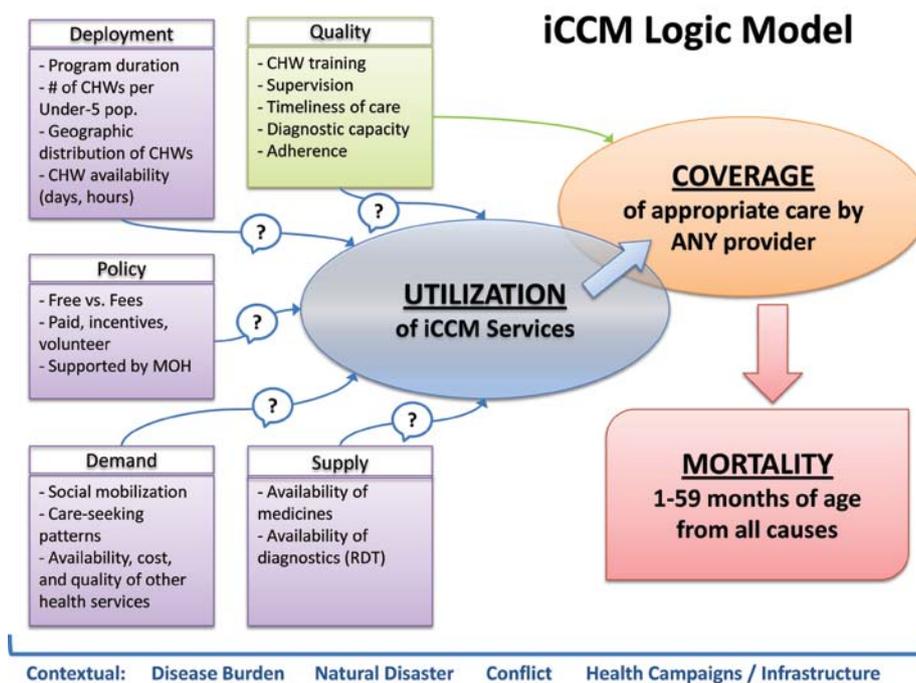


Figure 1. Logic model of integrated community case management.

**Box 1** Thematic areas, relationship to conceptual model and associated articles

1. **Coordination, Policy Setting and Scale-up:** the current state of iCCM policies in Africa and challenges in development of policy and scale up– RELATES TO POLICY  
Rasanathan et al. Community case management of childhood illness in Sub-Saharan Africa: Findings from a cross-sectional survey on policy and implementation (article # 020401)  
Rasanathan et al. Where to from here? Policy and financing of integrated community case management of childhood illness (iCCM) in sub-Saharan Africa (article # 020304)
2. **Human Resources and Deployment:** community health worker (CHW) selection, geographic disbursement, motivation and retention – RELATES TO DEPLOYMENT  
Pratt et al. Spatial distribution and deployment of community-based distributors implementing integrated community case management (iCCM): GIS mapping study in three South Sudan states (article # 020402)
3. **Supervision & Performance Quality Assurance:** strategies to ensure high quality care including strategies for effective training, use of alternative models for supervision, and the role of mHealth to support and motivate CHWs to provide quality care – RELATES TO QUALITY  
Bosh-Capblanch and Marceau. Training, supervision and quality of care in integrated community case management (iCCM) programmes in sub-Saharan Africa (article #020403)  
Strachan et al. The scale up of integrated community case management of malaria, pneumonia and diarrhoea across three African countries: A qualitative study exploring lessons learnt and implications for implementation (article # 020404)
4. **Supply Chain Management:** which systems ensure continuous supply, how best to forecast needs – RELATES TO SUPPLY  
Chandani et al. Evidence for improving community health supply chains from Ethiopia, Malawi, and Rwanda (article # 0204005)  
Sheishia et al. Strengthening community health supply chain performance through an integrated approach: Using mHealth technology and multilevel teams in Malawi (article # 020406)
5. **Costs, and cost-effectiveness and financing:** identifying cost drivers, improving cost-effectiveness and the importance of minimizing patient costs – RELATES TO POLICY AND DEMAND  
Collins et al. The costs of integrated community case management (iCCM) programs: A multi-country analysis (article # 020407)
6. **Monitoring, Evaluation and Health Information Systems:** innovations in monitoring, integrating with health management information systems, using results to drive programmatic decision-making and improvements, evaluation design and methods – RELATES TO ALL AREAS  
Guenther et al. Routine monitoring systems for integrated community case management programs: Lessons from 18 countries in sub-Saharan Africa (article # 020301)  
Oliphant et al. Multi-country analysis of routine data from integrated community case management programs in sub-Saharan Africa (article # 020408)  
Diaz et al. A proposed model to conduct process and outcome evaluations and implementation research of child health programs in Africa using integrated community case management as an example (article # 020409)
7. **Demand generation and social mobilisation:** the relationship between iCCM and care-seeking, treatment utilisation and treatment adherence, effective strategies to generate demand – RELATES TO DEMAND  
Sharkey et al. Demand generation and social mobilisation for iCCM and child health: Lessons learned from successful programmes in Niger and Mozambique (article # 020410)
8. **Impact and outcome evaluations:** Issues with measuring mortality and using coverage to model mortality– RELATES TO COVERAGE AND MORTALITY  
Amouzou et al. Assessing the impact of the integrated community case management (iCCM) programmes on child mortality: Review of early results and lessons learned in sub-Saharan Africa (article # 020411)  
Friberg et al. Using the Lives Saved Tool as part of evaluations of community case management programs (article # 020412)  
Additional topic areas:  
Newborns – Aboubaker et al. Community health workers: a crucial role in newborn healthcare and survival (article # 020303)  
Research – Wazny et al. Setting global research priorities for integrated community case management (iCCM): Results from a CHNRI (Child Health and Nutrition Research Initiative) exercise (article # 020413)  
Private sector – Awor et al. Integrated community case management and the private sector in africa – a relevant experiences and potential next steps (article # 020414)  
Conclusions – Young et al. The way forward for integrated community case management programmes (article # 020304)

up and sustainability. In the area of human resources and deployment Pratt et al detail the use of GIS mapping in three states in Southern Sudan to improve deployment of CHWs. For training and quality Bosh-Capblanch et al provides a systematic review of training supervision and quality of care, while Strachan et al present a qualitative assessment of implementation practices in 3 African countries. In regards to maintaining supply chains Chandani et al de-

scribe how three countries were able to ensure commodities and supplies reached community health workers, while Sheishia et al describe an innovative technology to track supplies in Malawi. To examine costs of iCCM, Jarrah et al describe the cost drivers of iCCM in multiple countries using standardized methods. In the area of monitoring and evaluation Guenther et al put forth components and attributes of a comprehensive monitoring system for iCCM,

while Oliphant et al use routine monitoring from multiple country programs to demonstrate the utility of these data to examine key factors of program success or failure. Diaz et al review the study design and data elements collected for multiple recent evaluations of iCCM to suggest how such evaluations can be done in the future. In regards to demand, Sharkey et al present experience in two countries and the lessons learned on demand generation and social mobilization for iCCM. Finally, in the area of impact and outcome evaluation Agbessi et al report on the limitations of measuring and using mortality to assess iCCM as an end point in several countries in Sub-Saharan Africa and Friberg et al demonstrate how the Lives Saved Tool could be used to model the mortality impact of iCCM.

In addition to the articles covering the key thematic areas of the symposium we also have three additional articles. Awor et al describe how the private sector can contribute to iCCM. Aboubaker et al also present the role of Community Health Workers in newborn survival. Based on a systematic process to prioritize research areas, known as CHNRI (Child Health and Nutrition Research Initiative) Wazny et al report on priority iCCM research areas that are still needed. Finally, using the evidence available, Young et al suggest a way forward to improve and sustain iCCM where it is needed. This comprehensive set of articles provides the latest evidence for improving iCCM programs and ways to better monitor and evaluate such programs.

## REFERENCES

- 1 United National Child Fund (UNICEF). Countdown to 2015. Tracking progress in child survival: The 2005 report. New York: UNICEF, 2005.
- 2 Rasanathan K, Muñiz M, Bakshi S, Kumar M, Solano A, Kariuki W, et al. Community case management of childhood illness in Sub-Saharan Africa: Findings from a cross-sectional survey on policy and implementation. *J Glob Health*. 2014;4:020401. doi:10.7189/jogh.04.020401
- 3 Theodoratou E, Al-Jilaihawi S, Woodward F, Ferguson J, Jhass A, Balliet M, et al. The effect of case management on childhood pneumonia mortality in developing countries. *Int J Epidemiol*. 2010;39 Suppl 1:i155-71. Medline:20348118 doi:10.1093/ije/dyq032
- 4 Chinbuah MA, Kager PA, Abbey M, Gyapong M, Awini E, Nonvignon J, et al. Impact of community management of fever (using antimalarials with or without antibiotics) on childhood mortality: a cluster-randomized controlled trial in Ghana. *Am J Trop Med Hyg*. 2012;87(5 Suppl):11-20. Medline:23136273 doi:10.4269/ajtmh.2012.12-0078
- 5 World Health Organization/UNICEF Joint statement. Integrated community case management (iCCM). An equity-focused strategy to improve access to essential treatment services for children. New York: UNICEF, June 2012. Available at: [www.unicef.org/health/files/iCCM\\_Joint\\_Statement\\_2012.pdf](http://www.unicef.org/health/files/iCCM_Joint_Statement_2012.pdf). Accessed: 1 October 2014.
- 6 Marsh DR, Hamer DH, Pagnoni F, Peterson S. Introduction to a special supplement: Evidence for the implementation, effects, and impact of the integrated community case management strategy to treat childhood infection. *Am J Trop Med Hyg*. 2012;87(5 Suppl):2-5. Medline:23136271 doi:10.4269/ajtmh.2012.12-0504

**Correspondence to:**  
Theresa Diaz, UNICEF  
tdiaz@unicef.org

## ▶ Africa

▶▶ Aliko Dangote, Africa's wealthiest man, has pledged to build 11 health centres in Kano in north-west Nigeria, in an effort to improve routine immunisation and health for the state's citizens. Kano, with significant numbers of under-immunised children, has been particularly vulnerable to polio, and Nigeria remains one of three countries where polio is endemic. The Kano state government has already signed an agreement with the Bill and Melinda Gates Foundation to support free routine immunisations. Mr Dangote said he was minded to build the new centres because of the state government's commitment to better healthcare services, and he assured the governor that his foundation will work with them to strengthen the state's immunisation programme. (*Forbes*, 3 Jul 2014)

▶▶ Zambian sex workers report that efforts to reduce HIV infections are hampered by demand for unprotected sex, often at a price premium. This is increasing as circumcised men believe they cannot contract HIV and sexually transmitted infections. The Zambian Centre for Infectious Disease states that male circumcision provides 60% protection against HIV in line with WHO recommendations, along with other preventative measures. Sex workers are increasingly knowledgeable on health risks, and are supplying additional condoms if their client does not have any. Some of Zambia's sex workers are joining the Lifestyle Health Foundation, which campaigns to raise awareness on the dangers of unprotected sex. (*allafrica.com*, 11 Jul 2014)

▶▶ Ghana's 10-year-old National Health Insurance Scheme (NHIS) provides healthcare access, has been awarded the UN Global Award for Excellence, and countries such as Ethiopia, Benin, Mali and Bangladesh have visited Ghana to learn from it. 70% of its registrants pay no premiums, as certain categories (e.g. pregnant women, the elderly, disabled people, etc.) are exempt. However, 15 million from Ghana's 25 million population are unregistered and citizens report problems with registration and accessing healthcare. Registration queues can begin at 3 am with no guarantee

of success – a huge burden on families and ill people. Others report having to wait 6–8 hours to see a doctor, and concerns over substandard medicines. The NHIS is taking steps to improve access, although Ghana remains seriously short of health professionals, and many Ghanaians continue the “cash and carry” system of healthcare access. (*Al Jazeera*, 6 Aug 2014)

▶▶ Nigeria met with its first Ebola case in July, followed by an additional scattering of cases across two states. However, there have been no new cases since 5 September 2014, and this success offers valuable lessons in dealing with an Ebola outbreak. According to a report published in *Eurosurveillance*, the key elements were: fast and thorough tracing of all potential contacts; ongoing monitoring of them; and rapid isolation of potentially infectious contacts. With a centralised and co-ordinated Incident Management System, Nigeria's authorities identified cases quickly, and rigorously surveyed their contacts, thus preventing Ebola's further spread. Nigeria could draw on funding, staff and tools to halt Ebola's spread; but in the three countries worst affected by Ebola, implementing standard outbreak control procedures are near-impossible due to dire infrastructure and capacity. (*Scientific American*, 18 Oct 2014)

▶▶ The World Bank will invest US\$ 100 million in increasing the number of overseas health workers in West Africa to care for people with Ebola. Doctors, nurses and other healthcare workers are desperately needed to staff treatment centres – according to the UN, 5000 international workers are needed, including 1000 health workers. There has been a gap in providing training to healthcare workers, due to safety concerns over the risks of contracting Ebola, and workers have sought reassurance that they would be repatriated in the event of illness. The new funds will set up coordination hubs with the affected countries' governments, the WHO, the UN's Ebola co-ordination centres and other agencies to recruit, train and deploy qualified health workers. (*The Guardian*, 30 Oct 2014)

## ▶ Asia

▶▶ Drug-resistant malaria parasites have spread to border regions of Southeast Asia, threatening efforts to control and eliminate the disease. WHO states that resistance to the most effective drug, artemisinin, is reported in four countries, and 64 countries have evidence of resistance. There are no signs of resistance in Kenya, Nigeria and DR Congo,

but if resistance spreads out of Asia and into Africa much progress in decreasing malarial deaths will be reversed. Although new drugs and a vaccine are in the pipeline, they are several years from market so existing drugs must be conserved where they are still working. Prof. Nicholas White, chair of the Worldwide Antimalarial Resistance Net-

work, says that conventional malaria control measures will not be enough, calling for it to be a global public health priority. (*Reuters*, 30 Jul 2014)

▶▶ The Indonesian government has launched a programme to promote safer cooking practices, which aims to prevent 165,000 premature deaths each year. It will introduce affordable, biomass-fuelled, cooking stoves to the 24.5 million households who still use traditional (mostly firewood) methods for cooking. Household air pollution from firewood stoves increases the risks of asthma, lung TB and acute respiratory infections, especially in children who spend more time indoors. The programme will include a public awareness campaign of the risks of firewood. The World Bank has signed agreements with the Indonesian government and PT Bank Rakyat Indonesia to support the programme's second phase. (*World Bank*, 14 Aug 2014)

▶▶ Vietnam's Ministry of Finance is proposing a phased increase consumption tax on cigarettes from its current 42% to 65% in 2014, 75% in 2015 and 85% in 2016. This would raise US\$ 136.5 million of revenue in 2015, rising to £362.5 million in 2018. The WHO estimates that if additional taxes increase the price of cigarettes by 10%, consumption would fall by 5%. According to the Ministry of Health, 15 million Vietnamese people smoke – one of the highest rates in the world – and there are 40,000 tobacco-related deaths each year, set to rise to 70,000 per year by 2030. There are concerns that the proposed tax increases are insufficient to decrease consumption, given that cigarettes are relatively cheap in Vietnam. (*Xinhua*, 16 Sep 2014)

▶▶ Historically, Indonesia has a uniquely strong and successful family planning programmes, doubling its contraceptive prevalence rate to almost 60% from 1976–2002, and halving its fertility rate to 2.6 children per woman. This helped towards Indonesia's impressive annual economic growth rate of 5%. However, progress has stalled, mainly due to shifting responsibilities for these programmes, with resulting uncertainties over roles. The Indonesian government is attempting to revitalise its family planning programmes, by strengthening local programmes to bolster access, free service access, and improved health worker training and facilities etc. Ultimately, the government aims to reduce fertility to 2.1 children per woman by 2015. (*Devex*, 25 Sep 2014)

▶▶ In Afghanistan, opioid use and dependency were the main contributors to disability, morbidity and mortality (e.g. via overdoses, HIV infection) from illicit drug use in 2010. Afghanistan has a tradition of opium smoking, and is a source of illegal opiates. More recently, Afghans have begun to inject heroin and use pharmaceutical opioids. It is estimated that 5.1% of the population have recently used drugs, and that this is increasing. This is a major problem in a war-scarred country with little treatment infrastructure. There is an urgent need for effective interventions such as substitution therapy, needle and syringe programmes to reduce the transmission of blood-borne viruses, and HIV and hepatitis C treatment programmes to reduce the infection burden. This needs additional resources and the co-ordinated implementation of programmes by the government and civil society, supported by international and non-governmental organisations. (*The Lancet Global Health*, 31 Oct 2014)

## ▶ Australia and Western Pacific

▶▶ A survey found that 24% of girls and 34% of boys in the remote Cook Islands – dependent on imports for 82% of foodstuffs – are obese. The traditional diet of fish, fruit and taro has been replaced with imported, calorie-rich and nutrient-poor processed food and drinks, and the tourism boom has increased fast-food outlets. The Islands' Director of Public Health, Dr Rangi Fariu, says that 80–90% of men are obese, with high cholesterol levels, blood pressure, diabetes and heart disease, and are dying prematurely as a result. To tackle this, the government has increased sugary drink taxes, and instigated an “invest in your health” campaign to encourage exercise, and fruit and vegetable consumption. However, it is a challenge to supply local produce to compete with processed imports, and the Ministry of Agriculture is working with the UN Food and Agricul-

ture Organization to increase availability. (*The Guardian*, 2 Sep 2014)

▶▶ The New Zealand Ministry of Health has clamped down on the sale of e-cigarettes containing nicotine – previously readily available in shops – and have dispatched enforcement officers to inform retailers that their sale is prohibited. Leading public health specialists have criticised the move, noting that it could drive people back to traditional, more harmful, cigarettes, and half of the country's smokers will die from smoking-related causes. The Ministry of Health recommends other cessation aids (e.g. patches and gum) rather than e-cigarettes. The WHO reports that e-cigarettes are less toxic than combustible cigarettes, but they do pose threats to adolescents and unborn babies, and increase ex-

posure to second-hand nicotine and other toxicants. (*New Zealand Herald*, 14 Sep 2014)

▶▶ Comparisons between energy expenditure of today's children with children in 1919 suggest that the latter were 50% more active than today's children, with four more hours of physical activity and three less hours of sitting. In Australia, 25% of children now walk or cycle to school, compared to 70% in 1970, and the number of sports played by children is declined, as is the amount of outdoor free play (e.g. tree climbing). Australia's children are in the bottom one-third of childhood fitness, and its children spend the third highest amount of time with TV and computer screens. This reflects a wider societal move towards less energy expenditure through labour-saving devices and sedentary work, with related weight increases. The challenge is offset these developments by creating spaces and technologies that encourage active leisure. (*theconversation.com*, 21 Sep 2014)

▶▶ The 2014 Aid Transparency Index ranked Australia as 25th out of 68 aid providers ("fair"), down one place from 2013. The UN Development Programme was first, followed by the UK's Department for International Development, the US's Millennium Challenge Corporation, GAVI and the Asian Development Bank. Donor countries are assessed on their commitment to aid transparency, including transparency of organisation- and activity-level information. The Index commented on Australia's inaccessible project-level information, and criticises it for its 'unambitious' aid transparency implementation, urging full implementation by the end of 2015. (*DevPolicy Blog*, 9 Oct 2014)

▶▶ Fiji will stop sending peace-keeping police officers to Liberia due to the Ebola crisis, where it has 27 officers serving with the UN Mission in Liberia. The serving officers are reported to be in good health, and all necessary precautions are in place to protect them. Fiji's Ministry of Health has activated its communicable taskforce, and is meeting with other agencies to ensure it is fully prepared for the Ebola virus. (*Xinhau*, 15 Oct 2014)

## ▶ China

▶▶ In 2013, China's mortality rate for children under 5 years of age fell to 20% of its 1991 level, and maternal mortality fell by 71%; whilst children with Hepatitis B fell from 10% to less than 1%. WHO and the World Bank reported China's exceptional progress in reducing child and infant mortality, underpinned by better care at birth and country-wide immunisation. Women giving birth in hospital are subsidised, thereby reducing complications (especially neonatal tetanus), and bringing inaccessible groups into the health system. 95% of children are vaccinated against measles, rubella and polio, and eight vaccinations were added to its portfolio (although measles outbreaks show that children can miss doses). China has a blanket approach to vaccination, effective when infectious diseases are rife. A testimony to China's initial success is that a more sophisticated and targeted approach is now required (e.g. screening infants for suitability), as many diseases have been eradicated. (*The Economist*, 26 Jul 2014)

▶▶ Air pollution, smoking, obesity and accidents – especially road accidents – kill at least 4.7 million Chinese people each year, according to research published in *The Lancet*. It showed that China's health has improved in many ways, e.g. life expectancy has increased from 40 years in 1950 to 76 years in 2011, and many infectious diseases have rapidly declined. However, the risk of premature death and illness from pollution, smoking, accidents and

other lifestyle-related illness is at record levels. The authors say that China can learn from developed countries' experiences of non-communicable diseases, and many risks can be lowered by effective interventions. (*AFP*, 29 Aug 2014)

▶▶ Air pollution regulations over the past decade in the city of Taiyuan have substantially improved its citizens' health, leading to a more than 50% reduction in costs arising from disability and loss of life. Taiyuan is a major centre for energy production and metallurgy, and the provincial government implemented new environmental legislation to combat air pollution, including allowing the closure of polluters, setting emission standards and promoting energy efficiency. This led to concentrations of particulate matter falling by 50% from 2000 to 2010, resulting in 30 000 fewer disability-adjusted life years arising from 2810 fewer premature deaths, 31 810 fewer hospital admissions and 141 457 fewer outpatient admissions. This is consistent with research that demonstrates a link between air quality and childhood developmental scores. It makes a strong case for tighter regulation, as only three out of 74 cities monitored by the government meet minimum air standards. (*Asian Scientist*, 10 Sep 2014)

▶▶ According to research published in *The Lancet Diabetes and Endocrinology*, China has the largest number of people with diabetes, reaching epidemic proportions in the adult

population. In 1980, less than 1% of adults had diabetes, but this rose to 12% in 2010, and estimates show that around 50% of adults are pre-diabetic, putting them at risk of diabetes and related illnesses. Of particular concern is that 70% of diabetic adults are undiagnosed, 25% have received treatment and it is controlled in only 40% of these cases, suggesting increases in related cardiovascular and kidney disease, cancer etc. The epidemic is caused by rapid economic development and urbanisation. It also seems that Chinese people are relatively susceptible to type 2 diabetes, which tends to develop at lower body mass index. (*sciencedaily.com*, 10 Sep 2014)

▶▶ China will dispatch a unit of the People's Liberation Army to Liberia, in response to UN calls for intensified efforts to fight Ebola in West Africa. The US has led the drive to halt the spread of the disease, and China has faced criticism for not doing enough to help its trade partner. The unit will build a 100-bed treatment centre in Liberia, the first one in the three countries most affected by Ebola. This is the first time that China has deployed an entire unit of epidemic prevention forces and military medical staff to another country. In other measures to combat Ebola, China has donated US\$ 123 million, dispatched health workers, and sent doses of an experimental drug. Lin Songtian, a government minister, said that China's assistance would not stop until the Ebola epidemic is halted. (*Reuters*, 31 Oct 2014)

## ▶ Europe

▶▶ Health expenditure continued to fall in Greece, Italy, Portugal and Spain, the Czech Republic and Hungary, according to the 2014 edition of OECD *Health Statistics*. Greece's health spending fell in real terms by 25% between 2009 and 2012, mainly due to public spending cuts. This is in contrast to the USA (2.1% increase), Korea (6% increase) and Mexico (8.5%). Spain, France, Denmark and the UK saw particularly sharp increases in the market share for cheaper generic drugs, with increases of 100%, 60%, 44% and 28% respectively. (*pharmatimes.com*, 1 Jul 2014)

▶▶ Britain has a long history of clinical trials, but these are increasingly moving overseas; the number of trials fell by 14% between 2005 and 2013 whilst its global market share fell sharply. Each day's delay in getting a drug to market can cost a company up to US\$ 10 million, and trials are moving to east Europe and China which have fewer hurdles. The main challenges are the very slow process for testing new treatments in Britain, and difficulties in recruiting subjects. Britain risks losing its share of a global industry worth US\$ 51 billion a year and, more subtly, the erosion of clinical standards. However, there is potential for more large trials, where researchers can take advantage of Britain's unique centralised patient data system to trawl NHS data to recruit subjects. If medical confidentiality can be resolved, Britain could continue to lead the world in clinical testing. (*The Economist*, 26 Jul 2014)

▶▶ The appointment of the new EU leadership team to sit alongside the EC President Jean-Claude Juncker has slowed down the work of European institutions, and a paralysed commission cannot respond to external crises, e.g. Ukraine, Gaza and Central African Republic. Devex have

identified five global long-term challenges essential to European prosperity which require international and European action. Firstly growth must deliver jobs and sustainable livelihoods, both to Europe's young people and globally people living in extreme poverty. Secondly, Europe must work towards an ambitious global climate agreement in 2015, and the transition towards a green economy. Thirdly, conflict and state fragility must be tackled in the longer-term. Fourthly, human rights, from political prisoners to gender inequality, must be supported on a wider scale. Finally, the EU must tackle poverty and inequality both at home and in the developing world. (*Devex*, 1 Sep 2014)

▶▶ Sweden will announce US\$ 14 million of funding for a new agency – the International Land and Forest Tenure Facility – that will provide grants and expertise to help indigenous people and forest communities to secure land rights. It will be independent, and governed by representatives from indigenous peoples, community and civil-society groups, donors and business. Where indigenous and other groups claim customary ownership of land and forests that is not legally recognised, conflict can arise with governments and business. This can be costly for investors, local people and ecosystems, and recognizing land rights can be an effective way to implement forest-based carbon-mitigation schemes. (*Thomson Reuters Foundation*, 18 Sep 2014)

▶▶ HIV continues to spread in Europe despite improved treatment and prevention options, with 136 000 new cases diagnosed across Europe and Central Asia in 2013 – an 80% increase from 2004. Roughly 105 000 cases were reported in Eastern Europe and Central Asia (EECA), 29 000 in the European Union and European Economic Area (EU/

EEA), and 2000 in other non-EU countries. New cases in EECA doubled from 2004, remaining constant in EU/EEA. This means that Europe has not reached the Millennium Development Goal of halting and reversing the spread of HIV/AIDS. The WHO Regional Office for Europe states that high-risk populations are not being effectively reached –

the main cause of the continued spread – and prevention and control among men who have sex with men is the cornerstone of European HIV programmes. The WHO Regional Office and European Center for Disease Prevention and Control call for a strengthened and tailored response to curb the epidemic. (*WHO*, 27 Nov 2014)

## ▶ India

▶▶ India's pharmaceutical regulator has cut and capped prices of 108 drugs used for a variety of diseases, which will affect the profit margins of drug companies such as Sanofi SA. This coincides with efforts by India's health ministry to widen the list of essential medicines that will be subject to a price cap. Price caps help provide affordable medicines for the 70% of India's people living on less than US\$ 2 a day, and the more-than-80% without health insurance. The companies affected did not respond immediately, but analysts believe it could lead to more controls in the longer-term. (*Reuters*, 14 Jul 2014)

▶▶ In a study published in *Geophysical Research Letters*, pollution from ground-level ozone, formed by emissions from vehicles, cooking stoves etc., damaged 6 million tonnes of India's wheat, rice, soybean and cotton crops in 2005. Wheat and rice are major food sources in India, and cotton is a major commercial crop. This caused cumulative losses of US\$ 1.29 billion, and destroyed crops that could have fed millions of people living below the poverty line. India currently has no air quality standards to protect agriculture from ground-level ozone pollution, and this research could help policymakers formulate them. (*Times of India*, 5 Sep 2014)

▶▶ Following on from the September flooding, Kashmir is in the midst of a health crisis, hospitals damaged by flood water, and people living in areas choked by putrid, infectious and sometimes impassable water. This is worsened by many residents choosing to stay in their homes, thus increasing the risk of cholera, hepatitis A and typhoid outbreaks, when Kashmir has little scope to treat them. The state health minister, Taj Mohiuddin, outlined plans to deal

with the crisis, including mobile units to dispense medicine and chlorine tablets, and getting the state's main hospitals operational quickly. Although there have been few cholera cases to date, there are fears that they will increase, and that there will be a rush of people visiting doctors once the roads are passable – with the government could be hard-pressed to respond. (*New York Times* 19 Sep 2014)

▶▶ India's recent efforts to reach out to Africa, supported by Africa's emerging middle-class being a ready market for India's 'frugal innovation' products, and Africa's abundant natural resources, were set back by India's cancellation of the largest-ever India-Africa summit. This was due to the risk of Ebola being brought from Africa. However, the risk was small as three countries are suffering from Ebola, not the entire continent. Despite this, India is generously assisting to relieve the outbreak. It is difficult to strike a balance between protecting against Ebola and avoiding damage to trade and relationships with Africa, and isolation will not avoid a pandemic. Continued support in the form of donations, equipment and expertise is more helpful, and may be the best way of preventing its spread elsewhere. (*The Economist*, 13 Oct 2014)

▶▶ India has offered "full co-operation" to Pakistan in eradicating polio, noting concern over its neighbour's accounting for 85% of global polio cases. Health Minister Harsh Vardhan said that previous co-operative efforts made little progress. He praised Pakistan's latest initiative against polio, stating that a similar model in India was highly successful. India risks a polio outbreak imported from Pakistan, and the government will replace oral vaccines with injectable ones in 2015. (*The Economic Times India*, 24 Oct 2014)

## ▶ The Americas

▶▶ Mapp Biopharmaceutical, a small US biotech company, was at the centre of a race to find a cure for Ebola, and an ethical debate over using unproven treatments. Mapp pro-

duces the experimental drug ZMapp, given to two US aid workers with Ebola, who appear to have responded. Whilst this raises hopes for a cure, there are questions over why it

did not emerge until two Americans were affected, rather than 900 West Africans. Mapp replied that the drug is at an early stage, untested on humans, the aid workers' employer had requested it, and they lack capacity to scale-up production. Also, there are few commercial incentives to develop drugs for a sporadic disease in one of Africa's poorest regions. Without proper trials, ZMapp's effectiveness is unclear, as the aid workers may have survived regardless; and WHO is convening medical ethicists to explore this. (*Financial Times*, 7 Aug 2014)

▶▶ A UN Development Programme report shows that poverty levels in Latin America and the Caribbean fell from 41.7% to 25.3% from 2000–2012, lifting more than 56 million people out of poverty. It warns that 200 million people – 37.8% of the population – are vulnerable, and calls for more investment in social protection programmes as the pace of social and economic progress slows. It calculates poverty as living on less than US\$ 4/day, and also reveals that the proportion of people living on US\$ 4–10/day rose by 3.4% over the same period. It singled out Bolivia and Peru for the greatest poverty reductions – 32.2% and 26.3% respectively – and praised progress in Chile and Argentina. However, poverty levels remained constant in Uruguay, Honduras and the Dominican Republic, and rose by 6.8% in Guatemala. (*BBC News*, 26 Aug 2014)

▶▶ Tegucigalpa, the capital of Honduras, is one of the world's most violent cities, with high levels of murder, rape and abductions. Rape survivors often do not report rapes out of fears of retaliation and stigmatisation, and only a small fraction receive the support and care they need. In response, Médecins Sans Frontières (MSF) and the Honduran Ministry of Health set up a priority service in 2011 to provide emergency support to the victims of violence, including sexual violence. The emergency medical treat-

ment includes post-exposure prophylaxis against HIV. However, this vital service is unable to prescribe the emergency contraceptive pill to prevent pregnancy following rape, as it has been banned in Honduras since 2009. MSF campaigns for its legalisation, so that rape victims need not fear an unwanted pregnancy or an unsafe abortion. (*MSF*, 28 Aug 2014)

▶▶ Harvard University received US\$ 350 million from the Morningside Foundation for the School of Public Health – the largest donation in its history. The donation is unrestricted, and will be used for student financial support, new teaching facilities, and seed funding for ground-breaking research etc. Julio Frenk, the School's dean said the donation would particularly be used to support research and training in: pandemics from malaria and Ebola to obesity and cancer; environmental health risks; poverty and humanitarian crises; and failing health systems. (*Reuters*, 8 Sep 2014)

▶▶ Type 2 Diabetes Mellitus (T2DM) comprises 90–95% of all US diabetes cases, and prevalence rose from 25.8 million in 2010 to 29.1 million in 2012, although mortality decreased over the same period. A CDC study published in *The Lancet Diabetes and Endocrinology* examined the lifetime risk, and life years' lost, of T2DM. It found that the average 20-year old American male's T2DM risk rose from 20% in 1985–1989 to 40% in 2000–2011, and female risk from 27% to 39%. Hispanic men and women, and black women, have the highest risk at 50%. Life years' lost fell by 1.9 for both sexes, although the overall number of years lost rose by 50%, and years spent living with T2DM increased by 156% and 70% for men and women respectively, due to increased incidence. This will increase pressure on resources, and more effective lifestyle interventions are needed to reduce new cases. (*Medical News Today*, 13 Aug 2014)

## ► The Bill and Melinda Gates Foundation

►► The BMGF is set to expand its presence in Ethiopia and Nigeria in 2014, and may open new offices in East and West Africa. The Foundation emphasised that it does not intend to become a large field operating agency, despite its recent rapid growth, and tries to strike a balance between having staff based in Africa away from its Seattle headquarters, and the need to keep a presence in country offices to link between governments and more traditional donors. It has formed “leveraged partnerships” with the Ethiopian government to develop a strategy for agricultural investment, aligning donor funding in a more unified fashion, and believes that this model can work elsewhere. (*Devex*, 7 Jul 2014)

►► The BMGF has awarded US\$ 25 million to Oregon Health and Science University, who are developing a vaccine that shows promise in preventing HIV infection in primates. The scientists hope to develop a vaccine that prevents infection in exposed people, and eliminates it from those already infected. The grant funding will establish if the vaccine can be safely used in humans in a clinical trial, and to develop a version suitable for larger-scale testing, which is needed to bring it to market. It is expected that this will take at least 10 years. (*Reuters*, 3 Sep 2014)

►► The BMGF announced that it is accepting applications for Round 14 of the Grand Challenges Explorations Initiative, which “seeks innovative solutions to some of the world’s most pressing global health and development problems” with US\$ 100 000 grants available to early stage, innovative ideas. The topics for this round are: enabling universal acceptance of mobile money payments; reducing

childhood deaths from pneumonia; reducing malaria transmission from outdoor mosquitoes; supporting new mosquito-control approaches; measuring brain development and gestational age; and integrating community-based interventions. (*BMGF*, 8 Sep 2014)

►► The BMGF pledged US\$ 50 million to the fight against Ebola in West Africa, the largest sum it has ever committed to one outbreak. This is in addition to the US\$ 12 million support it has already given to the WHO, UNICEF and Centers for Disease Control and Prevention to support efforts against Ebola. The new funding will be used for emergency operations and to help develop drugs, diagnostics and vaccines. The BMGF could make funds immediately available, unlike other donors. The UN estimated that defeating this outbreak could cost at least US\$ 600 million. (*New York Times*, 10 Sep 2014)

►► At an event commemorating the 10th anniversary of the Grand Challenges Initiative, a group of partners announced three new initiatives aimed at creating breakthroughs in science, namely: All Children Thriving; Putting Women and Girls at the Centre of Development; and Creating New Interventions for Global Health. “Melinda and I have always believed that advances in science can help reduce inequality in a big way. But you have to be willing to take some risks and see some projects fail. That’s the idea behind Grand Challenges – to focus bright scientists on the problems of the poorest, take some risks and deliver results. We’re delighted with what’s happened in the first decade, but we’re not satisfied, and we hope to see even more progress in the coming years,” says Bill Gates. (*BMGF*, 7 Oct 2014)

## ► The GAVI Alliance

►► GAVI approved the strategic framework that would support a fully-funded Alliance to enable developing countries to immunise an additional 300 million children from 2016–2020, helping save an estimated 5–6 million lives. GAVI will consolidate progress on the rapid acceleration of GAVI-supported vaccine introductions, putting the world’s poorest countries on target to immunise almost 250 million children from 2011–2015, saving nearly 4 million lives. The new framework will bring the GAVI partners together to work towards these key goals: accelerate uptake and coverage of vaccines; increase effectiveness and efficiency of immunisation delivery; improve sustainability of national programmes; and shape markets

for vaccines and other immunisation products. (*GAVI*, 19 Jun 2014)

►► Niger has introduced vaccines against pneumococcal disease and rotavirus that should significantly reduce child mortality. Nearly a million children will be vaccinated against the diseases that are the leading cause of child mortality in Niger, accounting for more than 30% deaths in children under 5 years. Niger joins Ghana, Tanzania and Burkina Faso in introducing the vaccines with GAVI support. This helps Niger play its part in the Global Action Plan for the Prevention and Control of Pneumonia and Diarrhoea, which aims to eliminate childhood deaths from these diseases by 2025. (*allafrica.com*, 5 Aug 2014)

▶▶ GAVI has given Uganda a grant of US\$ 190 000 to support the country's immunisation programmes. It will be used to buy fridges and motorcycles, support outreach programmes in inaccessible areas, improve immunisation data management, and train health workers in integrated disease surveillance and response. The government will also undertake a house-to-house polio campaign, targeting all children under 5 years. Although Uganda has not reported any polio cases since 2010, it is still vulnerable due to the influx of Somali refugees and its location within the wild polio importation belt (a band of countries at risk of infections from northern Nigeria). In response, Uganda will introduce injectable polio vaccinations in 2015, as part of the global eradication strategy. The funds will also be used to roll out the HPV vaccine to protect against cervical cancer. (*The Observer Uganda*, 12 Oct 2014)

▶▶ GAVI released the findings of an audit into US\$ 29 million of funding given to Nigeria between 2011 to 2013. It found the Nigerian Federal Ministry of Health and the National Primary Health Care Development agency guilty of arrant malpractice and fraud, and the money – intended for vaccine procurement and health systems strengthening for children – badly mis-used. As a result, GAVI has suspended cash-based support from April 2014 onwards, and unused disbursed funds have been frozen. Weak leader-

ship, disorganisation and conspiracy to commit fraud were all part of the malpractice, with lack of controls around procurement and evidence of collusion leading to irregular activities. The immediate past Minister of Health, Prof. Onyebuchi Chukwu acknowledged financial management weaknesses, gave assurances that the government would refund misappropriated money, and improve financial transparency and accountability. GAVI and the government will appoint an agent to oversee the management of GAVI's grants to Nigeria. (*Sahara Reporters*, 30 Oct 2014)

▶▶ For the World Pneumonia Day on 12 Nov, GAVI published figures on vaccination against the leading causes of pneumonia. They show that almost 40 million children in developing countries received the pentavalent vaccine, and 15 million children were immunised with pneumococcal conjugate vaccine (PCV) in 2013 alone. Causing 1 million deaths a year amongst children aged under 5 years – mostly in developing countries – pneumonia is a leading cause of death. GAVI has supported the introduction of pentavalent vaccine in 73 of the world's poorest countries, and funded PCV introduction in almost 45 countries. Children die from pneumonia due to lack of access to effective interventions, and vaccination, proper nutrition, hand-washing with soap, low-emission cooking stoves and exclusive newborn breastfeeding can help protect children against pneumonia. (*GAVI*, 12 Nov 2014)

## ▶ The World Bank

▶▶ The World Bank's *Global Economic Prospects* shows developing countries facing disappointing growth in 2014, as adverse weather in the US, the Ukrainian crisis, rebalancing in China, political tensions in several countries, slow structural reforms and capacity constraints contribute to sub-5% growth. This is considered insufficient for job creation levels required to improve the lives of the poorest 40%. High-income countries' recovery is accelerating, and overall the global economy will expand by 2.8% in 2014, 3.4% in 2015 and 3.5% in 2016. High-income countries will contribute 50% towards global growth, compared to sub-40% in 2013. Overall, growth is expected to be moderate in East Asia and the Pacific; recover modestly in the developing countries of Europe and Central Asia (although the situation in Ukraine is expected to cause a 1% decrease); continue weakly in Latin America and the Caribbean; gradually strengthen in the Middle East and North Africa; be subdued in South Asia; and strengthen in sub-Saharan Africa. (*World Bank*, 10 Jun 2014).

▶▶ The World Bank, World Health Organisation, Merck and other partners celebrated 40 years of success in con-

trolling river blindness in Africa, via the African Programme for Onchocerciasis Control (APOC). APOC, one of the most successful public-private partnerships in Africa, treats 100 million people each year in 31 countries, using free medicines donated by Merck. The celebratory event highlighted lessons from APOC's efforts to control river blindness and the impact of its programmes to neglected tropical diseases' control and elimination. (*endthenelect.org* 19 Jun 2014)

▶▶ According to the World Bank, Egypt, Iran, Jordan, Lebanon, Libya, Tunisia and Yemen are trapped in a "poor policy-poor growth" cycle, preventing their economies from moving to a sustainable growth pattern, and worsening since the 2011 uprisings in the region. Each country has high unemployment rate with large numbers working in the informal sector, facing the related job insecurity and poor wages. Although economic growth has rebounded in Egypt and Tunisia, at current levels it cannot create enough jobs to absorb population increases. The Bank estimates that growth would need to double to reduce unemployment. Moreover, the ongoing instability in the region will

affect short-term prospects. Each country has suffered from over-optimistic growth forecasts, leading to a lack of government action on the necessary reforms to ensure the private sector can drive growth and create jobs. (*World Bank*, 7 Aug 2014)

▶▶ The World Bank plans to raise up to US\$ 500 million of Islamic bonds ('sukuk') to help fund immunisation. The International Finance Facility for Immunisation (IFFIm) will help issue these bonds, which would roll-forward future donor pledges into cash-in-hand today to finance immunisation efforts. As they are not interest-based, they follow Islamic religious principles banning charging interest and monetary speculation. The World Bank is increasingly considering using sukuk in other ways, eg, as 'green bonds' to finance energy-efficiency projects. This could help close

the gap between ethics and investing in the region. (*Reuters*, 3 Sep 2014)

▶▶ The IMF and World Bank have pledged US\$ 300 million in emergency aid to Guinea, Liberia and Sierra Leone, the countries most affected by the rapidly spreading Ebola virus. The IMF will provide US\$ 127 million to cover the US\$ 300 million financing gap, and will discuss further support in October. The World Bank has separately pledged US\$ 200 million in emergency assistance, and the Bank's President, Dr Jim Yong Kim, said that member countries were ready to provide funds. These measures were announced the day after US President Barack Obama confirmed that 3000 soldiers would be dispatched to help contain the outbreak. The WHO has warned in September that the number of deaths may double every three weeks. (*Financial Times*, 17 Sep 2014)

## ▶ United Nations (UN)

▶▶ The UN Environment Assembly (UNEA) met for the first time in Nairobi, Kenya, to discuss illegal wildlife trade, chemical waste and air pollution, and new universal development goals. In his opening message, Achim Steiner, the UN Environmental Protection (UNEP) Executive Director, said that the UNEA embodies the notion that challenges are best addressed and opportunities realised when nations and citizens join to promote economic prosperity, social equity and environmental sustainability. The UNEP also launched a report on South-South trade and the green economy, which explored the growing trend of development "for the South, by the South". It coincided with the launch of a joint UNEP-INTERPOL report that highlights the links between environmental crime insecurity. (*UN News*, 23 Jun 2014)

The UN documented more than 4000 incidents of children recruited into armed conflicts in 2013, with thousands more estimated to have joined armies and rebel groups. In its annual report on children and armed conflict, Nigeria's extremist group Boko Haram is included on its list of eight government forces and 51 armed groups that recruit, use, kill, or commit sexual violence against children, or attack schools and hospitals – and these groups generally act with impunity. Advances by Islamic extremist groups in Iraq create dangerous conditions for children, and there is widespread use of child soldiers in South Sudan, with the outbreak of fighting in December reversing recent gains. However, one hopeful sign is Chad's removal from the UN list as its army has implemented a joint UN action plan to protect children. (*ndtv.com*, 2 Jul 2014)

▶▶ The 2014 UN Millennium Development Goals (MDG) report shows progress in eradicating extreme poverty, but that 20% of people in developing countries still live on less than US\$ 1.25/d. The MDG of halving global poverty by 2015 has been achieved, although progress is uneven with some regions (eg, Eastern and South Eastern Asia) meeting the target, with other regions (eg, sub-Saharan Africa, Southern Asia) lagging behind. China has made huge progress in reducing its extreme poverty rate, from 60% to 12%. However, along with India, it has the largest share of global extreme poor. Apart from India and China, high poverty rates are often found in small, fragile countries that are affected by conflict. (*CNBC*, 16 Jul 2014)

▶▶ Some development experts claim that the UN's next set of development goals should comprise five discrete, quantitative, achievable goals. The Copenhagen Consensus Center think-tank has devised a methodology to assess how to spend finite resources on global development, creating a cost-benefit analysis for proposals and ranking them by their effectiveness. The UN's Open Working Group used this method on their development targets to assess their value for money. The targets that provide "phenomenal" value for money (benefits are 15 times greater than costs) include universal health coverage, access to education, free trade, and R&D on communicable disease treatments that affect developing countries. Poor value targets (benefits are uncertain, or less than cost) include widening access to higher education and investment in renewable energy. (*WSJ*, 25 Jul 2014)

▶▶ World leaders were joined by business, finance and civil society leaders at the UN September 2014 Climate Summit, aiming to create political momentum for a universal climate agreement in Paris in 2015, and to galvanise action towards reducing emissions and increasing resilience to climate change. The summit committed to limiting global temperature rises to 2°C, within the context of eradicating extreme poverty and promoting sustainable development.

Outlining the Summit's long-term vision, the Chair, the UN Secretary-General Mr Ban Ki-moon, announced that without timely and significant cuts in emissions it will not be possible to limit temperature rises to 2°C. He called for maintaining the Summit's spirit of commitment and action, and for looking back on the Summit as the point where the human race decided to make the world sustainable, safe and prosperous for future generations. (*UN*, 23 Sep 2014)

## UN AIDS and The Global Fund

▶▶ The Global Fund has entered into new agreements with suppliers of artemisinin-based combination therapy (ACT) for malaria. It aims to improve value for money and save more lives, via maximised transition funding for a private sector co-payment for ACTs (the mechanism for providing high-quality medicines at reduced prices to low-income countries). The agreement will save US\$ 100 million over two years, and more intelligent procurement will benefit overall global health efforts. (*Global Fund*, 10 Jun 2014)

▶▶ According to the UN, new HIV infections and AIDS-related deaths are declining, making it possible to control the HIV epidemic by 2030, and eventually end it. New infections fell by 38% from 2001, AIDS-related deaths fell by 35% from their 2005 peak, and globally the numbers of infections is stabilising at 35 million. According to UNAIDS, US\$ 19.1 billion was spent on the HIV/AIDS response in 2013, and estimates that US\$ 22–24 billion is needed in 2015. If the epidemic is controlled by 2030, 18 million new infections and 11.2 million AIDS-related deaths would be averted. Following evidence on the impact of early treatment on reducing the spread of HIV, the WHO set new guidelines which increased the numbers of people requiring treatment by 10 million. However, Médecins Sans Frontières argue 50% of people with HIV do not receive the treatment they need. (*Reuters*, 16 Jul 2014)

▶▶ The 20th International AIDS Conference in Melbourne, Australia, was in mourning at the loss of colleagues on the Malaysia Airlines flight when the plane, *en route* to the conference, was shot down over Ukraine. The International AIDS Society confirmed its lost colleagues include Joep Lange, pioneer of cheap anti-retrovirals for poor people, Pim de Kuijer from STOPAIDSNOW, Lucie van Mens and Maria Adriana de Schutter from AIDS Action Europe, WHO official Glenn Thomas and Jacqueline van Tongeren

from the Amsterdam Institute for Global Health and Development. “We will honour their commitment and keep them in our hearts as we begin our programmes on Sunday,” said the Society's President, Françoise Barre-Sinoussi. (*yahoo.com*, 18 Jul 2014)

▶▶ The UNAIDS *Gap Report* reveals that scaling-up anti-retroviral therapy (ART) access to HIV-positive people is working, with an additional 2.3 million people accessing treatment in 2013, bringing the global number to 13 million, and estimated to reach almost 14 million during 2014. In sub-Saharan Africa, 76% of people on ART have viral suppression, whereby transmission is unlikely; and every 10% increase in treatment means a 1% decline in new infections. If HIV scale-up is accelerated by 2020, the HIV epidemic could end by 2030, averting 18 million new infections and 11.2 million deaths from 2013–2020. To achieve this, it is essential to: focus on under-served populations at higher risk of HIV, addressing their specific needs to ensure service access; tackle complex micro-epidemics with speedy tailored solutions; and end stigmatisation to ensure equal access to quality HIV services as both a human rights and public health imperative. (*UNAIDS*, 20 Jul 2014)

▶▶ UNAIDS welcomed Uganda's Constitutional Court decision to overturn the law that allowed for 14-year jail terms for a first conviction, and life imprisonment for ‘aggravated homosexuality’. Although homosexuality remains illegal, the annulment means that gay men and men who have sex with men are more likely to seek HIV testing, prevention and treatment services. “President Yoweri Museveni has personally indicated to me that he wants Uganda to accelerate its AIDS response to ensure all people have access to life-saving services,” said Michel Sidibé, the Executive Director of UNAIDS. (*UNAIDS*, 1 Aug 2014)

## ▶ UNICEF

▶▶ In efforts to prevent the spread of polio and other diseases amongst children displaced by violence into the Kurdish Region of Iraq, UNICEF and the Kurdistan Regional Government have agreed to extend immunisation to host populations, displacement camps and border crossings, as an estimated 300 000 people have fled the ongoing conflict. This is heightened by the re-appearance of polio in Iraq after 14 years' absence, where poor routine immunisation and problems in reaching children in conflict zones makes the region vulnerable to a large outbreak. UNICEF calls for extending immunisation services beyond the Syrian refugee camps, and for locating polio immunisation teams at refugee transit points. The government agreed to support vaccinations at key points, followed by a catch-up polio campaign targeting more than 700 000 children aged under 5 years. (*UNICEF*, 19 Jun 2014)

▶▶ According to UNICEF's new population estimates, by the end of the 21st century 40% of all people and nearly 50% of all children will be African, heralding a radical demographic shift. Whilst other regions are seeing slower increases or declines in births, 1.8 billion babies could be born in Africa over the next 35 years, and the total population could quadruple to 4.2 billion by 2100. Africa could either reap a demographic dividend from a large workforce with relatively few dependents, or efforts to eliminate poverty by economic growth could be undermined by the population burden. Africa's life expectancy is also increasing, and is becoming more urbanised and crowded. These changes are often happening in the poorest and most fragile countries, and UNICEF calls for more action to deal with the challenges of Africa's growing population. (*The Globe and Mail*, 12 Aug 2014)

▶▶ Globally, more than 700 million women were younger than 18 years on marriage, with 1-in-3 married before their 15th birthday, according to a UNICEF survey. On current trends this could reach 1 billion by 2050. Although relative numbers have fallen, increasing population growth in countries where it is practised means numbers are con-

stant. The same survey found that 130 million women and girls have experienced female genital mutilation (FGM). Although the prevalence of FGM has fallen sharply, an additional 63 million girls could face FGM by 2050. Girls who marry under 18 are less likely to remain in school, have a higher risk of domestic violence and death from pregnancy and childbirth complications. FGM risks excessive bleeding, infection, infertility and death. UNICEF's Chief Executive, Anthony Lake, calls for increased efforts to break the cycles of FGM and child marriage. (*The Guardian*, 22 Jul 2014)

▶▶ The UNICEF report *Hidden in Plain Sight* uncovers a 'shocking prevalence' of emotional, physical and sexual violence against children – often in their own communities, homes and schools, and much going unreported. It found that homicide is the leading cause of death amongst males aged 10–19 years in many Latin American countries, and Nigeria had the highest number of young murder victims – almost 13 000 in 2012. UNICEF has urged governments to do more to protect the rights of children, and also noted that 1 in 10 girls have been raped or sexually assaulted. It blames social attitudes on gender and child-rearing as being partially-responsible for the figures. "Too many victims, perpetrators and bystanders see it as normal, and when violence goes unnoticed and unreported, we fuel the belief among children that it is normal", says UNICEF's Deputy Director, Geeta Rao Gupta. (*Deutsche Welle*, 5 Sep 2014)

▶▶ Ghana launched its National Newborn Strategy and Action Plan to guide newborn delivery and care. The Minister of Health, Dr Agyemang-Mensah, described the country's statistics on newborn mortality as a "serious affront". As a result, Ghana has made little progress in reducing newborn mortality, and is unlikely to meet Millennium Development Goal on reducing under-5 mortality rates. Each year, 30 000 newborn babies die in Ghana – 71% of which is preventable if care during and after birth is available. Mrs Susan Ngongi, the UNICEF Country Representative, welcomed these efforts to reduce newborn deaths. (*ghanaweb.com*, 31 Jul 2014)

## ▶ World Health Organization (WHO)

▶▶ The 67th World Health Assembly (WHA) saw a record number of agenda items, documents and resolutions, and closed with the adoption of more than 20 resolutions on public health issues of global importance. They focused on: antimicrobial drug resistance; implementation of the Inter-

national Health Regulations; health impact of exposure to mercury and mercury compounds; the global challenge of violence, particularly against women and girls; renewed commitments towards universal health coverage; financing and co-ordinating health research and development; access

to essential medicines; regulatory system strengthening; health intervention and technology; health in the post-2015 agenda; and newborn health. The agenda reflected both the growing complexity of health issues, and the drive to address them. (*WHO*, 24 May 2014)

▶▶ WHO data shows that 38 million people die from preventable and treatable chronic illnesses (eg, diabetes, heart disease) each year, and nearly half die prematurely before the age of 70 years. The majority are in developing countries. Deaths from these illnesses have increased since 2000, especially in South East Asia and the Western Pacific, but Africa will see the largest increases by 2020. Progress in tackling this has been inadequate and uneven, although more than 50% of governments have signed up to a WHO action plan to reduce these deaths by 25% by 2025. WHO notes that falling rates of childhood obesity – an indicator for these diseases – would indicate progress, and that prevention, early diagnosis and treatment are important in reducing these deaths. (*Voice of America*, 10 Jul 2014)

▶▶ According to the WHO, the current Ebola outbreak is the “most severe acute health emergency in modern times”, and proves that the world is not prepared to respond adequately to severe public health emergencies. The WHO’s director-general, Margaret Chan, said that the disease is now “rising exponentially” in Guinea, Liberia and Sierra Leone, and could threaten the very surviv-

al of societies and governments in very poor countries. She added that she had never seen an infectious disease contribute so strongly to potential state failure. (*Telegraph UK*, 13 Oct 2014)

▶▶ According to WHO figures, there are more than 10 000 cases of Ebola globally in the largest outbreak of the disease, mainly in Guinea, Liberia and Sierra Leone. There are a suspected 4665 cases and 2705 deaths in Liberia, 3896 cases and 1281 deaths in Sierra Leone, and 1553 cases and 926 deaths in Guinea. Mali had one reported Ebola case, which resulted in death, Nigeria had 20 cases and eight deaths, Senegal and Spain had one case and no deaths, and the US had four cases and one death. Approximately 450 health workers are likely to have been infected with Ebola, although a large number is unrelated to caring and treating Ebola patients. (*UPI*, 25 Oct 2014)

▶▶ The WHO confirmed that a bubonic plague outbreak in Madagascar has killed 40 people and infected 80 others, warning of the dangers of a rapid spread of the disease, especially in the densely-populated capital city, Antananarivo. The bubonic plague is normally spread by bites from an infected flea, and there are high resistance levels to insecticide amongst fleas. However, 2% of cases in Madagascar are the more dangerous pneumonic form, which is spread person-to-person by coughing, and a task-force has been convened to manage the outbreak. (*BBC*, 21 Nov 2014)

## ► Demography

►► It is widely agreed that 2.1 children per woman is the replacement rate for stable populations in developed countries, and slightly higher in developing countries. Increasingly, fertility rates have fallen below this; 1.5 in China, 1.6 in Europe, 1.4 in Japan and 1.3 in South Korea, and are also falling in several less wealthy south Asian countries. Soon, half the world's population will live in countries where the population is not reproducing itself. Fewer children means fewer workers to support a growing number of pensioners, leading to efforts to boost fertility eg, tax incentives, child benefits and child-care provision, with mixed results. However, some experts believe that this is an over-estimate, as higher educational levels means that populations are independent for longer. This leads to estimated optimal fertility rates of 1.5–1.8; and countries with high immigrant rates need lower replacement rates. (*The Economist*, 31 May 2014)

►► A UN population report shows that the global urban population is set to rise to more than 6 billion people by 2050. Africa and Asia will face challenges in meeting the needs of their growing urban populations, from basic services – such as education – to energy, infrastructure and employment. Africa is predicted to experience the highest rate of urbanisation, and there is an anticipated 40 megacities worldwide, each with populations of at least 10 million. Delhi, Shanghai and Tokyo will be the world's most populous cities. The global rural population will decline as urbanisation increases, and the UN says that cities must generate income and employment and invest in the necessary infrastructure to support their citizens and protect the environment. (*The Guardian*, 10 Jul 2014)

►► According to an IPSOS survey, 77% of people in developed countries are happy, although most wish their lives

were simpler. Whilst most were happy with their personal lives, there was concern about the future, globalisation and the effects of inequality. The survey questioned 16 000 people on 10 areas, including the digital revolution, health care, generational tensions and immigration. It found that people in developing countries felt both more positive about globalisation compared to developed countries, and more pressure to make money and display their success. (*The Guardian*, 16 Jul 2014)

►► According to Myanmar's Central Census Commission, the country's population is probably less than the accepted 60 million people. The country has lacked reliable population estimates for 30 years. The first census for 30 years controversially asked people to identify their ethnicity and religion, causing tensions in the multi-ethnic country. One group was excluded as it refused to self-identify using the government's preferred term, and census-takers could not gain access to other rebel-controlled areas. (*Irrawaddy Magazine*, 14 Aug 2014)

►► The upper range of the latest UN population projections suggest that the world's population could increase to 12 billion by 2011, from its current 7.2 billion. These trends have been apparent for some time, with global population growth slowing down and stabilising, although not stopping. Long-range population forecasts can be unreliable, as the assumptions made about birth rates are often off-target, eg, the fall in Iran and Bangladesh's fertility rates from 6 to 2 from 1980–2014 was not foreseen. Therefore, if Africa's birth rates, which form much of the projected increase, experience the same decline, then the 2100 population figures could be very different. (*The Economist*, 24 Sep 2014)

## ► Economy

►► To mark the 50th anniversary of the founding of the Group of 77 (G77) developing countries, the group published a re-affirmation of the needs of developing countries, noting that it was established in 1964 to address imbalances in the global economy which are still prevalent in 2014. It emphasised the importance of World Trade Organization agreements on Trade-Related Aspects of Intellectual Property Rights for public health and access to medicines, and called on developed countries not to take action,

eg, trade measures, against developing countries making use of these flexibilities. It also called for more technology transfers, capacity-building, wider South-South co-operation, financial reform, and for the “democratic deficit” in global economic governance to be addressed. (*IP-Watch*, 18 Jun 2014)

►► The “BRICS” countries of Brazil, Russia, India, China and South Africa have reached a broad agreement on their US\$ 100 billion development bank, and are expected to

sign a treaty to officially launch the bank in July 2014. The new bank symbolises the growing influence of emerging economies in the global financial architecture. Although consensus on some technical aspects of the bank has still to be reached, it is anticipated that it will help fund the growing demand for project funding which is not completely met by global agencies. (*Reuters*, 7 Jul 2014)

▶▶ According to analysis from the World Bank Group, Ebola's economic impact could increase eight-fold in already-fragile Guinea, Liberia and Sierra Leone – a potentially catastrophic blow. This could be limited if the epidemic is contained. In the short-term, this could reduce economic growth in Guinea by 2.1%, 3.4% in Liberia and 3.3% in Sierra Leone – equivalent to losses of US\$ 359 million. If Ebola is not contained, the estimated economic damage increases to US\$ 809 million. Inflation and food prices are already rising due to shortages, panic buying and speculation. In line with other epidemics, most economic damage arises from aversion behaviour rather than direct costs, and underlines the need for a concerted international response, including humanitarian aid, fiscal support, screening fa-

cilities and strengthening health systems. (*World Bank*, 17 Sep 2014)

▶▶ Jean Tirole, an economics professor at the University of Toulouse, France, won the 2014 Nobel Prize for economics. His work on understanding and regulating industries with a few powerful firms is becoming increasingly important as public monopolies such as water, electricity and telecoms are privatised, and has been adopted by competition regulators worldwide. Upon announcing the winner, Staffan Normark said “this year's prize in economic sciences is about taming powerful firms”. (*The Guardian*, 13 Oct 2014)

▶▶ According to the Credit Suisse global wealth report, the richest 1% of the world's population are getting wealthier, have net worth of about US\$ 800 000 or more, and own more than 48% of global wealth – and the bottom 50% own less than 1% of global wealth. Other research findings from Credit Suisse suggest that global wealth inequality has increased over recent years, and that overall wealth in the US has grown faster than incomes – a possible precursor to recession. (*The Guardian*, 14 Oct 2014)

## ▶ Energy

▶▶ The UN Secretary-General, Ban Ki-Moon, praised Nicaragua's efforts to promote sustainable energy in a visit to the country's Camilo Ortega Wind Park. The wind park represents almost 25% of Nicaragua's wind power, and will reduce CO<sub>2</sub> emissions by at least 100 000 tons annually. Mr Ki-Moon spoke about Nicaragua's vast potential for renewable energy, noting that it has already partially met the UN's *Sustainable Energy for All* targets. He outlined the importance of energy in changing lives, improving the quality of life and promoting human dignity, and the importance of clean energy in addressing climate change; and called upon Nicaragua to continue investing in renewable energy to help everyone live a life of dignity. (*UN*, 29 Jul 2014)

▶▶ Re-starting Japan's nuclear facilities after the 2011 Fukushima nuclear crisis may be delayed until 2015, increasing pressure on energy prices. Kyushu Electric Power's Sendai plant will probably be the first to re-start following tightened safety rules after the 2011 disaster, reducing the purchase of fossil fuels by US\$ 1.9 billion. All of Japan's nuclear reactors closed after the nuclear crisis at Fukushima, forcing companies to import gas and coal to run power stations, leading to losses of US\$ 34 billion and a government bailout for Kyushu. Electricity prices have increased as a result, and Hokkaido Electric Power have

requested permission to raise household electricity rates by 17%, and Kyushu may be forced to follow suit. (*Reuters*, 6 Aug 2014)

▶▶ Following measures to save natural gas, Ukrainians are resorting to “wash visits” by using family members' and friends' shower facilities, as well as school closures and DIY insulation to cope with energy shortages. Authorities are trying to stockpile supplies ahead of winter, after Russia, its main supplier, stopped shipments in June following the accumulation of Ukrainian debts of US\$ 5.3 billion. Gas supplies are half their normal capacity – insufficient to cover Ukraine's winter needs. Homes must be kept cooler, and there are warnings of power cuts. Energy supplies are also affected by road and rail damage in the coal mining areas of Donetsk and Luhansk during the recent conflict. (*Bloomberg*, 18 Sep 2014)

▶▶ New York's major, Bill de Blasio, committed to an 80% reduction in the city's greenhouse gas emissions by 2050. This follows on from his predecessor Michael Bloomberg, whose 2007 greener-city agenda set out reducing emissions by 30% below their 2005 levels by 2030. Mr de Blasio's plan focuses on making the city's buildings more energy-efficient via strict regulations on new buildings and

retro-fitting existing buildings. This is important as buildings contribute nearly 75% of the city's CO<sub>2</sub> emissions. The plan will be extremely expensive to implement (although many changes could be self-financing). It has proved difficult to reduce emissions by top-down agreements, although the city is fortunate to have had mayors who have recognised the facts and obstacles on climate change, and taken action. (*New York Times*, 22 Sep 2014)

▶▶ Nigeria, Africa's largest economy, relies heavily on expensive diesel generators to supplement its unreliable national power grid. Its energy-generating capacity compares poorly with India and China, and the World Bank estimates

that power shortages decrease Africa's GDP growth by 2% annually, and by 4% in Nigeria. However, across Africa there is a rush to invest in energy capacity, which is estimated to increase by over 50% by 2020. Some of this increase should come from coal-fired power stations, but there are moves towards cleaner, renewable energy. This expansion is driven by more private investment in renewable energy, and its rapidly falling costs. Africa has some of the world's best potential sites for wind, solar and hydro-power, and could jump from being an energy laggard to a world leader in renewables, with the right leadership. (*The Economist*, 27 Sep 2014)

## ▶ Environment

▶▶ Mary Robinson, former President of the Republic of Ireland, has been appointed as special envoy for climate change. In 2010, she set up "The Mary Robinson Foundation – Climate Justice" to campaign for justice for victims of climate change. There was some urgency in her appointment because of the forthcoming 2014 Climate Summit, hosted by the UN Secretary-General. "Our work on climate justice emphasises the urgency of action on climate change from a people's perspective and I intend to take this approach in my new mandate as special envoy for climate change," said Mary Robinson. (*BBC*, 14 Jul 2014)

▶▶ The first global conference on health and climate change took place in Geneva, Switzerland. Climate change is already responsible for thousands of additional deaths each year, as rising temperatures cause diseases to spread to new areas, shifting weather patterns affect crops yields, and extreme events such as heat waves and floods degrade water supplies. Children and poor people are mainly affected by climate-related disease, and Dr Flavia Bustro, the WHO assistant director general of family, women's and children's health warns that "without effective action to mitigate and adapt to the adverse affects of climate change on health, society will face one of its most serious health challenges." (*RTCC*, 27 Aug 2014)

▶▶ According to the UN's World Meteorological Association (WMO), levels of atmospheric carbon dioxide (CO<sub>2</sub>) grew at the fastest rate for 30 years; with CO<sub>2</sub> emissions being the biggest driver of global warming. WMO say that average daily levels reached their highest recorded level of 400 ppm (ppm) in May 2013, and some scientists warn that 350 ppm is the safe upper limit. The increase could be linked to faltering storage of carbon in the Earth's oceans and forests, which currently locks away almost 50% of CO<sub>2</sub>

emissions, albeit at the cost of increased acidification. If this mechanism fails, the chances of avoiding dangerous climate change may be much reduced. The warnings come ahead of a UN climate summit in New York, aimed at bolstering efforts to reduce the burning of fossil fuels and resulting CO<sub>2</sub> emissions. (*Financial Times*, 9 Sep 2014)

▶▶ At a Hong Kong conference, 11 Nobel laureates will unite to warn that humankind is living beyond its means, and darkening its future. They argue that the list of planetary ailments – global warming, deforestation, ocean acidification etc. – is lengthening, and that everyone must consider the environmental impact of each decision made. They urge more focus on cleaner energy sources, adaption of sustainability in wider contexts – food, water, soil and atmosphere – and for everyone to understand the benefits to humanity of adaptation to the dangers posed by over-exploitation of resources. (*The Guardian*, 7 Oct 2014)

▶▶ High consumption in developing countries combined with industrialisation in emerging economies have caused huge demand for raw materials, and the quantity of materials extracted for consumption increased by 60% in the past 30 years. 20% – more than 12 billion tonnes annually – ends up as waste. The global economy is set to grow by 400% by 2050 alongside rising populations, leading to questions of sustainability. One solution is to break the link between economic growth and materials use, by re-using and recycling products as much as possible. Product design can support this by eg, making products easy to disassemble and using recycled materials. This reduces input costs, making it cost-effective for businesses, plus being environmentally-beneficial. Consumer awareness on the importance of recycling and re-use is also vital for reducing waste and preserving resources. (*OECD*, 29 Oct 2014)

## ► Food, Water and Sanitation

►► The WHO/UNICEF report *Progress on Drinking Water and Sanitation: 2014 update* shows that almost 2 billion people have gained access to improved sanitation and 2.3 billion to improved drinking-water since 1990, and overall the access gap between rural and urban areas is narrowing, although urban areas are generally better supplied. However, 748 million people still use unimproved drinking-water. Stark inequalities persist, with the majority of those without improved sanitation are poorer people in rural areas. There can also be striking inequalities in urban access, with people living in informal or illegal settlements less likely to have improved water or sanitation. “If we hope to see children healthier and better educated, there must be more equitable and fairer access to improved water and sanitation”, says Sanjay Wijesekera, UNICEF Chief of Water, Sanitation and Hygiene. (*WHO*, 8 May 2014)

►► The Economist Intelligence Unit published a report on food loss and its intersection with food insecurity. It noted that globally there is enough food to feed everyone, but 1-in-8 people are chronically undernourished, with food waste and loss at the centre of the gap between production and consumption. It estimates that food loss amounts to US\$ 750 billion each year. Food loss is correlated with food security and income level. For developing countries, it calls for improved farming methods, infrastructure and operating environments to increase efficiency and mitigate loss. The problem of food waste in developed countries could be addressed by eg, by food waste becoming socially unacceptable, and clarifying date labelling on food. Overall, the report calls for a more efficient and responsive global food supply chain, where currently-wasted surpluses in the developed world can be diverted to countries where supply is short. (*EIU*, 28 May 2014)

►► The Millennium Development Goal for sanitation – halving the number of people without sustainable access to basic sanitation – is unlikely to be met, and according to the UN, 2.5 billion people still lack “improved sanitation facilities”. This is a mere 7% reduction from 1990, when 2.7 billion lacked access. This affects human dignity, health

and the environment, and is cross-cutting – improved sanitation can reduce child mortality, improve maternal health and improve education, as better sanitation makes it easier for girls to attend school. The UN Deputy Secretary-General, Jan Eliasson, expects sanitation to figure highly in the post-2015 Sustainable Development Goals. “Invest in sanitation and you will have concrete results with positive changes for people’s lives,” he says, calling for more emphasis on urban areas with inadequate infrastructure. (*The Guardian*, 28 Aug 2014)

►► Participants in the 2014 World Water Week emphasised the importance of a water goal, and the integration of energy and water in the post-2015 Development Agenda, and concluded that water efficiency is vital to fighting poverty and hunger. The event called for everyone to become as aware of water efficiency as they are of energy efficiency, for improved rainwater management to ensure development goals can be met, for the invention of a non-flush toilet to cut water usage, and for the need to grow biofuels in areas reliant on rainfall rather than irrigation. In addition, several prizes were awarded for water-related excellence, including to eThekweni Water and Sanitation (Durban, South Africa) for its approach to providing water and sanitation. (*World Water Week in Stockholm*, 5 Sep 2014)

►► The UN report *The State of Food Insecurity in the World* shows that the numbers of hungry people has fallen sharply over the past 10 years, although 805 million – 1 in 9 of the global population are still under-nourished. The numbers of chronically under-nourished people fell by more than 100 million. The ambitious goal of halving the number of chronically under-nourished people by 2015 has been met by 25 developing countries, but will not be met globally, as success stories like Brazil are partially off-set by eg, Haiti, where numbers rose from 4.4 million in 1990–92 to 5.3 million in 2012–14. Ebola has also undermined food security in West Africa by endangering harvests and increasing food prices, and ongoing conflicts in Syria, South Sudan and the Central African Republic hinder humanitarian efforts to reach affected people. (*Reuters*, 16 Sep 2014)

## ► Peace and Human Rights

►► The latest Global Peace Index (GPI) shows that nations spend an estimated US\$ 9.8 trillion on dealing with violence, as peace deteriorated slightly for the seventh year, due to conflicts in Syria, South Sudan etc. The Institute for

Economics and Peace (IEP), which produces the GPI, says that this is equivalent to 19% of global economic growth from 2012–13 – or US\$ 1350 per person. The true cost may be much higher, as some data are impossible to obtain.

Whilst major international conflicts are less common, internal conflicts are increasing. Eleven countries are in absolute conflict, but 500 million people live there, with 200 million living on less than US\$ 2/d. The GPI lists Iceland, Denmark and Austria as the most peaceful nations, and identified Zambia, Haiti, Argentina, Chad, Bosnia and Herzegovina, Nepal, Burundi, Georgia, Liberia and Qatar as vulnerable to small to medium deteriorations in peace. (*The Guardian*, 8 Jun 2014)

▶▶ The African Court of Justice and Human Rights was intended to be an alternative to the International Criminal Court (ICC) in The Hague – criticised by African governments for targeting African leaders. However, the 2014 African Union decided to grant serving leaders and senior officials immunity from prosecution, unlike the ICC. Although only valid while people are in office, critics say that it could encourage attempts to seize power for life. This means that victims would have to turn to the ICC for justice rather than the African Court. The African court has gained support amongst some African people, as it dovetails with a culture of reconciliation, but Amnesty International describes it as “a step backward for justice”. (*The Guardian*, 3 Jul 2014)

▶▶ Data from the UNHCR shows that more than 3 million Syrians have fled from their country’s civil war – which has claimed 191 000 lives to date – with 1 million in the past year alone. This suggests increasingly horrific conditions within Syria, and places huge strains on their host countries, where nearly 40% of refugees are living in sub-standard conditions. The war has also displaced 6.5 million people internally, so almost 50% of Syrians have been forced to flee their homes. This has become the UNHCR’s largest relief operation, and it faces a funding shortfall of US\$ 2 billion by this year alone. There are signs that the journey out of Syria is becoming more difficult, and the

UNHRC is concerned about Syrians trapped inside the remote Iraqi al-Obaidi camp after agencies were forced to abandon the region after it was over-run by Islamic State jihadists. (*The Guardian/AFP*, 29 Aug 2014)

▶▶ According to a study by the Copenhagen Consensus Centre, the number of people killed in disputes between individuals globally – including domestic violence – is nine times higher than those killed in wars and conflicts, at an estimated cost of US\$ 9.5 trillion a year. The authors note that physical violence in societies is a much larger problem than military violence, with graver economic consequences. In 2008, 1-in-3 countries had homicide rates of more than 10 per 100 000 – defined by the WHO as “epidemic”. It shows that 43% of all female homicide victims were killed by a current or former partner, 30% of women are subject to domestic violence, and 290 million children suffer violence in the home. “Domestic abuse of women and children should no longer be regarded as a private matter but a public health concern”, it says. (*The Guardian*, 9 Sep 2014)

▶▶ Indian children’s rights activist Kailash Satyarthi and Pakistani teenager Malala Yousafzai (its youngest recipient), who was shot by the Taliban for advocating girls’ rights to education, won the 2014 Nobel Peace Prize. They were chosen because of their struggle against the suppression of children, and for the right of all children to education. Kailash Satyarthi has headed various peaceful protests and demonstrations, focusing on the exploitation of children for financial gain. Malala Yousafzai was shot in northwest Pakistan in punishment for her campaigning blog against Taliban efforts to deny women an education. “The Nobel Committee regards it as an important point for a Hindu and a Muslim, an Indian and a Pakistani, to join a common struggle for education and against extremism,” said Thorbjørn Jagland, head of the Nobel Committee. (*Reuters*, 10 Oct 2014)

## ▶ Science and Technology

▶▶ At the May 2014 *Big Data in Biomedicine* conference, Michele Barry (director of the Center for Innovation in Global Health at Stanford University) recorded a video interview, where she talked about the importance of big data for global health solutions. She outlined its importance for obtaining a clearer picture of population health, and would like to see big data surveillance used more widely in under-served areas, eg, sub-Saharan Africa, and amongst the world’s poorest billion people, who lack access to health care. She cited lack of funding and awareness as hampering efforts to use big data, and noted that cost-effective in-

novations, implemented pragmatically and preventatively, can support its usage. She said that big data can be used to identify dangerous pathogens for infectious disease control, which has positive outcomes for preventing of non-communicable diseases as they are often linked to infectious diseases. (*Scope*, 20 Jun 2014)

▶▶ The UN’s *Prototype Global Sustainable Development Report* says that crowd-sourcing could help to identify new development issues, and ensure that the global development agenda is more representative of views from the south. This follows on from a commitment at the Rio +20 summit to

improve the science–policy interface and associated decision–making by bringing disparate scientific assessments into one place. It identified crowdsourcing as a way to gather opinions from more varied groups of scientists. Tracking progress will require significant capacity building of national statistics offices, and the use of technology such as remote sensing and big data analysis. However, a representative from the UK's Overseas Development Institute doubts that the report will deliver much change, apart from monitoring global sustainable development, and calls for focused efforts at national levels to increase scientists' impact. (*SciDev.Net*, 10 Jul 2014)

▶▶ Research published in *Nature* investigated the effects of malnutrition on healthy postnatal development of microbiota. Therapeutic food intervention saves lives in children with severe acute malnutrition, but incomplete growth restoration (“stunting”) is a major problem. The study found that severe malnutrition is associated with significant relative microbiota immaturity that is only partially offset by nutritional interventions. This suggests that longer food–based interventions and/or addition of gut microbes may be needed to achieve durable repair of children's microbiota immaturity associated with malnutrition to improve clinical outcomes. (*Nature*, 19 Jun 2014)

▶▶ The 2014 Nobel Prize for Physiology or Medicine was awarded to John O'Keefe, May–Brit Moser and Edvard Moser for their work on the brain's internal positioning system. John O'Keefe initially discovered this system in 1971, and his work shows that different sets of nerve cells were activated whenever a rat was in different locations, and argued that these cells form a map within the brain. Husband and wife team, May–Britt and Edvard Moser, discovered a different part of the brain that acts like a nautical chart, enabling the brain to judge distance and navigate. The Nobel committee said that “a better understanding of neural mechanisms underlying spatial memory is therefore important, and the discoveries of place and grid cells have been a major leap forward to advance this endeavour.” (*BBC News*, 6 Oct 2014)

▶▶ Researchers have grown human brain cells in a gel, where they formed networks akin to those in an actual brain. When the neurons were given the genes for Alzheimer disease, they formed the characteristic plaques and tangles. This could potentially accelerate the testing of new drugs to treat the condition. The technique could also be used to study the effects of genes that predispose some–one to develop Alzheimer disease, and to develop models on how it develops. (*New York Times*, 12 Oct 2014)

#### REVIEWERS IN 2014

The editors in chief of the *Journal of Global Health* are grateful to experts who peer-reviewed the submissions in 2014:

Davies Adeloye (Edinburgh, UK)

Katharine A. Allen (Baltimore, MD, USA)

Angela Anson (San Francisco, CA, USA)

Lisa A. Bero (San Francisco, CA, USA)

Abdul Bari (Washington DC, USA)

Robert E. Black (Baltimore, MD, USA)

Jane Briggs (Guatemala City, Guatemala)

Luciana Brondi (Edinburgh, UK)

Kit Yee Chan (Beijing, China; Edinburgh, UK)

Arsalan Cheema (Islamabad, Pakistan)

Theresa Diaz (New York, NY, USA)

Tanya Doherty (Cape Town, South Africa)

Trevor Duke (Melbourne, Australia)

Christa Fischer Walker (Baltimore, MD, USA)

Wendy Graham (Aberdeen, UK)

Tanya Guenther (Washington DC, USA)

Davidson Hamer (Boston, USA)

Stephen Hargarten (Milwaukee, WI, USA)

Suzanne R. Hill (Canberra, Australia)

Musonda Kasonde (Abuja, Nigeria)

Emily Keane (London, UK)

Kelly Keisling (Fairfax, VA, USA)

Kate Kerber (Cape Town, South Africa)

Musonda Kasonde (Copenhagen, Denmark)

Ivana Kolčić (Split, Croatia)

Claudio Lanata (Lima, Peru)

Shabir Madhi (Johannesburg, South Africa)

Mersiha Mahmić-Kaknjo (Zenica, Bosnia and Herzegovina)

Mario Malički (Split, Croatia)

Scott Murray (Edinburgh, UK)

Harish Nair (Edinburgh, UK)

Rory Nefdt (Nairobi, Kenya)

Tom O'Connell (New York, NY, USA)

Lucy Paintain (London, UK)

Stefan Petersen (Kampala, Uganda)

Ozren Polašek (Split, Croatia)

Sara Riese (Bethesda, MD, USA)

Jane Robertson (Newcastle, Australia)

Carine Ronsmans (London, UK)

Dario Sambunjak (Zagreb, Croatia)

Sunil Sazawal (Baltimore, MD, USA)

Vanja Saftić (Zagreb, Croatia)

Devi Sridhar (Edinburgh, UK)

Mark Tomlinson (Cape Town, South Africa)

Wei Wang (Perth, Australia)

Alexa Wharton-Smith (London, UK)

Shelby Wilson (Seattle, WA, USA)

Cathy Wolfheim (Geneva, Switzerland)

Sachiyo Yoshida (Geneva, Switzerland)

Tomás Zapata (Windhoek, Namibia)

# Routine monitoring systems for integrated community case management programs: Lessons from 18 countries in sub-Saharan Africa

Tanya Guenther<sup>1</sup>, Yolanda Barberá Laínez<sup>2</sup>, Nicholas P Oliphant<sup>3</sup>, Martin Dale<sup>4</sup>, Serge Raharison<sup>5</sup>, Laura Miller<sup>6</sup>, Geoffrey Namara<sup>7</sup>, Theresa Diaz<sup>3</sup>

<sup>1</sup>Save the Children, Washington DC, USA

<sup>2</sup>International Rescue Committee, New York, NY, USA

<sup>3</sup>UNICEF, Programme Division, Health, New York, NY, USA

<sup>4</sup>Population Services International, Nairobi, Kenya

<sup>5</sup>John Snow Inc., Arlington, VA, USA

<sup>6</sup>International Rescue Committee, Freetown, Sierra Leone

<sup>7</sup>Malaria Consortium, Kampala, Uganda

Implementing integrated community case management at scale involves thousands of diverse community health workers providing services in the hardest to reach, most deprived communities where formal services have failed to adequately deliver the most basic preventive and curative care – systems for routine monitoring must be designed to fit this context, place the end-user at the forefront, and align with the capacity for response.

Integrated community case management (iCCM) programs are expanding rapidly in many low- and middle-income countries, particularly in sub-Saharan Africa. Conclusions from the recent review of iCCM programs in Africa emphasized the critical importance of using routine data to assess program performance and to inform impact evaluations [1]. Yet monitoring systems often fail to deliver quality data (defined as relevant, complete, timely and accurate [2]) and program managers do not have the

capacity or are not empowered to use data for decision-making and corrective action [3]. Monitoring systems for iCCM suffer from many of the same shortcomings of the broader routine health information systems (HIS), but extending these systems to the community level at scale presents unique challenges and constraints. While the literature highlighting results of iCCM programs has expanded, little has been published that explores the monitoring systems necessary to support successful implementation.

This paper aims to synthesize lessons learned from recent experience developing and implementing systems for routine monitoring of large scale iCCM programs. These lessons were compiled from the primary partners supporting iCCM implementation across 18 countries in sub-Saharan Africa through interviews with monitoring focal persons and review of relevant documents and tools and informed by literature on strengthening routine health information systems more broadly [3–5]. We first outline the rationale for routine data and the challenges iCCM programs face to establish functional monitoring systems to generate such data. We then characterize the current state of routine monitoring systems for iCCM, summarize lessons learned and conclude with a way forward.

## WHY IS ROUTINE MONITORING DATA SO IMPORTANT FOR iCCM PROGRAMS?

Children fall ill with iCCM conditions multiple times over the course of a year (estimated to range between 3.3 episodes of diarrhea [6], 1.7 episodes of malaria [7] and 0.3 episodes of pneumonia in sub-Saharan Africa [6]). Health services need to be routinely available and accessible to provide timely and appropriate treatment. Currently, the gold standard for measuring treatment coverage is through household surveys such as the Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) [8]. However, household surveys are resource intensive and typically capture data on care-seeking and treatment practices for only a two week recall period [8,9]. This timeframe is insufficient to capture performance over actual project cycles or long implementation periods, as coverage is sensitive to fluctuations in supply side factors (availability of providers, medicines and supplies), demand side factors (ability to cover transport or other associated costs, opportunity costs for family to seek care, awareness and perception of services) and contextual factors (seasonality, flooding, conflicts) [10]. Further, the validity of household survey questions to measure appropriate treatment coverage for pneumonia and malaria has been called into question; the small sample sizes for many conditions preclude precise estimates, especially at subnational level; and data on source of treatment are not always collected [9]. In addition, the samples used in most widely available household surveys, such as DHS and MICS, are often representative of the national or regional population, making it difficult for district managers to extract useful information for program monitoring. To better understand the con-

Strong monitoring systems, in which community treatment data are integrated within national health information systems and used to identify issues and take timely action, are essential to improve the ability of integrated community case management programs to achieve high levels of appropriate utilization and thereby impact child health.

tribution of iCCM and to improve implementation, program implementers, managers and evaluators require real-time, sound data that enables tracking trends over time on factors associated with high coverage, quality and cost-efficiency, such as rates of treatment, supervision and medicine availability [11].

## WHAT CHALLENGES DO WE FACE FOR ROUTINE MONITORING OF iCCM?

Building and maintaining systems to effectively monitor iCCM implementation at scale is inherently complex, involving data collection from thousands of multi-tasked community health workers (CHWs), who in many cases are volunteers with limited formal education. While community health information systems share characteristics and shortcomings with the broader routine HIS of which they are part of (or should be part of), the complexity of increasing the number, diversity and geographic dispersion of service delivery points creates several unique challenges.

Consider Rwanda, where an estimated 30 000 CHWs are providing iCCM services and generating data on a monthly basis – more than 50 times the number of public health facilities (576 in 2014 according to the Ministry of Health (MOH); personal communication; Ministry of Health Rwanda). There is often wide variation in levels of literacy and numeracy among CHWs even within a single country. In Uganda, CHWs in central districts are generally literate and numerate, while CHWs in western districts are semi-literate and those in remote northern districts are mostly illiterate. The timeline required for collect-



Photo: Courtesy of Yolanda Barberá Lainez, International Rescue Committee

ing reports from a large network of iCCM CHWs, who are by definition far from health facilities, is also greater in most settings; one cannot expect it will take the same amount of time to receive reports from a large set of CHWs as for health facility reports within a given administrative unit. Monitoring systems need to accommodate this scale and variation, and yet the window of time to develop procedures and tools (registers, reporting and compilation forms, data management processes, training materials) is typically very short with limited opportunity for testing and refinement. The costs of printing tools and retraining the thousands of CHWs and first level health workers each time a register or report is revised are prohibitive.

By design, community case management strategies target underserved areas with limited access to formal health services; not surprisingly, these areas typically also experience poor physical infrastructure (inadequate roads, limited transportation options, minimal electricity, spotty if any internet or mobile network coverage) and an already overstretched health system with inadequate human resources for supervision and monitoring. Moreover, in most countries, multiple donors and agencies are supporting iCCM implementation and have their own short-term reporting requirements that often do not meet country information needs or take into account the underlying system capacities or constraints [3]. This creates a tendency to impose far greater documentation and reporting requirements on CHWs than is expected at the facility level, putting pressure on the lowest level of the system and compromising data quality and completeness. Furthermore, there are limited incentives for partners to invest in strengthening a national system for routine monitoring, which requires time, compromise, priority setting and coordination. As such, in many cases routine monitoring data are often undervalued and marginalized in favor of periodic surveys over which donors and implementing partners can exert greater control.

Finally, whereas the technical content for an iCCM program can be relatively standard across settings and indicator definitions can and should adhere to international standards, there is no “one-size-fits-all” approach for *how* to implement an effective monitoring system for iCCM. Approaches must be tailored for each context and be light and flexible enough to adjust to rapidly changing program contexts.

## WHAT IS THE CURRENT STATUS OF ROUTINE MONITORING SYSTEMS FOR iCCM?

While iCCM programs are progressing to scale rapidly, monitoring systems are lagging behind in strengthening the six functional components required for a HIS to generate quality information as outlined by the Health Metrics Net-

work Framework [12]. **Table 1** contrasts the typical state of monitoring systems for iCCM with the ideal situation and demonstrates that monitoring systems for iCCM still need to improve. These issues are not unique to iCCM [4]. Few countries have strategic plans for their HIS and fewer still have annual, costed plans to operationalize them. Very few MOH have M&E staff explicitly responsible for iCCM data, and where they do exist, they are usually short-term secondments supported by partners. National M&E plans with prioritized indicators for iCCM are lacking in most countries with large scale iCCM programs and those countries with plans have struggled to operationalize them. Reporting systems tend to be burdensome and CHWs are often asked to record and report vast quantities of data that are rarely used and could be obtained more effectively and efficiently from other sources. In many countries, CHWs deliver more than just iCCM, but monitoring and supervision systems are set up vertically. To our knowledge, only a handful of countries (Ghana, Uganda, Zambia, Malawi, Mali, and Niger) have initiated capture of data on community treatments in their national HIS and even in these cases, the data are not fully compatible with facility level data making it difficult to measure the proportion of total treatments provided through iCCM to assess whether the program is expanding coverage as intended. Parallel data collection and reporting systems are commonplace and procedures to convert raw data into user-friendly information products and disseminate to decision-makers are generally absent.

## WHAT HAVE WE LEARNED ABOUT WHAT IT TAKES TO HAVE A FUNCTIONAL HEALTH INFORMATION SYSTEM FOR iCCM?

As noted, there is no single approach or strategy for how to strengthen routine monitoring for iCCM that will serve all contexts. However, our collective experience in 18 African countries (Cameroon, Cote d'Ivoire, Democratic Republic of Congo (DRC), Ethiopia, Ghana, Guinea, Kenya, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, South Sudan, Uganda, Zambia, Zimbabwe) involving more than 100 000 CHWs has generated some valuable lessons learned that we believe should inform the necessary efforts to help countries transition towards more functional routine monitoring systems. These lessons and recommendations build on those identified for broader HIS strengthening [4,5]:

- 1. Coordination and leadership by Ministry of Health** to develop an overarching framework and rational plans for monitoring and evaluation is necessary to prioritize and harmonize data needs across donors and implementing partners, limit development of parallel systems and promote pooling of resources to strengthen the national sys-

**Table 1.** Characterization of M&E for iCCM according to components of health information systems

HIS SYSTEM COMPONENTS	TYPICAL SITUATION FOR ICCM M&E	IDEAL SITUATION
Health information system resources	<ul style="list-style-type: none"> <li>Lack of M&amp;E and data management staff within MOH with clear roles, responsibilities and accountability for iCCM specified within job descriptions</li> <li>Inadequate human resource capacity to ensure timely and quality data collection, reporting, management, analysis and use</li> </ul>	<ul style="list-style-type: none"> <li>Trained staff within MOH with clear roles and responsibilities to manage iCCM monitoring data</li> <li>Support mechanisms in place to provide ongoing mentoring and refresher training</li> <li>Costed annual plan for health information systems including iCCM data needs</li> </ul>
Indicators	<ul style="list-style-type: none"> <li>Weak or non-existent national plan for monitoring and evaluating iCCM</li> <li>Use of non-standard indicators; proliferation of indicators that differ across donors and implementing partners</li> </ul>	<ul style="list-style-type: none"> <li>Clear national plan for M&amp;E of iCCM (as a part of a broader strategy and costed annual plan for health information systems)</li> <li>Prioritization of limited number of indicators that are harmonized across MOH, donors and implementing partners as part of a standardized minimum core set for the HIS</li> </ul>
Data sources	<ul style="list-style-type: none"> <li>Complicated registers and reporting tools that are burdensome for users and/or too costly for use at national scale (eg, color registers or too many registers)</li> <li>Lack of standardized tools across partners</li> <li>Limited integration and coordination with other programs/interventions implemented by CHWs</li> <li>Fragmented use of information communication technology (ICT) and mHealth solutions</li> </ul>	<ul style="list-style-type: none"> <li>User-centered, low cost, standardized tools that are appropriate for the literacy and numeracy level of the health workers, capture limited set of data elements linked to priority indicators, and can be produced at scale</li> <li>MOH-coordinated use of appropriate ICT and mHealth solutions that can be scaled up</li> </ul>
Data management	<ul style="list-style-type: none"> <li>Suboptimal capacity of information systems (HIS/LMIS) to meet needs for data management, analysis, visualization, sharing and learning</li> <li>Community treatment data not integrated into national HIS or not disaggregated by point of service</li> <li>Implementing partners maintaining parallel reporting systems</li> <li>Lack of mechanisms to periodically assess quality of ICCM data (through audits and triangulation with other sources)</li> </ul>	<ul style="list-style-type: none"> <li>Use of open-source platforms such as DHIS2 with built in data analysis and visualization aligned with prioritized indicators</li> <li>Community treatment data integrated into national HIS system to generate treatment ratios (treated over expected cases) by point of service (community/health facility)</li> <li>Implementing partners and donors support and strengthen the national reporting system</li> <li>Resources allocated for periodic assessment of ICCM data quality</li> </ul>
Information products	<ul style="list-style-type: none"> <li>Limited or no procedures in place to regularly transform data into useful information for timely response, priority setting, planning and resource allocation</li> <li>Limited capacity of staff, especially at district levels, to analyze data</li> </ul>	<ul style="list-style-type: none"> <li>User-friendly information products (dashboards, reports) analyzing monitoring data for priority indicators produced regularly (at least quarterly)</li> <li>District level staff with capacity to analyze data and produce information products</li> </ul>
Dissemination and use	<ul style="list-style-type: none"> <li>Weak linkages to processes for decision-making and corrective actions</li> <li>Limited tools and training on data use at all levels</li> </ul>	<ul style="list-style-type: none"> <li>iCCM data use integrated into existing data review and use mechanisms (eg, quarterly review meetings at district level)</li> <li>Simple tools and training to facilitate data use across levels</li> </ul>

M&E – monitoring and evaluation, iCCM – integrated community case management, MOH – Ministry of Health, HIS – health information systems, CHW – community health worker, ICT – information communication technology, DHIS – district health information systems

tem. Interagency technical working groups (TWG) led by the Ministry of Health have proven an effective mechanism in several countries (Malawi, Ethiopia, Sierra Leone, Uganda, Mali, Guinea and Rwanda). With expansion of iCCM, new donors and implementing partners enter the mix and these coordination mechanisms need to be sustained. The ability of TWGs to harmonize monitoring practices is sensitive to the extent to which the MOH exerts leadership and is able to bring partners in line.

**2. Prioritization of a limited number of indicators** that reflect the determinants for achieving high treatment coverage and are tied to specific actions is essential for a routine reporting system to continually generate quality data. The selection and definition of indicators should be informed by global recommendations and the underlying structure and capacity of the health information system [13,14]. **Table 2** outlines data elements that should be captured monthly at district level to generate a minimal set of

**Table 2.** Overview of priority data elements for monitoring program performance by frequency of collection

DATA ELEMENTS TO CAPTURE ROUTINELY (MONTHLY)	DATA ELEMENTS BEST CAPTURED PERIODICALLY (ANNUALLY OR LESS)
<p><b>Core elements required to generate numerators:</b></p> <ul style="list-style-type: none"> <li>• Number of CHWs reporting</li> <li>• Number of CHW treatments by condition</li> <li>• Number of health facility treatments by condition</li> <li>• Number of children referred by CHWs*</li> <li>• Number of CHWs reporting no stock-outs by commodity†</li> <li>• Number of CHW supervision visits conducted</li> </ul> <p><b>Programs using RDTs should include:</b></p> <ul style="list-style-type: none"> <li>• Number of RDT-tested fevers</li> <li>• Number of RDT+ fevers</li> <li>• Number of treatments for confirmed malaria</li> <li>• Number of treatments for presumptive malaria</li> </ul>	<p><b>Background data elements required to generate denominators</b> (update at least annually):</p> <ul style="list-style-type: none"> <li>• Number of children under-five (overall and in iCCM target areas)</li> <li>• Number of expected cases by iCCM condition (overall and in iCCM target areas)</li> <li>• Number of CHWs trained and deployed to provide iCCM</li> </ul> <p><b>Data best captured through household or CHW surveys and special studies:</b></p> <ul style="list-style-type: none"> <li>• Gender of cases treated</li> <li>• Follow-up visits for cases treated by CHWs</li> <li>• Referral completion and outcomes</li> <li>• Skills/knowledge of CHWs</li> <li>• Quality of care by provider type (first dose, counseling, use of RDT, use of timer,)</li> <li>• Care-seeking behavior</li> <li>• Timeliness of care-seeking/treatment and source of treatment</li> <li>• Child deaths (total or by cause)</li> </ul>

CHW – community health worker, RDT – rapid diagnostic test, iCCM – integrated community case management

\*Data on the number of children visiting a CHW during the reporting period must be collected to calculate the referral rate by CHWs

†The iCCM supply chain group recommends collecting three data elements for supply chain management through the Logistics Management Information System (LMIS) for resupply or quantification and monitoring a supply plan: CHW consumption by commodity; stock on hand by commodity; and number of days stocked out during reporting period by commodity.

indicators and identifies other data elements that are better captured periodically through household or CHW surveys. Capturing the number of treatments by CHWs and comparing against the expected number of episodes for each condition based on local epidemiology and care-seeking practices is especially important to understand program performance and identify issues that require further investigation into causes and formulation of appropriate responses [11]. While our experience shows that the data elements required for numerators can be generated even in extremely resource limited settings such as South Sudan, obtaining up to date and accurate information for the denominators (number of children under five in target areas; number of CHWs trained and deployed) remains difficult and requires strategic investments in health workforce tracking.

**3. Early involvement of a representative mix of end users in the development of monitoring tools and systems** contributes to better design and ultimately better quality data. The amount of time and resources required to develop simple, user-friendly tools is often underestimated, leading to sub-optimal or non-functional data collection systems. The CHWs, especially those with lower levels of education/literacy, should be at the center of the development and testing of registers and reporting tools and the same with district managers, facility staff and CHW supervisors for the design of paper-based reports and electronic tools. The design process should aim for **simplicity, efficiency** and **scalability** and be suitable for the lowest capacity levels. An example of an overly burdensome ap-

proach is the Democratic Republic of Congo, where volunteer, low-literacy CHWs must document details of each consultation using a complex individual sick child form and produce monthly reports containing 98 data elements for iCCM alone. While job aids to guide CHWs through case management protocols are critical, detailed documentation becomes unnecessary and counterproductive once CHWs are acquainted with the algorithm. Apart from setting a double standard by demanding more documentation than required from salaried facility staff, it dilutes data quality and is prohibitively expensive. Integrating use of the tools within initial and refresher trainings and supervision, with sufficient time dedicated for adequate skill-building, is also important.

**4. Integration of community treatment data into national HIS** is critical to allow program managers at various levels to look at treatment data disaggregated by point-of-service to better understand the contribution of iCCM and identify underserved or underperforming areas. The District Health Information Systems (DHIS 2; [www.dhis2.org](http://www.dhis2.org)), a free and open source software package, is a promising platform used by a growing number of countries to integrate community information into national HIS. Yet the process is rarely straightforward. The experience from Sierra Leone demonstrates that integration is often lengthy and requires coordination with many stakeholders from different departments and programs [15]. In some countries, such as Mali and Niger, community treatment data are aggregated with health facility treatments making it impossible to distinguish contribution of each point of ser-

vice. Other countries, such as Malawi, Uganda and Zambia, are unable to calculate treatment ratios because the community and facility sources use different classification systems for childhood illness. Further efforts and targeted investments will be needed to make the necessary progress to fully integrate iCCM data within national HIS.

**5. Strengthening mechanisms for data use and timely response** by program managers, health workers and CHWs requires concerted effort and culture change. Data use requirements are often highest at the district level, where management is in the position to take action. Providing simple tools for data visualization (such as dashboards) and training on data analysis and use promotes improved data quality, enhanced visibility of iCCM services and timely identification and implementation of solutions [16]. To be effective, approaches must focus on a small set of indicators with agreed targets and actionable responses, regularly engage program managers in critical thinking to identify bottlenecks and root causes and address the organization and behavioral determinants of data quality and use [4,5]. An example dashboard developed by PSI for the iCCM program in South Sudan is available on request from the authors and readers are encouraged to consult the paper from IRC on analysis of routine data from six countries for additional guidance [11]. Further work is needed to increase demand for data, integrate data use into existing review mechanisms, and increase accountability of program managers for timely response.

**6. Periodic triangulation of routine data with other data sources** and data quality audits (DQA) should be built into M&E plans to guide interpretation of routine data. Failure to assess quality of routine data early on can lead to false assurances of program performance. Experience shows this is particularly relevant for monitoring CHWs' skills, quality of care and medicine availability, as data captured through supervision checklists or CHW reports are particularly subject to bias and inter-rater reliability and tends to paint an overly positive picture compared with more structured assessments. For example, analysis of International Rescue Committee (IRC) supervision data from over 170 000 supervision visits in five sub-Saharan countries revealed a pattern of systematic overestimation of the ability of CHWs to correctly count breathing rates (96% of CHWs) when compared with structured assessments (57% of CHWs). These assessments need to be strategically targeted to avoid becoming another data collection burden on an already overstretched system. Participatory, rapid audits of data quality are an effective mechanism to help identify gaps and formulate strategies for improvement and can lead to increased confidence and use of routine data [16]. Reviews of data quality for a subset of the most important indicators can also be built into existing review meetings to institutionalize the process.

**7. Mobile technologies for CHW case management and reporting** can contribute to improved timeliness and availability of data, provided that the basic monitoring system has already been established. The most effective examples are those designed with Ministries of Health and end-users, focused on elements requiring immediate response and linked with platforms such as DHIS2 (for example the mTRAC system in Uganda). There are also good examples of how mobile phone applications have helped connect and motivate CHWs and supervisors by creating closed networks that allow them to communicate at no charge [17]. However, while mHealth solutions offer the potential to streamline reporting and data management procedures, in the short-term they often create an additional burden on CHWs and first level health workers, who are still required to maintain a paper record until mobile applications are widely implemented. Moreover, in many instances, mobile applications have been designed as small scale, resource-intensive projects that proved a distraction rather than a contribution [17,18].

## CONCLUSIONS AND WAY FORWARD

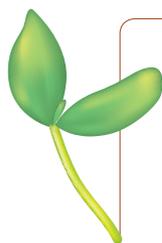
Strong monitoring systems, in which iCCM data are integrated within national health information systems and used to identify issues and take timely action, are essential to improve the ability of iCCM programs to achieve high levels of appropriate utilization and thereby impact child health. In this paper we have characterized the challenges countries face to establish functional monitoring systems for iCCM and outlined some lessons learned based on our experiences in 18 African countries and the literature on strengthening health information systems. As the number of donors funding iCCM and partners supporting implementation continues to grow, it is important to learn from these experiences to avoid repeating common mistakes and to help countries build and sustain functional monitoring systems.

An underlying theme in this paper is that far more attention needs to be paid to the operating environment of iCCM programs when designing monitoring systems. While systems for monitoring iCCM suffer from many of the same shortcomings present with broader health information systems, they do present unique challenges. Community health systems are over-stretched and additional tasks are being shifted from facilities to the lowest level health workers. Implementing iCCM at scale involves thousands of diverse CHWs providing services in the hardest to reach, most deprived communities where formal services have failed to adequately deliver the most basic preventive and curative care. Monitoring systems that expect the most peripheral parts of the health care system to meet rigid reporting timelines, bear the greatest data collection burden, and submit data without consistent,

timely and relevant feedback and response will not produce quality information; instead we need to develop systems in which the data collection and reporting requirements are simplified and aligned with the capacity for response, and invest in strengthening mechanisms and accountability for data use.

Going forward, all actors, including the MOH, must shift perspective and consider iCCM as an integral component of the overall health system, including when revising or strengthening monitoring systems and must adapt to the limitations and challenges of the community platform. Donors and implementing partners need to align with national strategic plans for health information systems, including

sub-systems such as for iCCM and community health interventions more broadly, harmonize funding toward annual, costed operational plans, streamline and limit routine reporting requirements to the core elements; avoid parallel systems and invest in strengthening routine systems; and provide increased support for institutionalizing capacity of national and district staff for data use and response. Ministries of Health must play a stronger role in coordinating across donors and implementing partners and asserting leadership to better integrate community treatment data into national HIS and to establish mechanisms to increase accountability for data use and response, especially at district and health facility levels.



**Acknowledgements:** The authors thank Anne Langston and Alison Wittcoff of IRC for their review and inputs to the paper.

**Funding:** This review was supported by UNICEF with funds provided by the Department of Foreign Affairs Trade and Development Canada.

**Disclaimer:** The opinions expressed are those of the authors and do not necessarily reflect the views of UNICEF or the Department of Foreign Affairs Trade and Development Canada.

**Authorship declaration:** All authors contributed to the development of the paper and approved the final version. TG and YB conceptualized the review and all co-authors provided country examples. TG wrote the manuscript and YB, NO, MD, SR, LM, GN, and TD reviewed and modified the manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). The authors declare that they have no competing interests.

## REFERENCES

- 1 UNICEF. Integrated community case management evidence review symposium: summary and conclusions. New York, NY: UNICEF, 2014. Available at: [http://iccmsymposium.org/wp-content/uploads/2013/08/iCCM-Symposium-summary-and-conclusions\\_EN.pdf](http://iccmsymposium.org/wp-content/uploads/2013/08/iCCM-Symposium-summary-and-conclusions_EN.pdf). Accessed: 4 April 2014.
- 2 Lippeveld T, Sauerborn R, Bodart C; World Health Organization. Design and implementation of health information systems. Geneva: World Health Organization. 2000.
- 3 AbouZahr C, Boerma T. Health information systems: the foundations of public health. *Bull World Health Organ*. 2005;83:578-83. [Medline:16184276](#)
- 4 Aqil A, Lippeveld T, Hozumi D. PRISM framework: a paradigm shift for designing, strengthening and evaluating routine health information systems. *Health Policy Plan*. 2009;24:217-28. [Medline:19304786](#) [doi:10.1093/heapol/czp010](#)
- 5 Nutley T, Reynolds HW. Improving the use of health data for health system strengthening. *Glob Health Action*. 2013;6:20001. [Medline:23406921](#)
- 6 Walker CL, Rudan I, Liu L, Nair H, Theodoratou E, Bhutta ZA, et al. Global burden of childhood pneumonia and diarrhoea. *Lancet*. 2013;381:1405-16. [Medline:23582727](#) [doi:10.1016/S0140-6736\(13\)60222-6](#)
- 7 Roca-Feltrer A, Carneiro I, Armstrong Schellenberg JR. Estimates of the burden of malaria morbidity in Africa in children under the age of 5 years. *Trop Med Int Health*. 2008;13:771-83. [Medline:18363586](#) [doi:10.1111/j.1365-3156.2008.02076.x](#)
- 8 Hancioglu A, Arnold F. Measuring coverage in MNCH: tracking progress in health for women and children using DHS and MICS household surveys. *PLoS Med*. 2013;10:e1001391. [Medline:23667333](#) [doi:10.1371/journal.pmed.1001391](#)
- 9 Bryce J, Arnold F, Blanc A, Hancioglu A, Newby H, Requejo J, et al. Measuring coverage in MNCH: new findings, new strategies, and recommendations for action. *PLoS Med*. 2013;10:e1001423. [Medline:23667340](#) [doi:10.1371/journal.pmed.1001423](#)
- 10 Guenther T, Sadruddin S, Chimuna T, Sichamba B, Yeboah-Antwi K, Diakite B, et al. Beyond distance: an approach to measure effective access to case management for sick children in Africa. *Am J Trop Med Hyg*. 2012;87:77-84. [Medline:23136281](#) [doi:10.4269/ajtmh.2012.11-0747](#)

- 11 Láinez YB, Wittcoff A, Mohamud AI, Amendola P, Perry HB, D'Harcourt D. Insights from community case management data in six sub-Saharan African countries. *Am J Trop Med Hyg.* 2012;87:144-50. *Medline:23136290 doi:10.4269/ajtmh.2012.12-0106*
- 12 Health Metrics Network. Framework and standards for country health information systems. 2nd ed. Geneva, Switzerland: WHO, June 2008. Available at: [http://www.who.int/healthmetrics/documents/hmn\\_framework200803.pdf?ua=1](http://www.who.int/healthmetrics/documents/hmn_framework200803.pdf?ua=1). Accessed: 19 May 2014.
- 13 McGorman L, Marsh DR, Guenther T, Gilroy K, Barat LM, Hammamy D, et al. A health systems approach to integrated community case management of childhood illness: methods and tools. *Am J Trop Med Hyg.* 2012;87:69-76. *Medline:23136280 doi:10.4269/ajtmh.2012.11-0758*
- 14 MCHIP. Indicator Guide: Monitoring and evaluating integrated community case management. 2013. Available at: [http://ccmcentral.com/wp-content/uploads/2013/12/iCCM-Indicators-Guide\\_MCHIP\\_2013.pdf](http://ccmcentral.com/wp-content/uploads/2013/12/iCCM-Indicators-Guide_MCHIP_2013.pdf). Accessed: 2 April 2014.
- 15 Braa J, Kanter AS, Lesh N, Crichton R, Jolliffe B, Sc̄bř J, et al. Comprehensive yet scalable health information systems for low resource settings: a collaborative effort in Sierra Leone. *AMIA Annu Symp Proc.* 2010;2010:372-6. *Medline:21347003*
- 16 Hazel E, Chimbanga E, Chimuna T, Guenther T, Nsona H, Bryce J. Improving data use of routine CCM M&E by health workers: Case study in Malawi. Baltimore, USA: JHU-IIP, 2014. Available at: <http://www.jhsph.edu/departments/international-health/centers-and-institutes/institute-for-international-programs/projects/traction/Data-use-package-report-2014.pdf>. Accessed: 10 March 2014.
- 17 Källander K, Tibenderana JK, Akpogheneta OJ, Strachan DL, Hill Z, et al. Mobile health (mHealth) approaches and lessons for increased performance and retention of community health workers in low- and middle-income countries: a review. *J Med Internet Res.* 2013;15:e17. *Medline:23353680 doi:10.2196/jmir.2130*
- 18 Braun R, Catalani C, Wimbush J, Israelski D. Community health workers and mobile technology: a systematic review of the literature. *PLoS ONE.* 2013;8:e65772. *Medline:23776544 doi:10.1371/journal.pone.0065772*

**Correspondence to:**

Tanya Guenther, MSc  
Advisor, Monitoring & Evaluation and HMIS  
Save the Children  
2000 L. St. NW  
Washington, DC, 20036  
[tguenther@savechildren.org](mailto:tguenther@savechildren.org)

# Community health workers: A crucial role in newborn health care and survival

Samira Aboubaker<sup>1</sup>, Shamim Qazi<sup>1</sup>, Cathy Wolfheim<sup>1</sup>, Adebowale Oyegoke<sup>2</sup>,  
Rajiv Bahl<sup>1</sup>

<sup>1</sup> World Health Organization, Geneva, Switzerland

<sup>2</sup> King's College London School of Medicine, London, UK

There is ample evidence from research and implementation to show that community health workers (CHWs), when appropriately trained, supplied, supported and supervised, can identify and correctly treat most children for pneumonia, diarrhoea and malaria [1,2]. Community management of childhood illness is an important contribution to the remarkable progress in reducing child mortality. Globally, the rate of under-five mortality has decreased by nearly half, from 90 deaths per 1000 live births in 1990 to 46 in 2013 [3].

However, in the same time period the decrease in newborn deaths has been significantly lower. The neonatal mortality rate has seen an annual decrease of only 2%, falling from 33 deaths per 1000 live births in 1990 to 20 in 2013. In consequence, the proportion of under-five mortality taking place in the first month of life has increased.

The 2.8 million newborns who died in 2013 represent 44% of all under-five mortality. In addition, most of these deaths took place during the first 24 hours after birth, and were due to conditions that can be prevented or treated with effective, existing interventions: prematurity, birth asphyxia and neonatal infections. The first 24 hours are also considered the most dangerous time period for a new mother [4].

This paper shows how a programme to reduce newborn mortality through the training and deployment of CHWs can lead to significant improvements in survival rates of newborns and mothers.

A fundamental principle underpinning the delivery of effective maternal, newborn and child health interventions

is the continuum of care. This continuum involves the seamless provision of care during pregnancy, delivery, as well as the newborn and infant periods. It encompasses home care, visits to the health facility/hospital, and follow-up in the community. The continuum of care is a cornerstone of the UN Secretary-General's Global Strategy for Women's and Children's Health [5], and is reflected in the Every Newborn Action Plan launched in June 2014 [6].

Community health workers play a vital role in facilitating that continuum of care, acting as the bridge between the community and the health facility. WHO and UNICEF have produced a set of materials titled *Caring for Newborns and Children in the Community*. This set comprises three packages for training and supporting CHWs. These are, in brief:

*Caring for the Newborn at Home*: The CHW counsels women during five home visits: two during pregnancy; one on the day of birth if the mother gave birth at home, or soon after she has returned home from the health facility; and on days 3 and 7 after birth. Additional visits are proposed for low birth weight babies.

During two visits to each pregnant woman, the CHW promotes antenatal care, helps prepare for birth, teaches home care during pregnancy, and encourages optimal newborn care practices.

In the first week after birth the CHW makes three home visits to assess the newborn for signs of illness, help with breastfeeding and thermal care, weigh the baby, and advise on care for mother and child. In case of small babies (under 2 500 gm), the CHW makes two additional visits to provide extra care.

*Caring for the Child's Healthy Growth and Development:* The CHW counsels families on practices that they can carry out at home, concerning infant feeding; communication and play for child development; recognition of and response to childhood illness; and illness prevention (handwashing, vaccination, use of bednets).

*Caring for the Sick Child in the Community:* The CHW assesses, classifies and treats children aged 2 months to 5 years with pneumonia, diarrhoea and/or malaria, and assesses for malnutrition. The treatment interventions include the use of four simple medicines: an antibiotic, an antimalarial, oral rehydration salts (ORS) and zinc tablets.

Most programmatic experience to date has been with caring for the sick child in the community, also known as integrated community case management, or iCCM. This curative care is indisputably important, and implementation is expanding in many countries. At the same time, there are many other tasks that CHWs can effectively carry out. The experience in iCCM can inform decision-makers to review the best means of using CHWs in strategies for improving newborn survival.

## HOME VISITS FOR THE CONTINUUM OF CARE

Strategies to train and deploy community health workers show great promise in increasing access to treatment and care of pregnant women and their newborns. While the jury is still out on the programmatic feasibility of CHW treatment of sick newborns, there is ample evidence on the value of home visits during pregnancy and after birth to promote maternal and newborn survival. Home visitation is an effective strategy to deliver care, improve key newborn care practices, and identify signs of maternal and newborn illness, especially in settings of high neonatal mortality. The UNICEF/WHO Joint Statement Home Visits for Newborn Care [7] puts forward a series of recommendations and describes the evidence behind each of them, while taking into account programmatic considerations.

**During pregnancy:** According to the 2014 report Fulfilling the Health Agenda for Women and Children [8], nearly half

of pregnant women in developing countries still do not attend antenatal care visits, and 37% receive no skilled care during delivery. CHWs can play a fundamental role in advising, encouraging and empowering families to seek antenatal care from a qualified health worker. They also help the family to prepare for delivery by ensuring they know where to go and helping them overcome barriers concerning money, transportation, and other necessary family logistics.

A CHW trained in the appropriate WHO/UNICEF package identifies pregnant women in the community, and makes two home visits to each one [9].

**Postnatal care:** The days and weeks following childbirth – the postnatal period – is a critical phase in the lives of mothers and newborn babies. Events occurring during this period can have a major effect on the well-being of a mother and her newborn.

It is also the most vulnerable time, when most maternal and infant deaths occur. It is nonetheless the most neglected period for the provision of quality services. The recently-published document “WHO Recommendations on Postnatal care of the Mother and Newborn” [10] summarizes the evidence for a series of recommendations that address the timing, number and place of postnatal contacts, as well as the content of postnatal care for all mothers and babies during the six weeks after birth. The recommendations also include assessment of mothers and newborns to detect problems or complications. CHWs can provide a number of these postnatal care services and interventions for lactating women and their newborns.

**Pre- and post-natal visits:** Studies conducted in Bangladesh, India and Pakistan [11–15] have shown that home visits can reduce newborn deaths in high-mortality, developing country settings by 30% to 61%. The visits also improved coverage of key newborn care practices in the home. This evidence complements the experience from developed country settings showing that postnatal home visits are effective in improving breastfeeding rates and parenting skills [16].

An additional observational cohort study in Bangladesh showed the effect of postnatal care home visits by trained CHWs on neonatal mortality rates [17]. The study showed that among infants who survived the first day of life, neonatal mortality was 67% lower in those who received a visit on day one than in those who received no visit. For those who survived the first two days of life, receiving the first visit day two was associated with 64% lower neonatal mortality than those who did not receive a visit.

A cluster-randomized controlled trial in the United Republic of Tanzania investigated the effect of home-based counselling on newborn care practices [18]. In this study, trained volunteers made home visits during pregnancy and after

childbirth to promote recommended newborn care practices including hygiene and breastfeeding. They also identified and provided extra care for low birth weight babies. Improvements in home care practices included delaying the baby's first bath by at least six hours (81% in intervention areas vs 68% in control areas), exclusive breastfeeding in the three days after birth (83% vs 71%), putting nothing on the cord (87% vs 70%), and, for home births, tying the cord with a clean thread (69% vs 39%).

A systematic review of randomized controlled trials [19] looked at the effect of home-based newborn care provided by community health workers on preventing neonatal, infant and perinatal mortality. The trials, all from South Asian countries, included home visits during pregnancy (4 trials), home-based preventive and/or curative neonatal care (all trials), and community mobilization efforts (4 trials). The intervention was associated with a reduced risk of mortality during the neonatal and perinatal periods. In one trial, a significant decline in infant mortality was documented. Subgroup and meta-regression analyses suggested a greater effect with a higher baseline neonatal mortality rate. This review further strengthened the argument for home-based neonatal care strategies in South Asian settings with high neonatal mortality rates and poor access to health facility-based care.

The Newhints cluster-randomized trial in Ghana showed the effects of home visits by trained community-based surveillance volunteers (CBSVs) on neonatal mortality and home care practices [20]. The CBSVs in the study zones were trained to identify pregnant women in their community and to make two home visits during pregnancy and three in the first week of life. During these visits they promoted essential newborn care practices, weighed and assessed babies for danger signs, and referred as necessary. The intervention achieved a reduction of 8% in the overall neonatal mortality rate (NMR), which are less than the results observed in South Asia. The meta-analysis summary estimate is a 12% reduction in NMR.

In an evaluation of a cluster-randomized controlled trial of a package of community-based maternal and newborn interventions in Bangladesh [13], CHWs identified pregnant women; made two antenatal home visits to promote birth and newborn care preparedness; made four postnatal home visits to negotiate preventive care practices and to assess



Photo: Courtesy of Christine Nesbitt, UNICEF (©UNICEF/CHRISTINE NESBITT)

newborns for illness; referred sick neonates to a hospital and facilitated compliance in the intervention sites. The study led to high coverage of antenatal home visits (91% visited twice) and postnatal home visits (69% visited on days 0 or 1). Although there was no impact on neonatal mortality, there were clear improvements in newborn care practices and care seeking.

A 2008 pilot study by Bhutta et al [21] investigated the feasibility of delivering a package of community-based interventions for improving perinatal care using lady health workers (LHWs) and traditional birth attendants (Dais) in rural Pakistan. The LHWs were trained on essential maternal and newborn care. They conducted community education group sessions, were encouraged to link up with local Dais and were supported by voluntary health committees. The interventions led to a reduction in neonatal mortality (from 57.3 to 41.3 per 1000 live births), and an increase from 18% to 30% in the proportion of facility deliveries. There was also an increase in key newborn care practices such as early and exclusive breastfeeding, delayed bathing and cord care.

Recent data available from the AFRican Neonatal Sepsis Trial (AFRINEST) studies in the Democratic Republic of the Congo, Kenya and Nigeria [22,23], show that CHWs can adequately assess a newborn for signs of illness, weigh the infant, and refer for medical care if needed.

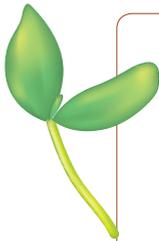
In Ethiopia, Health Extension Workers make home visits and also manage sick newborns in the community. It should be noted that these are not typical CHWs, as they benefit from almost a full year of pre-service training as well as a national policy that allows them to treat newborns with infection.

## CONCLUSION

Accelerated action against the main child killers is imperative as countries work to reduce the under-five mortality rate and achieve the fourth Millennium Development Goal by 2015. The adequate reduction of under-five mortality requires increased attention to newborns, and in the landscape of the continuum of care, to women before and after giving birth. This must be done by reaching out to underserved populations to provide them with the essential health services they need.

There is widespread consensus on the central role that community health workers can play in ending preventable maternal, newborn and child deaths. The Every Newborn Action Plan sets out a clear vision. Policy and recommendation documents provide the most up-to-date information, and training materials are available to support the implementation of a community-based strategy.

CHWs can identify pregnant women and newborns in need of medical attention and care, promote and encourage appropriate careseeking, and provide counselling and support for home care practices across the periods of pregnancy, newborn and childhood. As the fundamental link between a community and its health facility, and between the population and the health workers, CHWs can also promote adherence to treatment and follow-up. Community health workers are an important option for investment as part of a comprehensive primary health care system. Effective implementation of CHW strategies requires policy support, training, supervision, performance maintenance and regular supplies. In addition, community health workers are increasingly responsible for many health and development tasks, and expansion of their duties needs to be carefully considered in this light.



**Acknowledgements:** The authors greatly appreciate the input from experts involved in the promotion of community-based newborn care.

**Funding:** Not applicable.

**Disclaimer:** Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the World Health Organization.

**Authorship declaration:** SA drafted the main messages for this viewpoint article. SA, SQ and CW wrote the paper. SQ, CW, AO and RB provided critical input for structuring and finalizing the manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). The authors declare no financial relationships with any organizations that might have an interest in the submitted work in the previous 36 months; and no other relationships or activities that could appear to have influenced the submitted work.

## REFERENCES

- 1 George A, Menotti EP, Rivera D, Montes I, Reyes CM, Marsh DR. Community case management of childhood illness in Nicaragua: Transforming health systems in underserved rural areas. *J Health Care Poor Underserved*. 2009;20(4 Suppl):99-115. [Medline:20168036](#) [doi:10.1353/hpu.0.0205](#)
- 2 Yeboah-Antwi K, Pilingana P, Macleod WB, Semrau K, Siazeele K, Kalesha P, et al. Community case management of fever due to malaria and pneumonia in children under five in Zambia: A cluster randomized controlled trial. *PLoS Med*. 2010;7:e1000340. [doi:10.1371/journal.pmed.1000340](#). [Medline:20877714](#)
- 3 UN Interagency group for child mortality estimation. Report 2014. Levels and trends in child mortality. New York: UNICEF, 2014. Available at: [http://www.childmortality.org/files\\_v17/download/UNICEF%202014%20IGME%20child%20mortality%20Report\\_Final.pdf](http://www.childmortality.org/files_v17/download/UNICEF%202014%20IGME%20child%20mortality%20Report_Final.pdf). Accessed: 1 October 2014.
- 4 Save the Children International. State of the world's mothers: surviving the first day. London, UK: Save the Children International, 2013.
- 5 The Partnership for Maternal, Newborn and Child Health. Global strategy for women's and children's health, United Nations Secretary-General, 2010. Available at: [http://www.who.int/pmnch/activities/advocacy/fulldocument\\_globalstrategy/en/](http://www.who.int/pmnch/activities/advocacy/fulldocument_globalstrategy/en/). Accessed: 1 October 2014.
- 6 The Every Newborn. The Every Newborn Action Plan 2014. Available at: <http://www.everynewborn.org/every-newborn-action-plan>. Accessed: 1 October 2014.
- 7 World Health Organization, United Nations Children's Fund. WHO and UNICEF Joint Statement. Home visits for the newborn child, a strategy to improve survival. New York, USA: WHO and UNICEF, 2009.

- 8 Countdown to 2015. Fulfilling the health agenda for women and children. 2014 report. Geneva: WHO and UNICEF; 2014. Available at: [http://www.countdown2015mnch.org/documents/2014Report/Countdown\\_to\\_2015-Fulfilling%20the%20Health\\_Agenda\\_for\\_Women\\_and\\_Children-The\\_2014\\_Report-Conference\\_Draft.pdf](http://www.countdown2015mnch.org/documents/2014Report/Countdown_to_2015-Fulfilling%20the%20Health_Agenda_for_Women_and_Children-The_2014_Report-Conference_Draft.pdf). Accessed: 1 October 2014.
- 9 World Health Organization and the Global Health Workforce Alliance. Global experience of community health workers for delivery of health related Millennium Development Goals, 2010. Available at: <http://www.who.int/workforcealliance/knowledge/publications/alliance/CHWreport.pdf>. Accessed: 1 October 2014.
- 10 World Health Organization. Recommendations on postnatal care of the mother and newborn. Geneva: WHO, 2013. Available at: [http://apps.who.int/iris/bitstream/10665/97603/1/9789241506649\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/97603/1/9789241506649_eng.pdf). Accessed: 1 October 2014.
- 11 Baqui AH, El-Arifeen S, Darmstadt G, Saifuddin A, Williams EK, Seraji HR, et al; Projahnmo Study Group. Effect of community-based newborn-care intervention package implemented through two service-delivery strategies in Sylhet district, Bangladesh: a cluster-randomised controlled trial. *Lancet*. 2008;371:1936-44. [Medline:18539225](#) [doi:10.1016/S0140-6736\(08\)60835-1](#)
- 12 Kumar V, Mohanty S, Kumar A, Misra RP, Santosham M, Awasthi S, et al. Effect of community-based behaviour change management on neonatal mortality in Shivgarh, Uttar Pradesh, India: a cluster-randomised controlled trial. *Lancet*. 2008;372:1151-62. [Medline:18926277](#) [doi:10.1016/S0140-6736\(08\)61483-X](#)
- 13 Darmstadt GL, Choi Y, Arifeen SE, Bari S, Rahman SM, Mannan I, et al. Evaluation of a cluster-randomized controlled trial of a package of community-based maternal and newborn interventions in Mirzapur, Bangladesh. *PLoS ONE*. 2010;5:e9696. [Medline:20352087](#) [doi:10.1371/journal.pone.0009696](#)
- 14 Bhutta ZA, Soofi S, Cousens S, Mohammad S, Memon ZA, Ali I, et al. Improvement of perinatal and newborn care in rural Pakistan through community-based strategies: a cluster-randomised effectiveness trial. *Lancet*. 2011;377:403-12. [Medline:21239052](#) [doi:10.1016/S0140-6736\(10\)62274-X](#)
- 15 Bhandari N, Mazumder S, Taneja S, Sommerfelt H, Strand TA. Effect of implementation of Integrated Management of Neonatal and Childhood Illness (IMNCI) programme on neonatal and infant mortality: cluster randomised controlled trial. *BMJ*. 2012;344:e1634. [Medline:22438367](#) [doi:10.1136/bmj.e1634](#)
- 16 Hannula L, Kaunonen M, Tarkka MT. A systematic review of professional support interventions for breastfeeding. *J Clin Nurs*. 2008;17:1132-43. [Medline:18416790](#) [doi:10.1111/j.1365-2702.2007.02239.x](#)
- 17 Baqui AH, Ahmed S, El Arifeen S, Darmstadt G, Rosencrans AM, Mannan I, et al. Effect of timing of first postnatal care home visit on neonatal mortality in Bangladesh: a observational cohort study. *BMJ*. 2009;339:b2826. [Medline:19684100](#) [doi:10.1136/bmj.b2826](#)
- 18 Penfold S, Manzi F, Mkumbo E, Temu S, Jaribu J, Shamba D, et al. Effect of home-based counselling on newborn care practices in southern Tanzania one year after implementation: a cluster-randomised controlled trial. *BMC Pediatr*. 2014;14:187. [Medline:25052850](#) [doi:10.1186/1471-2431-14-187](#)
- 19 Gogia S, Sachdev HS. Home visits by community health workers to prevent neonatal deaths in developing countries: a systematic review. *Bull World Health Organ*. 2010;88:658-666B. [Medline:20865070](#) [doi:10.2471/BLT.09.069369](#)
- 20 Kirkwood BR, Manu A, ten Asbroek AH, Soremekun S, Weobong B, Gyan T, et al. Effect of the Newhints home-visits intervention on neonatal mortality rate and care practices in Ghana: a cluster randomised controlled trial. *Lancet*. 2013;381:2184-92. [Medline:23578528](#) [doi:10.1016/S0140-6736\(13\)60095-1](#)
- 21 Bhutta ZA, Memon ZA, Soofi S, Salat MS, Cousens S, Martinez J. Implementing community-based perinatal care: results from a pilot study in rural Pakistan. *Bull World Health Organ*. 2008;86:452-9. [Medline:18568274](#) [doi:10.2471/BLT.07.045849](#)
- 22 AFRINEST Group. Simplified regimens for management of neonates and young infants with severe infection when hospital admission is not possible. *Pediatr Infect Dis J*. 2013;32:S26-32. [Medline:23945572](#)
- 23 AFRINEST Group. Treatment of fast breathing in neonates and young infants with oral amoxicillin compared with penicillin-gentamicin combination. *Pediatr Infect Dis J*. 2013;32:S33-8. [Medline:23945574](#)

**Correspondence to:**

Samira Aboubaker  
 Medical Officer  
 Maternal, Newborn, Child and Adolescent Health  
 World Health Organization  
 Avenue Appia 20  
 1211 Geneva 27, Switzerland  
[aboubakers@who.int](mailto:aboubakers@who.int)



# The way forward for integrated community case management programmes: A summary of lessons learned to date and future priorities

Mark Young<sup>1</sup>, Alyssa Sharkey<sup>1</sup>, Samira Aboubaker<sup>2</sup>, Dyness Kasungami<sup>3</sup>, Eric Swedberg<sup>4</sup>, Kerry Ross<sup>5</sup>

<sup>1</sup> UNICEF, New York, NY, USA

<sup>2</sup> World Health Organisation, Geneva, Switzerland

<sup>3</sup> Maternal and Child Survival Program (MCSP)/John Snow International, Washington, DC, USA

<sup>4</sup> Save the Children, Fairfield, CT, USA

<sup>5</sup> USAID, Washington, DC, USA

## SUMMARY OF “LESSONS LEARNED” FOR ICCM PROGRAMMING

Integrated community case management (iCCM) programming is an important and increasingly common strategy used to deliver essential health and nutrition interventions to families in sub-Saharan Africa [1–3]. Between 3 and 5 March 2014, over 400 individuals from 35 countries in sub-Saharan Africa and 59 international partner organisations gathered in Accra, Ghana for an iCCM Evidence Review Symposium. The objective of the Symposium was twofold: first, to review the current state of the art of iCCM implementation by bringing together researchers, donors, government, implementers and partners to review the map of the current landscape and status of evidence in key iCCM programme areas, in order to draw out priorities, lessons and gaps for improving child and maternal–newborn health and nutrition. Second, to assist African countries to integrate and take action on key frontline iCCM findings presented during the evidence Symposium around eight thematic areas: 1) Coordination, Policy Setting and Scale up; 2) Human Resources and Deployment; 3) Supervision & Performance Quality Assurance; 4) Supply Chain Management; 5) Costs, and cost-effectiveness and financing; 6) Monitoring, Evaluation and Health Information Systems; 7) Demand generation and social mobilisation; and

8) Impact and outcome evaluations. The eight thematic areas were based on the CCM benchmark framework, a tool for iCCM program planners and managers to systematically design and implement iCCM programs from the early phases through expansion and scale up. The framework specifies key steps that should be completed for each component and phase of implementation [4].

The evidence presented at the 2014 iCCM Symposium and included in this journal theme issue illustrates the tremendous progress made in iCCM programming in recent years and the range of innovations that have facilitated this progress across the thematic areas. Some examples of practices that have been effective and should now be scaled up include improvements in data availability and quality (as well as new tools to collect and disseminate data) [5–7] which have helped in critical areas such as costing and monitoring [8], investments in demand generation activities which have improved utilisation of services [9] and participatory, targeted, and adult-focused training methodologies which have been used successfully in some settings to improve the quality of care provided [10,11].

This collection of papers also sheds light on the numerous challenges that remain. For example, engaging “champions” of iCCM (at policy and technical levels) has been dif-

difficult in many countries in sub-Saharan Africa [12]. Similarly, the collection and use of routine data for programming as well as collection of financing data on iCCM programmes [5,7,8], ensuring continuous medicine and supplies [6,13], and retention and motivation of trained and remunerated community-based health workers have been challenging [10,11,14].

## KEY MESSAGES OF THE SYMPOSIUM

Two overall messages emerged from the Symposium evidence review and discussions with country implementers.

### 1. Increase utilisation of iCCM

First, in order to be cost-efficient and to ensure maximum impact of efforts it is critical to increase utilisation of iCCM. This can be supported by:

- deploying community health workers (CHWs) to areas of greatest need,
- assessing demand barriers and addressing them through behaviour change, community engagement and social mobilisation activities,
- ensuring continuous supplies, while at the same time maintaining quality of services and
- structuring supervision and management to be affordable and effective.

### 2. Monitoring and evaluation must be appropriate

Second, routine reporting data should be used to assess and monitor programme progress and endline impact evaluations should only be conducted after an iCCM programme has been operating at scale (that is, when 80 percent of providers have been trained and equipped) with high utilisation for at least one year. Specific steps recommended to ensure appropriate monitoring and evaluation include: 1) examine routine data to determine if high rates of appropriate treatments are being provided, 2) once routine data show high rates of treatment are being provided, collect data on coverage and quality, and model mortality based on the Lives Saved Tool (LiST), and 3) use data from routine sources, as well as contextual, qualitative, coverage, quality of care and costing data to conduct final evaluations.

In addition, operational research should be conducted as a priority over impact evaluations in order to determine how programmes can increase their coverage rates, effectiveness and cost-effectiveness. Utilising household surveys (baseline and follow up) to measure care seeking behaviour, source of treatment and timeliness of treatment to assess if these outcomes are moving in the right direction is also critical.

**Box 1** Recommendations to improve iCCM programme implementation, as presented at the closing of the Evidence Review Symposium

- National government leadership is essential.
- iCCM must be integrated in national health systems and seen as a priority means of delivering care, and embedded as a costed element of national health sector plans, with a clear budget line.
- Integration and collaboration is key among all health-related programmes at community level (water and sanitation, nutrition, etc.).
- Coordination mechanisms should extend beyond health to include other sectors (eg, finance).
- High levels of utilisation are necessary for iCCM programs to be cost-efficient and have maximum impact. Utilisation is supported by deploying staff to areas of greatest need, assessing and addressing demand barriers, ensuring continuous supplies, maintaining quality of services and structuring supervision and management to be affordable and effective.
- Providing integrated treatment for malaria, pneumonia and diarrhoea increases utilisation of services for each illness.
- Using rapid diagnostic tests (RDTs) promotes appropriate treatment of malaria and pneumonia suggesting more appropriate antibiotic/antimalarial usage and improved quality of treatment.
- Private public partnerships should be explored as vehicles for iCCM implementation. In addition, iCCM can be used as vehicle for private sector quality improvement in settings where the private sector is an important source of care for children.
- New mHealth technologies such as *Rapid SMS*, *cStock*, and *mTRAC* can facilitate monitoring and management.
- iCCM programmes must be well documented, periodically reviewed and evaluated in order to guide implementation at scale.

There were several clear “lessons learned” shared at the Symposium based on experiences to date. At the closing of the Symposium, these were presented as recommendations to improve the success of future iCCM implementation (**Box 1**).

## KEY PRIORITIES IDENTIFIED IN COUNTRY ACTION PLANS

In order to support ministries of health to address relevant challenges in their local contexts, a major objective of the March 2014 iCCM Evidence Review Symposium was to assist African countries to integrate and take action on key iCCM findings relating to the eight thematic areas of the Symposium.

We present recommendations to improve the success of future iCCM implementation, key priorities identified in country action plans discussed during the Symposium, and agreed research priorities for iCCM over the next five to ten years.

Country work had three phases: 1) pre-Symposium, to analyse and summarize the status of iCCM programs, including major achievements and challenges. 2) At the symposium, based on the evidence presented, country teams (which were comprised of government, UNICEF, WHO and other partner staff) identified priority actions to be addressed in 6 and 12 months respectively. To help countries during the Symposium, templates addressing each thematic area, were developed and used to record key messages coming out of each presentation or discussion. 3) Finally, country teams reviewed the key messages and identified those that they felt were relevant to their contexts. These were translated into final country specific action plans. Out of 35 countries from Sub-Saharan Africa, 26 submitted action actions. Post-Symposium, the teams were expected to share the action plans with a wider group of in country stakeholders, adjust as necessary and incorporate a final list of actions in existing iCCM workplans. After the Symposium, country priorities were summarised in a spreadsheet (2×2 table of thematic area and country) by all eight thematic areas against 26 countries. This formed the basis for the actions under each thematic area described in **Boxes 2 and 3**.

While there were important differences across the stated priorities and action plans of the diverse countries in attendance at the Symposium, in part influenced by the current stage of iCCM programming, some summary points can be informative. Themes that resonated across country teams included coordination and policy setting, supply chain management, and human resources and deployment. Specific actions relating to country themes that were identified are listed in **Box 2**.

Priority actions were identified by some country teams for the other thematic areas as well (**Box 3**).

Once each country identified their priority activities, country teams worked together to discuss the key financial and human resources, and technical support needed to support their identified priority areas of work.

Although countries identified many problems related to iCCM programming that are well known, the Symposium provided them with opportunities for sharing best practices and lessons learned as well opportunities for learning

**Box 2** Common key activities from country action plans relating to coordination and policy setting, supply chain management, and human resources and deployment

### Coordination and policy setting

1. Adoption/expansion of policies that would support integration of iCCM into national policies (eg, community health policy, child survival policy, community health worker policy, integration of iCCM in national strategic plans, improving tools for iCCM, ensuring that iCCM policies and implementation are reflective of one another).
2. Adoption/expansion of policies to include improved access of CHWs to essential commodities (eg, amoxicillin, zinc, oral rehydration salts, and RDTs).
3. Inclusion of newborn care into existing community health/child health/iCCM policy.
4. Improved inter- and intra-sectoral coordination and collaboration between iCCM programmes and other child health related programmes (eg, between iCCM implementers and national government ministries including health and finance vis-à-vis sensitisation, between district councils, among NGOs, formation of task forces, formation of working groups, establishment of knowledge-sharing mechanisms).

### Supply chain management

1. Decrease of drug stockouts (by ensuring that stocking of drugs is based on *real*, rather than *perceived* needs and collecting data to determine drug needs and commodity gaps).
2. Exploration of innovations to improve supply chain efficiency (eg, mHealth for more accurate data collection; performance-based supply chains).

### Human resources and deployment

1. More strategic methods for recruitment (through mapping of CHWs to determine geographic areas for increased coverage, selection of the most appropriate people to fill iCCM CHW role)
2. Improved quality and frequency of CHW trainings (before and during deployment, revision of tools to be the most appropriate for the specific cadre's needs (eg, job aids, mentoring)
3. Exploration of incentivizing/motivating CHWs (eg, performance-based incentives, value in moving from volunteer to paid cadre, Living Goods' micro-franchise model).

There are tremendous opportunities for iCCM implementation in the current context which includes effective interventions and innovations that facilitate community-based programming, as well as new funding opportunities and partnerships.

**Box 3** Priority actions identified by country teams participating in the iCCM Symposium

#### Monitoring and evaluation

- introducing/strengthening HMIS at community level
- improving/standardizing monitoring
- improving the use of indicators and data collection methods

#### Supervision and performance quality assurance

- standardizing/strengthening supervision of CHWs
- starting to collect (or improving collection of) data on treatment, referral, and supplies, etc.
- developing better tools to support CHW supervisors
- exploring reporting incentives and the peer supervision model

#### Costing, cost–effectiveness, and financing

- increasing government funding for an integrated package of services
- using gap analyses and studies to identify iCCM programme costs

#### Demand generation and social mobilisation

- building the capacity of CHWs to utilize behaviour change communication strategies
- increasing demand for iCCM services by ensuring consistent access to commodities

#### Other priority actions

- identifying potential private sector partnerships (through strengthened coordination with those that already exist)
- building private sector capacity through IMCI training and local commodities production
- integrating/scaling–up newborn care in iCCM services provided by CHWs
- integrating mHealth into iCCM programmes for a range of functions such as planning, logistics, monitoring and supervision, improved data management and reporting, and well as a method for paying CHWs.

about innovative solutions that countries are using to solve traditional problems. The messages shared by some of the country level senior decision makers in attendance (Niger, Ethiopia) also provided extra motivation for countries as they were able to see that with limited resources but with the right leadership and commitment, it is possible to make significant progress in reducing under five mortality.

## REMAINING RESEARCH QUESTIONS

While much information was shared regarding lessons learned about successful policy development, programme implementation and monitoring and evaluation of iCCM

Many problems experienced in implementing iCCM are not new but there are recent advances and opportunities that can support countries as they work to address these problems.

programmes, several critical questions remain. In 2013, the CCM Operational Research Group (CCM.ORG) led a process to identify research priorities for iCCM over the next five to ten years. These were presented at the Symposium. With the support of the Centre for Global Child Health at the University of Toronto, the process was guided by the Child Health and Nutrition Research Initiative (CHNRI) method [15]. The conclusions and recommendations from the evidence review re–enforce the priority research questions identified by the CHNRI process [16], with the former identifying the gap or needed action (for example, the need to increase utilization of services) and the later addressing the priority research questions that could facilitate increased utilization of services (for example, which strategies best ensure continuous availability of drugs, what are the best ways to generate demand?). The conclusions from the evidence review also provided additional topics for research that may have not been identified or didn't rank highly in the CHNRI scoring. For example: What are successful models of integrating iCCM and financing in health sector plans and national budgets? The paper focusing on the CHNRI approach used to identify priority research questions for iCCM includes more information about the methods and process used [16]. As indicated in **Box 4**, strategies to improve motivation, retention, training and supervision of CHWs ranked highly among global and country experts, as did strategies to increase uptake of iCCM through demand generation, identification of determinants of non–use, motivating factors for care–seeking behaviour and improving compliance.

## CONCLUSION

The time for improving iCCM implementation is now. As illustrated by the papers included in this theme issue, we have effective interventions that address the major causes of child mortality and are well packaged for delivery. We have evidence showing that many treatments can be delivered successfully in the community, and although many problems implementing these interventions are not new, we now have innovations that facilitate community–based programming, including rapid diagnostic tests (RDTs) and mobile technologies, as well as improved and user–friend-

1. Assess perceptions of beneficiaries and levels of community satisfaction in CHWs' capacity to diagnose and treat sick children (with malaria, pneumonia, diarrhoea and severe malnutrition) at the community level.
2. Identify and evaluate strategies for retention and motivation of CHWs.
3. Identify and evaluate strategies for improving referral between communities and health facilities, including referral compliance.
4. Identify determinants of non-use of iCCM services by caretakers and develop strategies to increase the uptake of iCCM.
5. Identify and evaluate new diagnostic tools for improved classification of pneumonia (ie, different ARI timers, respiratory counting beads, etc.) at the community level that are most appropriate for various cadres.
6. Evaluate the effectiveness of 3-day vs 5-day oral amoxicillin treatment in Africa.
7. Identify and evaluate innovative strategies to improve community engagement and mobilisation for CCM.
8. Evaluate the feasibility, effectiveness and impact of adding community-based infant and young child feeding (ciYCF) counselling skills to the CHW workload.
9. Identify the primary barriers to CHW supervision and develop and evaluate strategies to motivate CHW supervisors to provide continuous support to CHWs.
10. What is the impact of pre-referral antibiotics on treatment outcomes of possible serious bacterial infections?



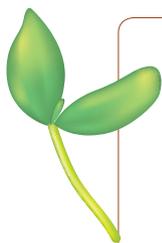
Photo: Courtesy of Indrias Getachew, UNICEF (© UNICEF/INDRIAS GETACHEW)

ly medicines. In addition, there are important new opportunities to mobilise resources from domestic as well as external funds (eg, the Global Fund to Fight AIDS, Tuberculosis and Malaria, the World Bank's Health Results Innovation Trust Fund/Results Based Financing initiative) and, in many countries, to integrate public private partnerships with government systems. In particular, by the end of 2014, it is expected that more than a dozen countries

will submit concept notes with iCCM components to the Global Fund. A key challenge for these countries will be identifying the necessary co-financing opportunities from government and partners to complement Global Fund inputs for comprehensive iCCM programme scale up.

All of these activities can be supported with the advocacy platforms provided through stated country commitments for A Promise Renewed (APR), Every Woman Every Child (EWEC) and USAID's Ending Preventable Child and Maternal Deaths (EPCMD) vision. Critical priorities should include strengthening and supporting country coordination, policy setting and leadership (perhaps through the identification of "iCCM champions" in ministries of health) as well as expanding iCCM programmes to scale. Acting on identified barriers relating to supply chain management and human resources and deployment may be particularly critical, as these appear to be key challenges across many settings in sub-Saharan Africa.

Following discussions about the opportunities and challenges in their respective countries, participants are poised to work with their colleagues and partners to ensure that iCCM programmes are based on the latest evidence and are most appropriate for, and integrated into, their particular health systems and contexts.



**Acknowledgements:** The authors would like to acknowledge the contributions of the iCCM Symposium country team participants who provided information about current programmatic initiatives and identified future programmatic and policy priorities. This information informed the content of this paper.

**Funding:** This work was made possible through a grant from the Department of Foreign Affairs, Trade and Development, Government of Canada (SC130207).

**Authorship declaration:** MY, SA, DK, ES and KR designed and coordinated the country team sessions at the iCCM Symposium. MY, AS, SA, DK, ES and KR contributed to the content of this paper.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from AS). We declare that we have no conflicts of interest.

- 1 Marsh DR, Hamer DH, Pagnoni F, Peterson S. Introduction to a special supplement: evidence for the implementation, effects, and impact of the integrated community case management strategy to treat childhood infection. *Am J Trop Med Hyg.* 2012;87(5 Suppl):2-5. [Medline:23136271](#) [doi:10.4269/ajtmh.2012.12-0504](#)
- 2 Rasanathan K, Muñiz M, Bakshi S, Kumar M, Solano A, Kariuki W, et al. Community case management of childhood illness in Sub-Saharan Africa: Findings from a cross-sectional survey on policy and implementation. *J Glob Health.* 2014;4:020401 [doi:10.7189/jogh.04.020401](#).
- 3 World Health Organisation, United Nations Children's Fund. Joint statement: integrated community case management (iCCM). An equity-focused strategy to improve access to essential treatment services for children. New York: UNICEF, 2012.
- 4 McGorman L, Marsh DR, Guenther T, Gilroy K, Barat LM, Hammamy D, et al. A health systems approach to integrated community case management of childhood illness: methods and tools. *Am J Trop Med Hyg.* 2012;87(5 Suppl):69-76. [Medline:23136280](#) [doi:10.4269/ajtmh.2012.11-0758](#)
- 5 Guenther T, Barberá Láinez Z, Oliphant N, Dale M, Raharison S, Miller L, et al. Routine monitoring systems for integrated community case management programs: Lessons from 18 countries in sub-Saharan Africa. *J Glob Health.* 2014;4:020301. [doi:10.7189/jogh.04.020301](#)
- 6 Shieshia M, Noel M, Andersson S, Felling B, Alva S, Aggarwal S, et al. Strengthening community health supply chain performance through an integrated approach: Using mHealth technology and multilevel teams in Malawi. *J Glob Health.* 2014;4:020406. [doi:10.7189/jogh.04.020406](#)
- 7 Oliphant NP, Muñiz M, Guenther T, Diaz T, Barberá Láinez Y, Cohlihan H, et al. Multi-country analysis of routine data from integrated community case management programs in sub-Saharan Africa. *J Glob Health.* 2014;4:020408. [doi:10.7189/jogh.04.020408](#)
- 8 Collins D, Jarrah Z, Gilmartin C, Saya U. The costs of iCCM programs: A multi-country analysis. *J Glob Health.* 2014;4:020407. [doi:10.7189/jogh.04.020407](#)
- 9 Sharkey AB, Berzal R, Wetzler E, Cerveau T, Martin S. Demand generation and social mobilisation for iCCM and child health: Lessons learned from successful programmes in Niger and Mozambique. *J Glob Health.* 2014;4:020410. [doi:10.7189/jogh.04.020410](#)
- 10 Bosch-Capblanch X, Marceau C. Training, supervision and quality of care in iCCM programmes in sub-Saharan Africa. *J Glob Health.* 2014;4:020403. [doi:10.7189/jogh.04.020403](#)
- 11 Strachan C, Wharton-Smith A, Sinyangwe C, Mubiru D, Ssekitooleko J, Meier J, et al. The scale up of integrated community case management of malaria, pneumonia and diarrhoea across three African countries: A qualitative study exploring lessons learnt and implications for implementation. *J Glob Health.* 2014;4:020404. [doi:10.7189/jogh.04.020404](#)
- 12 Rasanathan K, Bakshi S, Rodriguez S, Oliphant NP, Jacobs T, Brandes N, et al. Where to from here? Policy and financing of integrated community case management of childhood illness (iCCM) in sub-Saharan Africa. *J Glob Health.* 2014;4:020304. [doi:10.7189/jogh.04.020304](#)
- 13 Chandani Y, Andersson S, Heaton A, Noel M, Shieshia M, Ombeva A, et al. Evidence for improving community health supply chains from Ethiopia, Malawi, and Rwanda. *J Glob Health.* 2014;4:020405. [doi:10.7189/jogh.04.020405](#)
- 14 Pratt A, Dale M, Olivi E, Miller J. Spatial distribution and deployment of community-based distributors implementing integrated community case management (iCCM): GIS mapping study in three South Sudan states. *J Glob Health.* 2014;4:020402. [doi:10.7189/jogh.04.020402](#)
- 15 Rudan I, Gibson JL, Ameratunga S. for CHNRI. Setting priorities in global health research investments: guidelines for implementation of the CHNRI method. *Croat Med J.* 2008;49:720-33. [Medline:19090596](#) [doi:10.3325/cmj.2008.49.720](#)
- 16 Wazny K, Sadruddin S, Zipursky A, Hamer DH, Jacobs T, Kallander K, et al. Setting global research priorities for integrated community case management (iCCM): Results from a CHNRI (Child Health and Nutrition Research Initiative) exercise. *J Glob Health.* 2014;4:020413. [doi:10.7189/jogh.04.020413](#)

**Correspondence to:**

Alyssa Sharkey  
 Health Specialist  
 UNICEF  
 Three United Nations Plaza  
 New York, NY 10017, USA  
[asharkey@unicef.org](mailto:asharkey@unicef.org)



# Where to from here?

## Policy and financing of integrated community case management (iCCM) of childhood illness in sub-Saharan Africa

Kumanan Rasanathan<sup>1</sup>, Salina Bakshi<sup>1</sup>, Daniela C. Rodriguez<sup>2</sup>, Nicholas P. Oliphant<sup>1</sup>, Troy Jacobs<sup>3</sup>, Neal Brandes<sup>3</sup>, Mark Young<sup>1</sup>

<sup>1</sup> UNICEF, New York, NY, USA

<sup>2</sup> Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

<sup>3</sup> USAID, Washington, DC, USA

Integrated community case management of childhood illness (iCCM) is a strategy to equip, train, support and supervise community health workers (CHWs) to assess children and deliver curative interventions in communities [1]. In particular, iCCM includes the delivery of amoxicillin (with use of respiratory timers) for pneumonia, oral rehydration salts and zinc for diarrhoea, and rapid diagnostic tests and artemisinin-based combination therapy for malaria. iCCM may also include screening, referral and treatment for malnutrition, and of newborns with illness. A “community health worker” (CHW) in this context is a health worker that provides health care in the community, with some training in the interventions they deliver (and who may or may not receive monetary payment), but who does not have a formal health professional or paraprofessional certificate or tertiary education degree.

In sub-Saharan Africa, recent years have seen increasing recognition of iCCM as a core strategy to deliver care to children, particularly those with poor access to health facilities, and reduce child mortality, in the context of the drive to achieve the Millennium Development Goals. Twen-

ty-eight countries in sub-Saharan Africa are now the site of delivery of community case management for each of pneumonia, diarrhoea and malaria, albeit at widely differing levels of coverage between countries [2]. Despite this progress, there are significant remaining obstacles to realizing the potential of iCCM to provide effective coverage of interventions for childhood illness at scale and quality. Here we review current trends in policy and financing of iCCM in sub-Saharan Africa to highlight two key issues: sustainable financing of iCCM, particularly from domestic sources, and the integration of iCCM in national health systems. We conclude by providing suggestions for how to move forward on these linked challenges.

### FROM POLICY TO IMPLEMENTATION

Policy development for iCCM in sub-Saharan Africa has proved challenging in many countries [3]. It is, however, no longer the major obstacle as most countries now have some type of written policy supporting delivery of care by CHWs, at least for pneumonia, diarrhoea and malaria [2]. The main challenges lie instead in implementation, with problems across countries in supply of commodities, utilization, scale, quality, financing and monitoring of services. iCCM for newborn care, especially treatment of neonatal sepsis, is an exception to this conclusion, as much also still remains to be done in terms of policy development, including greater consensus among development partners about guidelines and the effective role of CHWs in providing care. Few coun-

Discussions on iCCM have not necessarily been linked to broader health system policy, including dialogues on human resources for health and health system financing.

tries in sub-Saharan Africa have established substantive iCCM newborn policy but there is growing momentum.

Despite the overall progress in policy development for iCCM, challenges seen in implementation can be linked to deficits in iCCM policy-making. Implementation of iCCM in sub-Saharan Africa is as heterogeneous as the prevailing health systems, but common policy-related issues can be identified which provide a partial explanation for difficulties encountered in scale, utilization and financing. In too many countries, iCCM policy development has been mainly limited to technical staff in Ministries of Health and development partner agencies, failing to engage sufficient high-level political commitment and thus leadership at the same time as not involving CHWs themselves and the communities for whom iCCM is designed to provide benefit [3]. Even within Ministries of Health, discussions on iCCM have not necessarily been linked to broader health system policy, including dialogues on human resources for health and health systems financing. It is no coincidence that the countries with the greatest progress in scale and achievement in terms of iCCM, such as Ethiopia, Rwanda and Niger, are also those that have had high-level political champions (often at Ministerial level) and positioned iCCM as a core part of their national health strategies [4–7].

It is also important to recognise that iCCM in sub-Saharan Africa has not developed in a vacuum but with critical contextual influences on implementation. Prior to iCCM, many countries had meaningful experiences with community-based use of some maternal and child health commodities and vaccines through CHWs as well as outreach activities [8–10]. In the 1990s, many of these same countries implemented (and continue to implement) the integrated management of childhood illness (IMCI) approach in facilities. Continued implementation has sometimes occurred in fragmented fashion, even following decreasing support from global development partners. So while iCCM has attempted to address some of the shortcomings of this history, countries implement iCCM in the larger context of their own experience and those of peer countries.

## ENSURING CONTINUING AND LONG-TERM FINANCING FOR iCCM

Financing remains a critical concern for delivery of iCCM services, particularly its sustainability. Funding for iCCM in sub-Saharan Africa is overwhelmingly dependent on development partners, including for core activities such as remuneration of CHWs, commodities and general programme support [2]. In very few countries is external support for iCCM provided as general budget support – mostly it is directly provided for programmes. For many countries, future expansion of iCCM is dependent on what

A prerequisite for discussions on financing and integration is greater clarity on the role of iCCM and whether this is the same for all countries.

development partners will fund, and only a minority of countries report plans to increase funding for iCCM from domestic resources. With so much of the funding dependent on external sources, the future of iCCM programmes in sub-Saharan Africa seems fragile. Even after expected Global Fund support of US\$ 50–100 million and likely support from ministries and bilateral donors, a gap of more than US\$ 150 million is anticipated for 2015–2017 (Claire Qureshi, personal communication, 9 October 2014).

A key element of any sustainable solution for this problem in most countries is increased domestic financing of iCCM – which depends on the provision of interventions at community level, including iCCM, being seen as a core delivery channel for child services as part of the national health system. Yet Ministries of Finance have often been excluded from discussions on iCCM policy and financing, partly as a result of lack of high-level engagement in Ministries of Health [3]. The dearth of data on the true costs, both actual and marginal, of iCCM, and whether there is any viable alternative to which to compare cost-effectiveness, has also stifled the ability to make the case for greater domestic funding [2].

An iCCM funding issue most prevalent in West Africa that needs specific attention is the persistence of user fees and mark-ups on commodities [2]. This is a clear issue for utilization and equity of iCCM services, given the increasing evidence of the impact of financial barriers to services, particularly on the poorest [11–12]. Addressing this issue requires efforts aligned to broader health financing reform to avoid unintended negative consequences for communities and CHWs and ensure the financial sustainability of iCCM programmes [13].

## INTEGRATING iCCM INTO NATIONAL HEALTH SYSTEMS UNDER COUNTRY OWNERSHIP

The need to integrate iCCM into national health systems is not as self-evident to all as it may appear. But without such integration, persistent obstacles in supply of commodities, sustaining funding, providing adequate supervision, scaling up implementation and monitoring outcomes are unlikely to be overcome – notwithstanding that integration by itself will not resolve all of the problems seen in the functioning and governance of health systems. Yet partly due to iCCM services in most countries in sub-Saharan Africa being strongly driven (and often provided) by development part-

ners, only 9 countries have budget lines in the national health budget for iCCM [2]. There are encouraging trends in the reporting of and supervision of iCCM services to and by health facilities, but in many countries iCCM activities continue to function almost as stand-alone programmes.

This lack of integration of iCCM into national health systems and plans is related to poor integration of CHWs in general. Over thirty years after the Declaration of Alma Ata [14], the role of CHWs remains contested, particularly in terms of whether they should provide curative care. CHWs are often an after-thought in health policy discussions, despite the vital roles they have continued to play even before the advent of iCCM [8]. Countries which retain a strong influence of the primary health care approach have perhaps, unsurprisingly, benefitted from a stronger basis for the development and implementation of iCCM policy, even though lack of coordination and transition between older CHW cadres deriving from the Alma Ata era and newer cadres created for iCCM programmes has been problematic in some countries [3]. A further challenge for the integration of iCCM in national health systems is that given the dependence on development partner resources, local and national health officials may harbour fears that once external support ends, district fiscal resources will be insufficient to continue to provide services – making them hesitant to fully embrace integration.

Ethiopia provides a striking example of a country where iCCM and CHWs are fully integrated into national health systems, plans and budgets. Key to Ethiopia's relative success has been strong country ownership of iCCM, with the Ministry of Health fully committed to leading the planning process to develop an integrated national plan [4]. In Ethiopia, CHWs have been seen as integral parts of the health system for some time, with health extension workers and

a community delivery platform established prior to iCCM being introduced. In this context, CHWs have become part of an evolving primary care unit that is continually adapting to changing circumstances.

In addition to promising examples like Ethiopia, there are other positive signs for integration of iCCM into national health systems. The Global Fund has committed to providing greater funding for iCCM, providing a stimulus for integration of malaria control programmes with care for pneumonia and diarrhoea – which has often proved difficult where strong vertical malaria programmes are established. Memoranda of understanding between the Global Fund and other agencies such as UNICEF also provide the opportunity for a more harmonized approach between development partners towards increasing effective coverage of essential child services.

## WAY FORWARD: OPPORTUNITIES AND CHALLENGES

iCCM shows both the potential and the challenges for health service delivery in communities to extend effective coverage of essential child health interventions. Addressing the two highlighted issues of sustainable financing and integration is crucial to building on the momentum for iCCM seen in recent years to accelerate its contribution to the goal of ending preventable child deaths within a generation [15,16].

A number of key actions to overcome these problems can be articulated, but these need to be adapted to the specific context of each country for iCCM, which varies greatly between and even within countries. First, there is a need for a health systems approach to iCCM to be adopted [17]. Without institutionalizing iCCM as a core part of national health systems, plans and budgets, it will remain dependent and driven by development partners, and vulnerable to changing funding and policy winds. iCCM cannot continue to be discussed and implemented as a separate concern to broader dialogues on human resources for health and health financing within countries, and the “iCCM community” needs to reach outward to engage decision-makers and implementers across the broader health sector and beyond, including Ministries of Finance. This observation applies not only to advocates for iCCM within Ministries of Health and in national contexts, but also to those in development partners working at the “global” level.

Second, the often abstract concept of “sustainable financing” for iCCM needs to be tackled fully and unpacked, again with more granularity for the widely differing contexts in which iCCM is being implemented. Recent progress on costing of iCCM [18], along with the new opportunities provided by the Global Fund, can be built upon. But there is a need for a frank conversation on what part domestic financing can and should play in underwriting iCCM servic-



Photo: Courtesy of Michael Crook, UNICEF  
(©UNICEF/NYHQ2011/MICHAEL CROOK)

es. In the context of robust and continued economic growth in many sub-Saharan African countries, there is renewed discussion of how domestic health spending can and should rise, and how African countries might meet the call of the Abuja Declaration [19] in terms of the proportion of their national budgets devoted to health spending. iCCM needs positioning by Ministries of Health and development partners to take advantage of these developments.

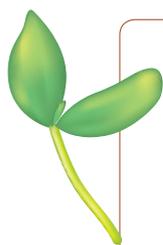
Third, a prerequisite for discussions on financing and integration is greater clarity on the role of iCCM and whether this is the same for all countries. There is confusion as to whether iCCM is a “stop-gap” measure while countries develop health facilities to provide effective coverage for all children, or whether community-based delivery by CHWs should be seen as a priority and permanent mode of providing services. This debate draws strong emotions, but the direction decided upon needs to be made explicit to underpin any national strategy, as it has important implications for how integration should be undertaken, how CHW cadres should be developed and supported (including in terms of career paths), and how financing decisions should be made. It is difficult to see how most sub-Saharan African countries can achieve and maintain universal coverage of essential child health services without ongoing and institutionalized support for iCCM provided by CHWs, particularly when considering demographic projections of rapidly increasing populations of children under 5 years [20]. But if the claim is made that iCCM is a “stop-gap”, answers are required on what the eventual alternative will be and how this will be financed and implemented. Regardless, a “one-size fits all” approach to iCCM policy and implementation is increasingly insufficient, and a minimum taxonomy of countries is required that provides differential approaches for countries with increasing fiscal space for health and those whom are likely to be dependent on development partners for the foreseeable future.

For the former group of countries, where domestic financing can and should increase (and is doing so) as a proportion of funding for health services, the universal health coverage (UHC) dialogue, including as part of the discussions on the Sustainable Development Goals (SDGs), provides an important policy entry point for institutionalizing iCCM. Efforts to

achieve UHC must prioritize improving the provision of essential life-saving interventions for children with poor existing access and coverage – as it would be nonsensical for a country to claim it is moving towards UHC without demonstrating this. Country commitments to achieve UHC are an opportunity to position iCCM as a key strategy to do so – as how else will the communities be reached for which iCCM provides services? Yet, currently there often seems a complete disconnection between UHC discussions and those on iCCM, similarly to how CHW discussions are often marginal in the debates on health workforces.

For the second group of countries, where external resources from development partners will need to fund the bulk of health expenditure for the medium term at least, an alternative strategy is required. UHC remains a distant goal for this shrinking but important group of countries, which includes many with the highest rates of child mortality. Here, equivocations on “sustainable financing” need to give way to explicit commitments by development partners of continued funding and coordinated, ongoing support for the delivery of essential health services for children, prioritising community-based delivery by CHWs, including iCCM, as the basis of national health systems. The current Ebola crisis [21] starkly illustrates the need for this change in approach for this group of countries and is illustrative of the array of system disruptions in these contexts.

In conclusion, further scale-up of iCCM is an opportunity to better integrate community service delivery into national health systems. Recent initiatives such as the aforementioned efforts by the Global Fund, and the recently announced Global Financing Facility [22], provide the opportunity to consolidate a financing basis for iCCM, but further work is required, including mobilization of increased resources and better harmonization to reduce the burden for countries in applying for, receiving and monitoring the use of funding. Moreover, for most countries, the role of domestic financing needs to be clarified and increased. The challenges posed by the increasing demand for universal health coverage, the tragedy of the Ebola crisis and the demographic projections of burgeoning child populations in Africa underline the urgent importance of getting iCCM policy and financing right.



**Funding:** None.

**Authorship declaration:** KR conceived of the paper and wrote the first draft of the manuscript. All authors contributed to the final draft of the manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). KR, SB, and NO work for UNICEF and TJ and NB work for USAID, which have both been major promoters and funders of iCCM policy and implementation in sub-Saharan Africa. There are no other conflicts of interest. This paper reflects the views of the authors and does not necessarily reflect the views or policies of UNICEF or USAID.

- 1 World Health Organization, United Nations Children's Fund. WHO. UNICEF. WHO/UNICEF joint statement: integrated community case management (iCCM). An equity-focused strategy to improve access to essential treatment services for children. New York: UNICEF, 2012.
- 2 Rasanathan K, Muñiz M, Bakshi S, Kumar M, Solano A, Kariuki W, et al. Community case management of childhood illness in Sub-Saharan Africa: Findings from a cross-sectional survey on policy and implementation. *J Glob Health*. 2014;4:020401.
- 3 Bennett S, George A, Rodriguez D, Shearer J, Diallo B, Konate M, et al. Policy challenges facing integrated community case management in Sub-Saharan Africa. *Trop Med Int Health*. 2014;19:872-82. [Medline:24750516](#) [doi:10.1111/tmi.12319](#)
- 4 Admasu K. Integrated community case management (iCCM) in Ethiopia. Integrated Community Case Management: Evidence Review Symposium; 2014 Mar 3-5; Accra, Ghana.
- 5 Binagwaho A, Farmer PE, Nsanzimana S, Karema C, Gasana M, de Dieu Ndirabega J, et al. Rwanda 20 years on: investing in life. *Lancet*. 2014;384:371-5. [Medline:24703831](#) [doi:10.1016/S0140-6736\(14\)60574-2](#)
- 6 Sanda S. Niger's success in child survival. *Lancet*. 2012;380:1127-8. [Medline:22999431](#) [doi:10.1016/S0140-6736\(12\)61514-1](#)
- 7 Amouzou A, Habi O, Bensaïd K. Reduction in child mortality in Niger: a countdown to 2015 country case study. *Lancet*. 2012;380:1169-78. [Medline:22999428](#) [doi:10.1016/S0140-6736\(12\)61376-2](#)
- 8 Haines A, Sanders D, Lehmann U, Rowe AK, Lawn JE, Jan S, et al. Achieving child survival goals: potential contribution of community health workers. *Lancet*. 2007;369:2121-31. [Medline:17586307](#) [doi:10.1016/S0140-6736\(07\)60325-0](#)
- 9 Perry HB, Zulliger R, Rogers MM. Community health workers in low-, middle-, and high-income countries: an overview of their history, recent evolution, and current effectiveness. *Annu Rev Public Health*. 2014;35:399-421. [Medline:24387091](#) [doi:10.1146/annurev-publhealth-032013-182354](#)
- 10 Smith Paintain L, Willey B, Kedenge S, Sharkey A, Kim J, Buj V, et al. Community health workers and stand-alone or integrated case management of malaria: a systematic literature review. *Am J Trop Med Hyg*. 2014;91:461-70. [Medline:24957538](#) [doi:10.4269/ajtmh.14-0094](#)
- 11 Lagarde M, Palmer N. The impact of user fees on access to health services in low- and middle-income countries. *Cochrane Database Syst Rev*. 2011;(4):CD009094. [Medline:21491414](#)
- 12 Meessen B, Van Damme W, Tashobya CK, Tibouti A. Poverty and user fees for public health care in low-income countries: lessons from Uganda and Cambodia. *Lancet*. 2006;368:2253-7. [Medline:17189038](#) [doi:10.1016/S0140-6736\(06\)69899-1](#)
- 13 Meessen B, Hercot D, Noirhomme M, Ridde V, Tibouti A, Tashobya CK, et al. Removing user fees in the health sector: a review of policy processes in six sub-Saharan African countries. *Health Policy Plan*. 2011;26 Suppl 2:ii16-29. [Medline:22027916](#) [doi:10.1093/heapol/czr062](#)
- 14 World Health Organization, United Nations Children's Fund. Declaration of Alma-Ata. Alma-Ata, USSR: WHO, 1978.
- 15 Glass RI, Guttmacher AE, Black RE. Ending preventable child death in a generation. *JAMA*. 2012;308:141-2. [Medline:22695930](#) [doi:10.1001/jama.2012.7357](#)
- 16 United Nations Children's Fund. Committing to child survival: a promise renewed (Progress report 2014). New York: UNICEF, 2014.
- 17 Zulu JM, Kinsman J, Michelo C, Hurtig A-K. Integrating national community-based health worker programmes into health systems: a systematic review identifying lessons learned from low- and middle-income countries. *BMC Public Health*. 2014;14:987. [Medline:25245825](#) [doi:10.1186/1471-2458-14-987](#)
- 18 Collins D, Jarrah Z, Gilmartin C, Saya U. The costs of integrated community case management (iCCM) programs: A multi-country analysis. *J Glob Health*. 2014;4:020407. [doi:10.7189/jogh.04.020407](#)
- 19 WHO. The Abuja Declaration: ten years on. Geneva: WHO, 2011. Available at: [http://www.who.int/healthsystems/publications/abuja\\_declaration/en/](http://www.who.int/healthsystems/publications/abuja_declaration/en/). Accessed: 5 October 2014.
- 20 O'Malley J, Wardlaw T, You D, Hug L, Anthony D. Africa's child demographics and the world's future. *Lancet*. 2014;384:730-2. [Medline:25129327](#) [doi:10.1016/S0140-6736\(14\)61331-3](#)
- 21 WHO Ebola Response Team. Ebola virus disease in West Africa—the first 9 months of the epidemic and forward projections. *N Engl J Med*. 2014;371:1481-95. [Medline:25244186](#) [doi:10.1056/NEJMoa1411100](#)
- 22 World Bank. Global financing facility in support of Every Woman, Every Child. Washington D.C.: World Bank, 2014. Available at: <http://www.worldbank.org/content/dam/Worldbank/document/HDN/Health/GFFExecutiveSummaryFINAL.pdf>. Accessed: 23 October 2014.

**Correspondence to:**

Dr Kumanan Rasanathan  
 Health Section, Programme Division  
 UNICEF  
 3 United Nations Plaza  
 New York, NY 10017, USA  
[krasanathan@unicef.org](mailto:krasanathan@unicef.org)

# Community case management of childhood illness in sub-Saharan Africa – findings from a cross-sectional survey on policy and implementation

Kumanan Rasanathan<sup>1</sup>, Maria Muñiz<sup>1</sup>, Salina Bakshi<sup>1</sup>, Meghan Kumar<sup>2</sup>, Agnes Solano<sup>3</sup>, Wanjiku Kariuki<sup>1</sup>, Asha George<sup>4</sup>, Mariame Sylla<sup>3</sup>, Rory Nefdt<sup>2</sup>, Mark Young<sup>1</sup>, Theresa Diaz<sup>1</sup>

<sup>1</sup> UNICEF, New York, NY, USA

<sup>2</sup> UNICEF Eastern and Southern Africa Regional Office, Nairobi, Kenya

<sup>3</sup> UNICEF West and Central Africa Regional Office, Dakar, Senegal

<sup>4</sup> Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

**Background** Community case management (CCM) involves training, supporting, and supplying community health workers (CHWs) to assess, classify and manage sick children with limited access to care at health facilities, in their communities. This paper aims to provide an overview of the status in 2013 of CCM policy and implementation in sub-Saharan African countries.

**Methods** We undertook a cross-sectional, descriptive, quantitative survey amongst technical officers in Ministries of Health and UNICEF offices in 2013. The survey aim was to describe CCM policy and implementation in 45 countries in sub-Saharan Africa, focusing on: CHW profile, CHW activities, and financing.

**Results** 42 countries responded. 35 countries in sub-Saharan Africa reported implementing CCM for diarrhoea, 33 for malaria, 28 for pneumonia, 6 for neonatal sepsis, 31 for malnutrition and 28 for integrated CCM (treatment of 3 conditions: diarrhoea, malaria and pneumonia) – an increase since 2010. In 27 countries, volunteers were providing CCM, compared to 14 countries with paid CHWs. User fees persisted for CCM in 6 countries and mark-ups on commodities in 10 countries. Most countries had a national policy, memo or written guidelines for CCM implementation for diarrhoea, malaria and pneumonia, with 20 countries having this for neonatal sepsis. Most countries plan gradual expansion of CCM but many countries' plans were dependent on development partners. A large group of countries had no plans for CCM for neonatal sepsis.

**Conclusion** 28 countries in sub-Saharan Africa now report implementing CCM for pneumonia, diarrhoea and malaria, or "iCCM". Most countries have developed some sort of written basis for CCM activities, yet the scale of implementation varies widely, so a focus on implementation is now required, including monitoring and evaluation of performance, quality and impact. There is also scope for expansion for newborn care. Key issues include financing and sustainability (with development partners still providing most funding), gaps in data on CCM activities, and the persistence of user fees and mark-ups in several countries. National health management information systems should also incorporate CCM activities.

## Correspondence to:

Dr Kumanan Rasanathan  
Health Section  
Programme Division  
UNICEF  
3 United Nations Plaza  
New York, NY 10017, USA  
krasanathan@unicef.org

Community case management (CCM) involves training, supporting, and supplying community health workers to assess, classify and manage sick children with limited access to care at health facilities, in their commu-

nities [1]. In this context, a “community health worker” (CHW) is a health worker delivering health care in the community, trained in some way in the context of the intervention, and having no formal health professional or paraprofessional certificate or tertiary education degree; regardless of whether or not they receive monetary payment. In recent years, there has been increasing momentum for CHWs to provide CCM to prevent mortality and morbidity for pneumonia, malaria, diarrhoea, malnutrition and neonatal infections [2], reflecting the fact that these conditions remain the leading causes of mortality for children under five [3].

Despite the existence of cost-effective and appropriate treatment for these conditions, effective care is often limited due to challenges with access to health facilities, supply of commodities and trained staff, and knowledge and incentives within communities to utilize services in a timely manner [4]. For instance, in sub-Saharan Africa, only 31% of children with diarrhoea receive treatment with oral rehydration salts [5]. Similarly, only 37% of children with fever receive any antimalarial (notwithstanding that not all of these children will have malaria), and medical care was sought for only 46% of children with symptoms of pneumonia [5].

CCM (or integrated CCM, or “iCCM”, where services for diagnosis and treatment for pneumonia, diarrhoea and malaria are provided together) is a strategy that attempts to overcome these deficits by providing support for health care services in the community, close to where people live, complementing, and referring to, facility-based services. Key aspects of CCM programmes include training and support of community health workers (CHWs) and algorithms for community-based treatments of childhood illnesses, such as diarrhoea, malaria, and pneumonia. There is increasing evidence that CCM and CHW programmes can contribute overall to a reduction in child mortality [6–9]. In a 2010 survey of countries in sub-Saharan Africa, 29/40 countries reported implementing CCM for diarrhoea, 26/39 for malaria, and 21/40 for diarrhea [10,11].

This paper aims to provide an overview of the status in 2013 of community case management (CCM) policy and implementation for malaria, pneumonia, diarrhoea, neonatal sepsis and malnutrition for under-5-year-old children in all sub-Saharan African countries. It presents findings from a 2013 cross-sectional, quantitative survey, building on previous surveys of CCM policy and implementation [10,12]. It should be noted that this overview includes both implementation of iCCM for the above conditions as well as CCM programmes for individual conditions that are not integrated. Following this overview paper, future papers are planned to report in-depth data from specific areas of the survey.

## METHODS

We undertook a cross-sectional, descriptive, quantitative survey from August 2013 to January 2014, focusing on community health workers who provide CCM services – that is basic health care services and referral where necessary for malaria, pneumonia, diarrhoea, neonatal sepsis and/or malnutrition for children under 5 years. For the purposes of this survey, CCM for pneumonia refers to at least the delivery by CHWs of an oral antibiotic (amoxicillin or cotrimoxazole); CCM for diarrhoea refers to at least the delivery by CHWs of oral rehydration salts and zinc; CCM for malaria refers to at least the delivery by CHWs of artemisinin-based combination therapy; CCM for neonatal sepsis refers to delivery by CHWs of oral or injectable antibiotics; and CCM for malnutrition refers to screening and referral by CHWs of severe malnutrition.

The survey instrument drew from previous survey studies of CCM implementation and policy to facilitate the possibility of comparison, in particular a survey undertaken in 2010 [10]. The 2013 survey also included questions on a number of areas that had not previously been examined such as monitoring and reporting, and financing. The 2013 survey examined five domains within CCM programming: policy, implementation, CHW profile, CHW activities, and financing. The survey was designed to be completed collaboratively by the focal point for CCM in the respective Ministry of Health for each country along with the technical officer responsible for CCM in each country’s UNICEF office.

The survey was distributed by email to two regional focal points in UNICEF’s Eastern and Southern Africa Regional Office (ESARO) and West and Central Africa Regional Office (WCARO) in Africa, who then distributed the questionnaires by email to focal points for CCM in both Ministries of Health and UNICEF country offices in all 45 countries in sub-Saharan Africa where UNICEF has a country office (see **Table 1**). The in-country focal points were then responsible for liaising with other in-country officials to fill in the questionnaire electronically, and then submit it back to the regional focal points. Where there was no focal point in the Ministry of Health for CCM, the UNICEF country office referred the survey to the most appropriate official. All the completed surveys were received by November 2013. Data entry was conducted by the regional offices using web entry forms designed in Formhub (<https://formhub.org/>). Triangulation, data cleaning and verification took place between November 2013 and March 2014. Triangulation was undertaken by review of surveys by technical experts in the region, and seeking of clarification on queries from those who originally completed the survey.

**Table 1.** Countries included in the survey

Angola	Liberia
Bénin	Madagascar
Botswana	Malawi
Burkina Faso	Mali
Burundi	Mauritania
Cameroon	Mozambique
Cabo Verde	Namibia
Central African Republic	Niger
Chad	Nigeria
Comoros	Rwanda
Congo	São Tomé e Príncipe
Côte d'Ivoire	Senegal
Democratic Republic of Congo	Sierra Leone
Equatorial Guinea	Somalia
Eritrea	South Africa
Ethiopia	South Sudan
Gabon	Swaziland
Gambia	Tanzania
Ghana	Togo
Guinea	Uganda
Guinea-Bissau	Zambia
Kenya	Zimbabwe
Lesotho	

The forms were entered online by two individuals, one from WCARO, and one from ESARO. The data entry screen facilitated: quality control checks and information to be accessed by UNICEF regional and headquarters offices in real-time; data cleaning and tracking of progress of entry; and data backup and sharing between the two offices. Following the entry of the information, the data was exported from Formhub as a csv, and then processed in SPSS (v22). Data processing included cleaning, labelling and transformation of the data.

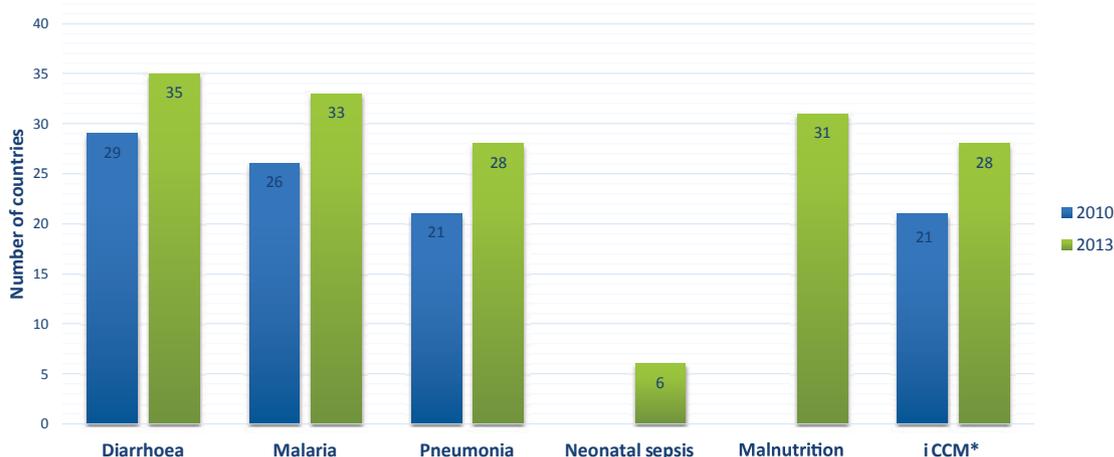
The following checks were undertaken with the data: 1) missing values; 2) consistency of responses, and 3) range checks. During the data cleaning process, missing questions or questions that needed further clarification were flagged, compiled and submitted to the UNICEF regional

offices for follow up with survey respondents. Additionally, country profiles were developed using each country's survey response and were circulated for review, to further assist in the data cleaning process. Finally, provisional results were presented and discussed at the iCCM Evidence Review Symposium in Accra, Ghana, in March 2014, providing further feedback and checks on the data. Descriptive analysis was conducted using Excel and STATA v. 13.0 (StataCorp LP, College Station, Texas, USA).

## RESULTS

Out of the 45 countries surveyed, 42 countries submitted a response. The non-responding countries were Cabo Verde, São Tomé e Príncipe and Equatorial Guinea, which do not have CCM programmes, and thus opted out of completing of the survey.

In 2013, 35 countries out of the 42 countries in sub-Saharan Africa that completed the survey reported implementing CCM for diarrhoea, 33 countries for malaria, 28 for pneumonia, 6 for neonatal sepsis, 31 for malnutrition and 28 countries for iCCM (treatment of 3 conditions: diarrhoea, malaria and pneumonia). There has been an increase in the number of countries implementing CCM for these conditions since 2010, as shown in **Figure 1**. Of the 28 countries implementing CCM for pneumonia, diarrhoea and malaria, 11 were in Eastern and Southern Africa, and 17 were in West and Central Africa. The 6 countries reporting implementation of CCM for neonatal sepsis were Gambia, Ghana, Niger, Democratic Republic of Congo, Swaziland, and Uganda. In all of these countries, implementation has not reached all intended communities and districts with the full range of planned activities. There were 6 coun-



**Figure 1.** Implementation of community case management (CCM) of diarrhoea, malaria, pneumonia, neonatal sepsis and malnutrition in sub-Saharan Africa (n=42). iCCM\* refers to community case management services for diagnosis and treatment of pneumonia, diarrhoea and malaria that are provided together. There was no data for neonatal sepsis and malnutrition in the 2010 survey.

tries who responded to the survey who are not implementing CCM activities: Botswana, Gabon, Guinea-Bissau, South Africa, Tanzania, and Zimbabwe.

### Gender and type of CHW and incentives for provision of CCM

The cadres of CHWs providing CCM services were of mixed gender in 17 countries, mostly female in 8 countries, mostly male in 9 countries, and exclusively female in 1 country.

In 27 countries, volunteers were providing CCM, compared to 14 countries where paid CHWs were doing so. Traditional birth attendants were implementing CCM in 3 countries and mid-level providers were doing so in 4 countries. In 5 countries, another type of CHW was providing CCM. It should be noted that in several countries, there was more than one type of cadre providing CCM.

Incentives for CHWs providing CCM varied, with different types of incentives often being used in the same country. A salary was provided by the Ministry of Health in 6 countries, and by non-governmental organizations (NGOs) in 2 countries. User fees were still charged for CCM in 6 countries and mark-ups on commodities in 10 countries, mostly in West Africa. Incentive payments were provided by the Ministry of Health in 10 countries, and by NGOs in 19 countries. In 23 countries, non-monetary incentives were used.

### CCM Policy and national guidelines

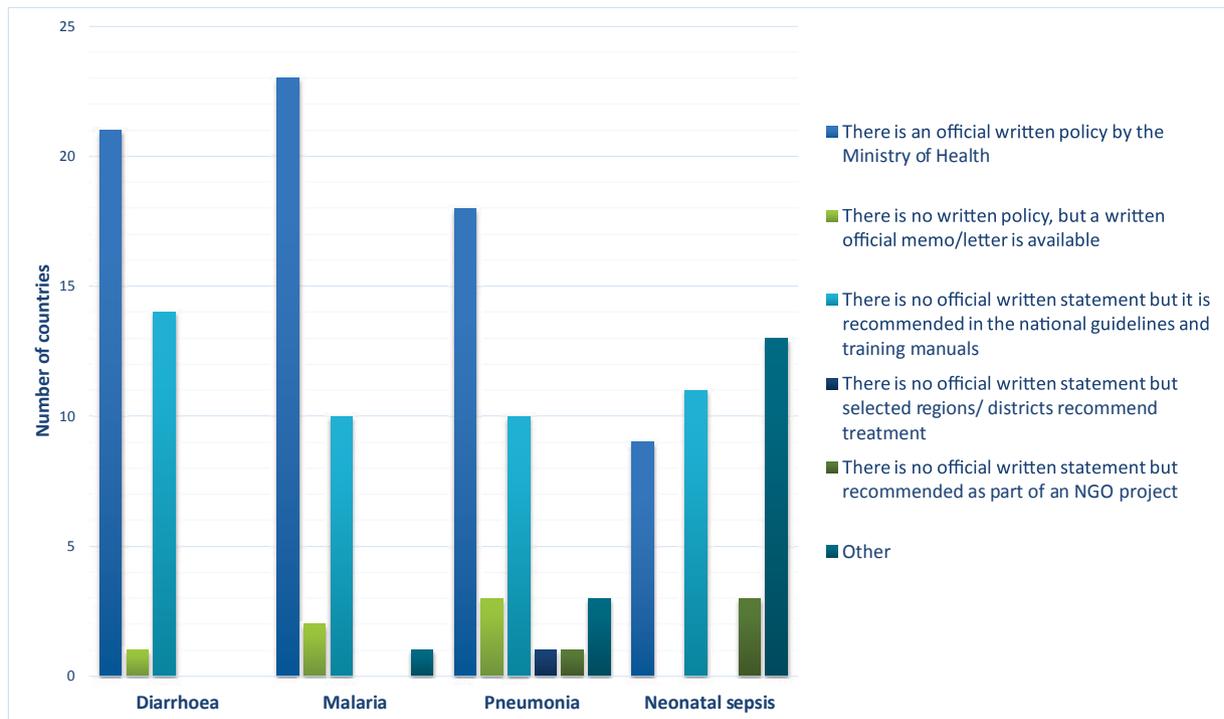
Most countries had a national policy, memo or written guidelines for the implementation of CCM for diarrhoea (in 36 countries) and malaria (in 35 countries), with a slightly lower number for pneumonia (in 31 countries), as shown in **Figure 2**. Twenty countries now had a national policy, memo or written guidelines for neonatal sepsis.

### Institutional involvement in CCM

Ministries of Health, multilateral agencies and NGOs were all reported as having major roles in CCM activities within countries. In 35 countries, it was reported the Ministries of Health had a major role. 36 countries reported that UNICEF had a major role while the corresponding number of countries for the World Health Organization (WHO) was 34. National NGOs played a major role in 24 countries and international NGOs in 32 countries. Research institutions had a major function in CCM activities in 14 countries and private sector groups in 5 countries.

### Monitoring, supervision and reporting

Monitoring and supervision of CHWs who provide CCM services was provided by health facilities in 33 countries. Community supervisors performed this role in 14 countries, and health committees in 9 countries. Other mechanisms were used for supervision in 3 countries. Again,



**Figure 2.** National policies on community case management in sub-Saharan Africa, by condition (n=36).

many countries employed more than one of these forms of supervision for CHWs.

CHWs also reported activities and patient data to health facilities in 33 countries and to community supervisors in 14 countries. In 3 countries, reporting was undertaken to health committees, while 4 countries also used other mechanisms. No countries reported an absence of a reporting function.

Thirteen countries reported the existence of a comprehensive national monitoring and evaluation plan for CCM activities including programme goals and objectives and indicators to be measured, with details of tools, frequency, and level of indicators, methodologies and dissemination. Thirteen countries reported a partial plan that covered only some of these components. In 9 countries, there was no monitoring and evaluation plan.

### Financing of CCM activities

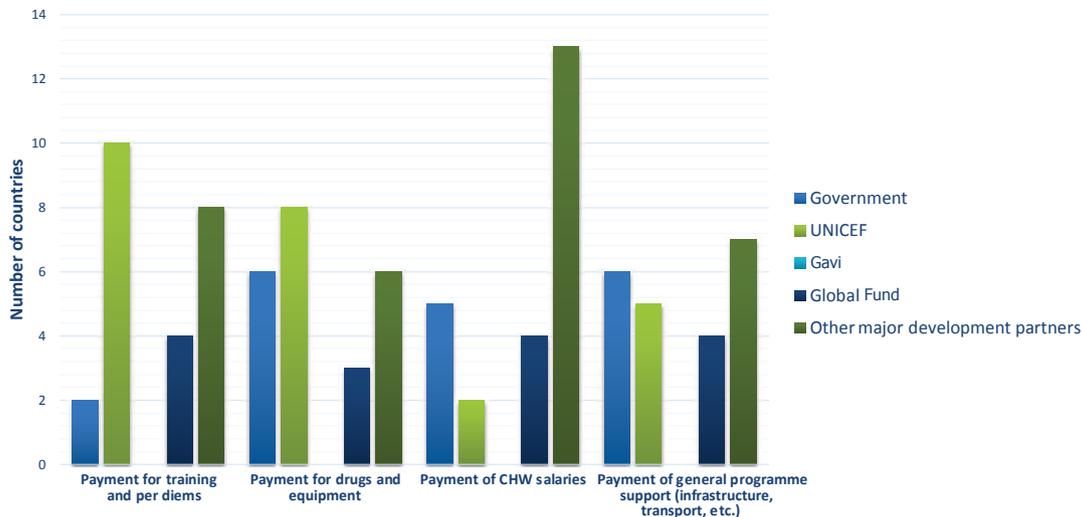
Nine countries reported that there was a budget line in the domestic government budget for CCM. 24 countries reported that there was not.

**Figure 3** presents data reported on the institutions providing primary funding for different aspects of CCM, including but not limited to the national government – overall, national governments were the primary funder for a minority of CCM programme components.

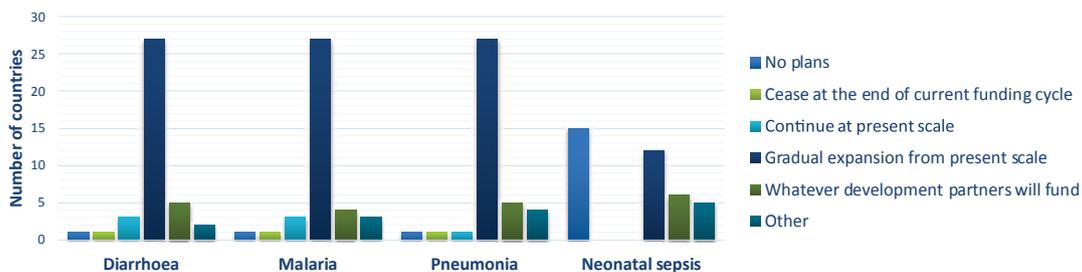
### Future plans

Most countries plan gradual expansion for existing CCM activities. However, many countries' plans were dependent on what development partners will fund and a large group of countries had no plans for CCM for neonatal sepsis. **Figure 4** presents data on future plans for CCM activities for each of the conditions.

Fifteen countries reported that the government planned to increase their percentage of total funding for CCM services in their country. Fifteen countries reported not planning to do so, and 4 countries reported being in the process of developing a sustainable finance model.



**Figure 3.** Institutions providing primary funding for different aspects of community case management in sub-Saharan Africa (n=27). CHW – community health worker.



**Figure 4.** Future plans for community case management in sub-Saharan Africa, by condition (n=42).

## DISCUSSION

The results of the survey reported in this paper confirm that the scale of implementation of CCM by CHWs as a strategy to improve effective coverage of essential health services for children under-5 in sub-Saharan Africa has increased. The number of countries implementing CCM has risen since 2010 for each of the conditions, and overall, 28 countries in sub-Saharan Africa now report implementing CCM for pneumonia, diarrhoea and malaria, or “iCCM”.

The findings of the survey build on and confirm previous profiles of CHWs providing CCM services [11]. The diverse nature of CHW cadres involved in implementing CCM implies that a contextualised approach to how CCM dovetails with health systems strengthening is essential. The existence of thousands of CHWs implementing CCM provides greater opportunities to evaluate their effectiveness, building on existing knowledge, particularly to show that CCM at scale can make a meaningful contribution to ending preventable child deaths. There is also the possibility to better understand the strategic importance of CHWs in the context of the current global crisis in human resources for health.

The study provides several findings of note for national and global partners involved in the implementation of CCM. First, the persistence of user fees and mark-ups for CCM services in several countries requires attention. This occurs mostly in West Africa but given the evidence of the negative impacts of user fees, particularly on the poor, sustainable solutions must be developed as part of broader health system reform [13]. Discussions on CCM and CHWs need to inform global and national efforts to move towards universal health coverage. The slow uptake of the provision of salaries for CHWs should also be of concern for sustaining CCM programmes, notwithstanding that the debate on the benefits and adverse consequences of voluntarism has not been settled [14,15].

Second, despite the documentation of challenges in the development of CCM policy [16], most countries in sub-Saharan Africa have been able to develop at least some sort of written basis for CCM activities. The focus now must thus be on implementation of these policies and guidelines, including a greater focus on monitoring and evaluation of performance, quality and impact.

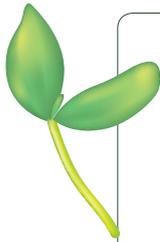
Third, financing and sustainability of CCM is a key issue – with CCM funding still largely driven by development partners, even for aspects that would be expected to be covered by governments, such as salaries and commodities. Only a minority of countries reported plans to increase the proportion of funding for CCM from domestic resources and few countries even have an item line for CCM activities in their domestic budgets. Further discussion of this important issue is presented in an accompanying paper [17].

Fourth, there is scope for expansion for newborn care. A small number of countries have started to embark on some CCM newborn activities. More support and guidelines are required from the global community to ensure this has a positive impact and further expansion occurs taking into consideration contextual factors such as CHW gender, existing workloads, and community and health system profiles. It is difficult to see how the goals of the Every Newborn Action Plan [18], to dramatically reduce newborn deaths, can be achieved without a greater role for community level engagement, including CHWs.

There are some limitations to this survey. It represents the expert opinion of the respondents. The extent to which this opinion was backed by data in national systems was dependent on its availability and at the discretion of the respondents, although triangulation was attempted through review of responses by regional experts. While surveys such as this provide useful data about trends in CCM policy and implementation, they are no substitute for improvements in national health management information systems, which must incorporate CCM activities and CHWs in general as integral parts of national health systems. For some questions in the survey (particularly around scale and cost), there were concerns about the completeness and quality of some of the reported data and hence these findings have not been included here. There seem to be generalised and significant knowledge gaps within many countries on the status of key aspects of CCM implementation, including, in some cases, basic information such as the number of CHWs that exist in the country.

Care must also be taken in interpreting the study findings with respect to scale of implementation. While 28 countries report implementing CCM for pneumonia, diarrhoea and malaria, the scale of implementation varies widely between these countries. This survey attempted to quantify the scale of implementation, but as noted above, data about the scale and cost of CCM activities is particularly lacking in many countries. Other instruments should be employed to provide an in-depth understanding of the scale of implementation of CCM activities, which is a crucial aspect to evaluate their potential success and impact, as well as to measure the quality of services.

In conclusion, this survey shows that much has been achieved in the development of policy and in the implementation of CCM to reduce child deaths in sub-Saharan Africa over the past decade. A major priority overall, discussed elsewhere, is the need to place CHWs and CCM as integral parts of national health systems [17]. Doing so is key to realizing the potential of CCM but also to addressing some of the information gaps on CCM activities revealed by this survey.



**Acknowledgements:** We thank the Ministry of Health and UNICEF colleagues who completed the survey in each of the 42 countries. We also acknowledge the contributions of the iCCM Evidence Symposium Working Group in the development of the survey instrument, and the support of Alyssa Sharkey, Nicholas Oliphant, Maureen Koech and Hallie Nickelson. We would also like to acknowledge the comprehensive comments of the peer reviewers of this manuscript, which significantly strengthened the paper.

**Funding:** Partial funding for this study was provided by the Bill and Melinda Gates Foundation. UNICEF staff time for this study was funded by DFATD (Canada), Mount Sinai School of Medicine and DFAT (Australia).

**Authorship declaration:** KR and TD conceived of the study. KR, MM, SB, MK and AS analysed the data. KR and MM wrote the first draft of the manuscript. All authors contributed to the final draft of the manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). They report that they currently work for UNICEF (or have done so in the past), which has been a major promoter and funder of CCM policy and implementation in sub-Saharan Africa. They report no other conflicts of interest.

## REFERENCES

- 1 Marsh DR, Hamer DH, Pagnoni F, Peterson S. Introduction to a special supplement: Evidence for the implementation, effects, and impact of the integrated community case management strategy to treat childhood infection. *Am J Trop Med Hyg.* 2012;87:2-5. Medline:23136271 doi:10.4269/ajtmh.2012.12-0504
- 2 Young M, Wolfheim C, Marsh DR, Hammamy D. World Health Organization/United Nations Children's Fund joint statement on integrated community case management: an equity-focused strategy to improve access to essential treatment services for children. *Am J Trop Med Hyg.* 2012;87:6-10. Medline:23136272 doi:10.4269/ajtmh.2012.12-0221
- 3 You D, Hug L, Chen Y; United Nations Inter-agency Group for Child Mortality Estimation. Levels and trends in child mortality. Report 2014. New York: UNICEF; 2014.
- 4 Chopra M, Sharkey A, Dalmiya N, Anthony D, Binkin N, UNICEF Equity in Child Survival, Health and Nutrition Analysis Team. Strategies to improve health coverage and narrow the equity gap in child survival, health, and nutrition. *Lancet.* 2012;380:1331-40. Medline:22999430 doi:10.1016/S0140-6736(12)61423-8
- 5 UNICEF. State of the world's children 2014: every child counts. New York: UNICEF; 2014.
- 6 Haines A, Sanders D, Lehmann U, Rowe AK, Lawn JE, Jan S, et al. Achieving child survival goals: potential contribution of community health workers. *Lancet.* 2007;369:2121-31. Medline:17586307 doi:10.1016/S0140-6736(07)60325-0
- 7 Christopher JB, Le May A, Lewin S, Ross DA. Thirty years after Alma-Ata: a systematic review of the impact of community health workers delivering curative interventions against malaria, pneumonia and diarrhoea on child mortality and morbidity in sub-Saharan Africa. *Hum Resour Health.* 2011;9:27. Medline:22024435 doi:10.1186/1478-4491-9-27
- 8 Chinbuah MA, Kager PA, Abbey M, Gyapong M, Awini E, Nonvignon J, et al. Impact of community management of fever (using antimalarials with or without antibiotics) on childhood mortality: a cluster-randomized controlled trial in Ghana. *Am J Trop Med Hyg.* 2012;87:11-20. Medline:23136273 doi:10.4269/ajtmh.2012.12-0078
- 9 Mugeni C, Levine AC, Munyaneza RM, Mulindahabi E, Cockrell HC, Glavis-Bloom J, et al. Nationwide implementation of integrated community case management of childhood illness in Rwanda. *Glob Health Sci Pract.* 2014;2:328-41. Medline:25276592 doi:10.9745/GHSP-D-14-00080
- 10 UNICEF. Community Case Management of Diarrhoea, Malaria and Pneumonia of Sick Children for Sub-Saharan Africa in 2010. Data Report of a Desk Based Survey of UNICEF Country Offices. Geneva: UNICEF; 2011.
- 11 George A, Young M, Nefdt R, Basu R, Sylla M, Clarysse G, et al. Community health workers providing government community case management for child survival in sub-Saharan Africa: who are they and what are they expected to do? *Am J Trop Med Hyg.* 2012;87:85-91. Medline:23136282 doi:10.4269/ajtmh.2012.11-0757
- 12 Marsh DR, Gilroy KE, Van de Weerd R, Wansi E, Qazi S. Community case management of pneumonia: at a tipping point? *Bull World Health Organ.* 2008;86:381-9. Medline:18545741 doi:10.2471/BLT.07.048462
- 13 Meessen B, Gilson L, Tibouti A. User fee removal in low-income countries: sharing knowledge to support managed implementation. *Health Policy Plan.* 2011;26 Suppl 2:ii1-4. Medline:22027914 doi:10.1093/heapol/czr071
- 14 Maes K. Examining health-care volunteerism in a food- and financially-insecure world. *Bull World Health Organ.* 2010;88:867-9. Medline:21076569 doi:10.2471/BLT.09.074120

- 15 Glenton C, Scheel IB, Pradhan S, Lewin S, Hodgins S, Shrestha V. The female community health volunteer programme in Nepal: decision makers' perceptions of volunteerism, payment and other incentives. *Soc Sci Med*. 2010;70:1920-7. Medline:20382464 doi:10.1016/j.socscimed.2010.02.034
- 16 Bennett S, George A, Rodriguez DC, Shearer J, Diallo B, Konate M, et al. Policy challenges facing integrated community case management in Sub-Saharan Africa. *Trop Med Int Health*. 2014;19:872-82. Medline:24750516 doi:10.1111/tmi.12319
- 17 Rasanathan K, Bakshi S, Rodriguez DC, Oliphant NP, Brandes N, Jacobs T, et al. Where to from here? Policy and financing of integrated community case management of childhood illness (iCCM) in sub-Saharan Africa. *J Glob Health*. 2014;4:020304. doi:10.7189/jogh.04.020304
- 18 Mason E, McDougall L, Lawn JE, Gupta A, Claeson M, Pillay Y, et al. From evidence to action to deliver a healthy start for the next generation. *Lancet*. 2014;384:455-67. Medline:24853599 doi:10.1016/S0140-6736(14)60750-9

# Spatial distribution and deployment of community-based distributors implementing integrated community case management (iCCM): Geographic information system (GIS) mapping study in three South Sudan states

Abigail Pratt, Martin Dale,  
Elena Olivi, Jane Miller

Population Services International, Washington  
DC, USA

**Aim** In late 2012 and in conjunction with South Sudan's Ministry of Health – National Malaria Control Program, PSI (Population Services International) conducted a comprehensive mapping exercise to assess geographical coverage of its integrated community case management (iCCM) program and consider scope for expansion. The operational research was designed to provide evidence and support for low-cost mapping and monitoring systems, demonstrating the use of technology to enhance the quality of programming and to allow for the improved allocation of resources through appropriate and need-based deployment of community-based distributors (CBDs).

**Methods** The survey took place over the course of three months and program staff gathered GPS (global positioning system) data, along with demographic data, for over 1200 CBDs and 111 CBD supervisors operating in six counties in South Sudan. Data was collated, cleaned and quality assured, input into an Excel database, and subsequently uploaded to geographic information system (GIS) for spatial analysis and map production.

**Results** The mapping results showed that over three-quarters of CBDs were deployed within a five kilometer radius of a health facility or another CBD, contrary to program planning and design. Other characteristics of the CBD and CBD supervisor profiles (age, gender, literacy) were more closely matched with other regional programs.

**Conclusions** The results of this mapping exercise provided a valuable insight into the contradictions found between a program “deployment plan” and the realities observed during field implementation. It also highlighted an important need for program implementers and national-level strategy makers to consider the natural and community-driven diffusion of CBDs, and take into consideration the strength of the local health facilities when developing a deployment plan.

## Correspondence to:

Abigail Pratt  
Population Services International  
1120 19th St NW #600  
Washington, DC 20036, USA  
apratt@psi.org



## SOUTH SUDAN SITUATION ANALYSIS

South Sudan has one of the highest childhood mortality rates in the world, with an infant mortality rate of 105 per 1000 live births [1]. A large quantity of these deaths can be attributed to malaria, which is endemic in the region [1]. In addition, the 2010 South Sudan Household Survey found that two weeks prior to the survey, one third of children had been ill with fever, 34% had suffered from diarrhea, and 19% had suspected pneumonia [1].

Prevention and treatment of these illnesses is challenging. In 2010, only 6.3% of children under five received all recommended vaccines, and only about half of children under five with diarrhea received oral rehydration therapy or increase fluids with continued feeding [1]. In 2010, only 12.4% of children under five with malaria were treated with artemisinin-based combination therapy (ACT) [1]. Furthermore, many patients receive ineffective medicines and treatments that are not in line with national policy [1].

Protracted civil war in South Sudan has significantly reduced access to services and is an ongoing challenge. It is estimated that only half of the population has access to health care services, with most living more than 5 km from the nearest facility [1]. Transport is scarce, and in the rainy season, roads are often washed out, leaving areas of the country completely inaccessible for months of the year. Where health facilities do exist, the quality of services has been low due to frequent stock-outs of medicines, inadequate staffing and supervision, as well as a lack of appropriate equipment and supplies. Currently, literacy rates are very low (only 13.4% among women and 35.4% among men) [1] and have led to a shortage of trained professionals in all sectors, including health.

In February of 2009, the Ministry of Health and international partners developed the 'Implementation Guide for Community-Based Management of Malaria, Pneumonia and Diarrhoea – A Community Child Survival Program'. Integrated Community Case Management aims to dramatically improve the quality of the South Sudan community health program, through the mechanisms of improved case management of patients with fever, increased trust in both anti-malarials and community service providers as a result of official Ministry of Health endorsement, strengthening of links between communities and facilities, and reduction in unnecessary use of anti-malarials. Despite the challenges of implementation in a post-conflict setting, South Sudan is capable of upholding the same high quality standards for fever case management found in other malaria endemic countries.

At the heart of any iCCM program is the community health worker, referred to as community-based distributors (CBD) in the South Sudanese context. CBDs are commu-

nity-based volunteer health workers, nominated by their communities and incentivized through non-monetary channels locally and from implementing organizations. There is no minimum educational requirement, as the national literacy rate is extremely low, though all CBDs are required to attend a five-day training course on the key skills (identification of danger signs, classification of malaria, pneumonia and diarrhoea, treatment of the three diseases and prompt referral) [2]. General global guidance recommends a network of CBDs at a ratio of 20–25 CBDs to one supervisor, 1 CBD to roughly 40 households (approximately six people per household equals one CBD per 240 people) [3].

This cadre of worker has operated in South Sudan since 2006 and is relied upon not only in iCCM but also in other strategy documents such as the Home Health Promoters policy. The CBD work force in South Sudan at the time of mapping, was roughly 13 000 strong [4], across eight states with Global Fund support and guidance from implementing agencies including PSI, Malaria Consortium, Save the Children, International Rescue Committee, Catholic Diocese of Torit and the Bangladeshi organization, BRAC.

There is an important link between the community and the public health facilities that must be strengthened and fostered when operating an iCCM intervention. Community ownership and engagement with the CBD will not only improve the quality of treatment through improved feedback mechanisms and quality of care oversight, but can also help lower attrition rate [5]. The facilities need to manage and supervise CBDs within their catchment area to ensure the movement of both commodities and data, in order to avoid gaps in service. As evidenced by the WHO, "*comprehensive CHW subsystems can be deployed across sub-Saharan Africa at a cost that is modest compared with the projected costs of the primary-health-care system. Given their documented successes, they offer a strong complement to facility-based care in rural African settings.*" [6].

This paper describes the trial of a low-cost mapping and monitoring system, not currently reliant on mobile health or high-tech solutions, though it is the first step in the direction of more complex mobile Health (mHealth) interventions, incorporating District Health Information System (DHIS2) or similar data warehousing software and analytic tools. A similar survey was conducted in Malawi to map their Health Surveillance Assistants [7], supporting the method and findings described here. This mapping exercise indicates that this type of program could be replicated in other parts of the world to aid in the appropriate and equitable distribution of health services, particularly at the community level, and could be used as a program management tool to monitor for continuous improvement, program coverage, and impact.

The mapping exercise was conducted with five main goals in mind. The primary goal was to assess geographical coverage of the PSI's iCCM program and consider scope for expansion. This would enable implementers to conduct a gap analysis based on both quantitative data and visually mapped points. Second, the pilot would assess the extent to which the iCCM program complements health facility service provision (ie, positioning of CBDs in relation to facilities). In South Sudan, iCCM exists for communities in remote areas without easy access to health facilities, and it is extremely important not to create parallel systems and duplicate the public health service delivery. Third, the exercise would produce a physical map to assess the CBD supervision from a spatial perspective, focusing on distances covered by supervisors during support visits, drug supply and data collection. Fourth, the mapping would enable spatial analysis of program data, and potentially allow for the linking of the ministry DHIS with community-based geographic information system (GIS) maps. The fifth and final goal of the exercise was to gather important base data on existing CBDs and CBD supervisors (CBDS) to inform the recruitment of new CBDs and potential redeployment of existing providers – including information about age, gender and education. Save the Children conducted a thorough endline mortality survey in South Sudan which included significant demographic data but did not include mapping as a program management tool.

## METHODS

### Mapping design

In late 2012, PSI used GPS units and GIS software to map the location of 1275 CBDS and 111 CBD Supervisors, trained to conduct classification, treatment and referral services, in their communities. 119 health facilities in these areas were also mapped. 18 PSI iCCM Field Officers (FOs) were trained on the use of the data collection forms and GPS units and were responsible for the mapping of programming in six counties – Yei, Lainya, Morobo, Mundri East, Mundri West, and Wau. Field data was collected over the course of three months and because the exercise was initially designed for programmatic use, all CBDs/CBD supervisors were mapped (no sampling frame required). The only requisite inclusion criteria were that the CBDs had been trained by PSI during the life of the project.

A simple data collection form was developed to capture base data on CBDs and CBD supervisors (age, gender, education/literacy and GPS coordinates). Health facilities operating within the iCCM program were also mapped. The aim was not to measure program effectiveness or impact, but rather to paint an accurate picture of the geographical scope of the program, a foundation upon which to overlay program data.

FOs were trained in the use of GPS devices, the data collection tool, and appropriate engagement techniques with CBDs during the mapping exercise. FOs were expected to move to the CBDs, in order to alleviate any observation bias, and so that CBDs were not expected to alter their regular schedules.

Each Field Officer was assigned the task of mapping CBDs, CBD supervisors, and health facilities within their catchment area (mapping activity combined with supervision activity to minimise costs). Once data points and demographic information had been captured, FOs were responsible for cleaning the data and exporting it to the monitoring and evaluation team. From there, the coordinates were compiled in the ArcSoft software and saved as a layer of points in .dxf format, which was then converted into a shape file that was superimposed over the map file. Data collected was quality assured, input into an Excel database, and subsequently uploaded to GIS for spatial analysis and map production.

Ethical approval was not required, however the Ministry of Health, via the National Malaria Control Program was involved in study design and rollout, as GPS mapping in South Sudan requires approval.

## RESULTS

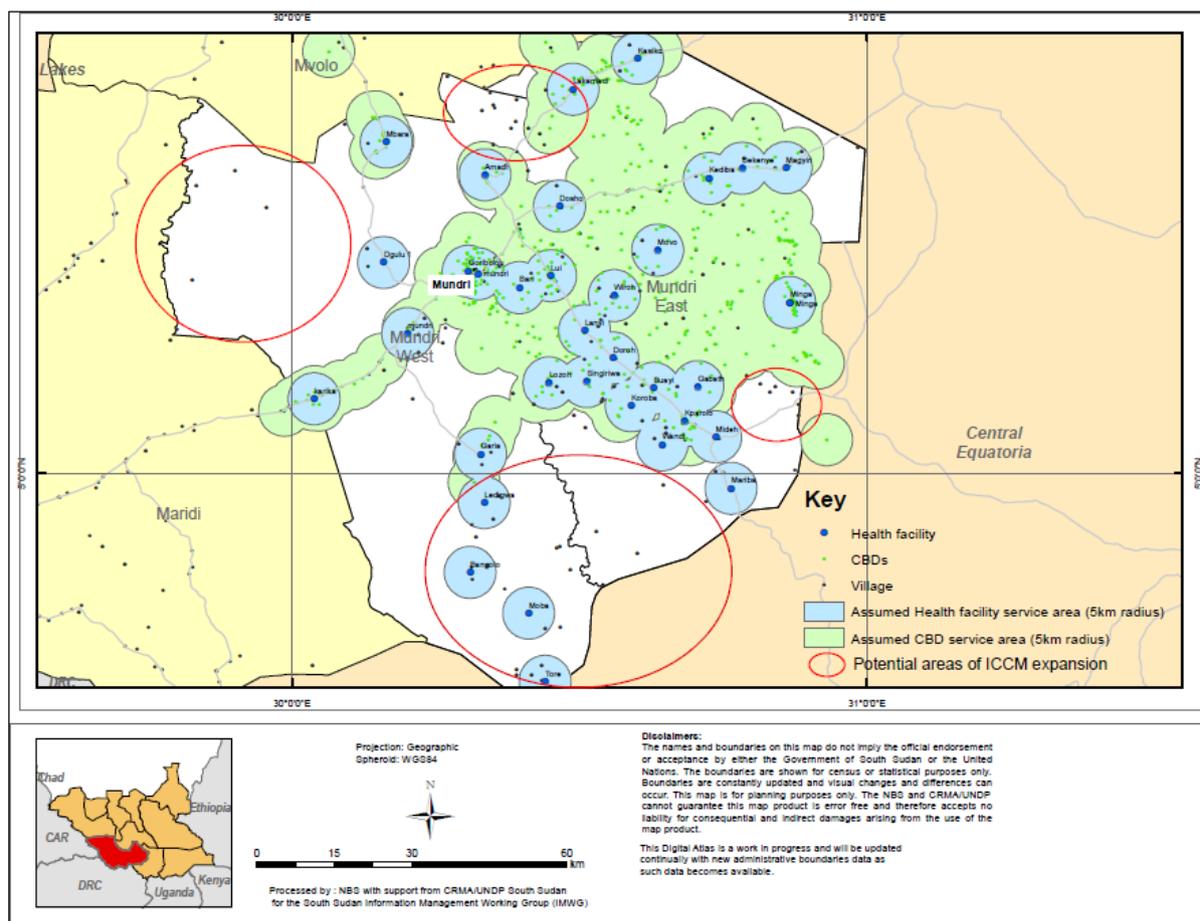
### Key findings

This exercise resulted in three county-level maps (**Figures 1 to 3**) pinpointing the positioning of CBDs and health facilities in project areas. The maps indicate CBD clustering near health facilities, where green and blue circles overlap. A significant proportion (69%) of CBDs are positioned within 5 km of health facilities. 79% in Western Bahr el-Ghazal (Wau); 58% in Western Equatoria (Mundri East and Mundri West); 77% in Central Equatoria (Yei, Morobo, and Lainya). The maps also highlight areas for potential expansion or reallocation of CBDs to areas designated as “underserved”.

A total of 1275 out of 1316 active CBDs were mapped between October and December of 2012 (**Table 1**). Mapping each CBD in their homes took longer than anticipated, due to standard challenges with roads and access, but 97% of CBDs were mapped along with all 111 active CBD supervisors, and all 119 referral facilities, 107 of which had a building and staff and were considered “operational”.

### Maps

Each map generated depicts one of the three states in which the program operates. Counties within the state not covered by PSI's iCCM program are shaded in yellow, and bor-



**Figure 1.** iCCM mapping: Mundri East and West Counties, Western Equatoria.

dering states are shaded in orange. The maps pinpoint CBDs and health facilities, surrounded by shaded 5 km catchment areas (green and blue respectively), and villages are similarly mapped. The maps indicate large swaths of the counties that are not currently covered by CBDs, demarcated in red. The mapping exercise also resulted in the identification of villages in the catchment area that were no longer occupied, which were recorded in the pilot findings but excluded from the maps.

**Figure 1**, with the map of Western Equatoria, shows comparatively complete coverage of inhabited areas, and less

overlap of facility and CBD catchment areas. There are a number of villages in the northwest and southeast of Mundri West that should show increased CBD coverage. Figures 2 and 3 show a more clustered deployment of CBDs and areas of significant overlap, particularly in Western Bahr el-Ghazal.

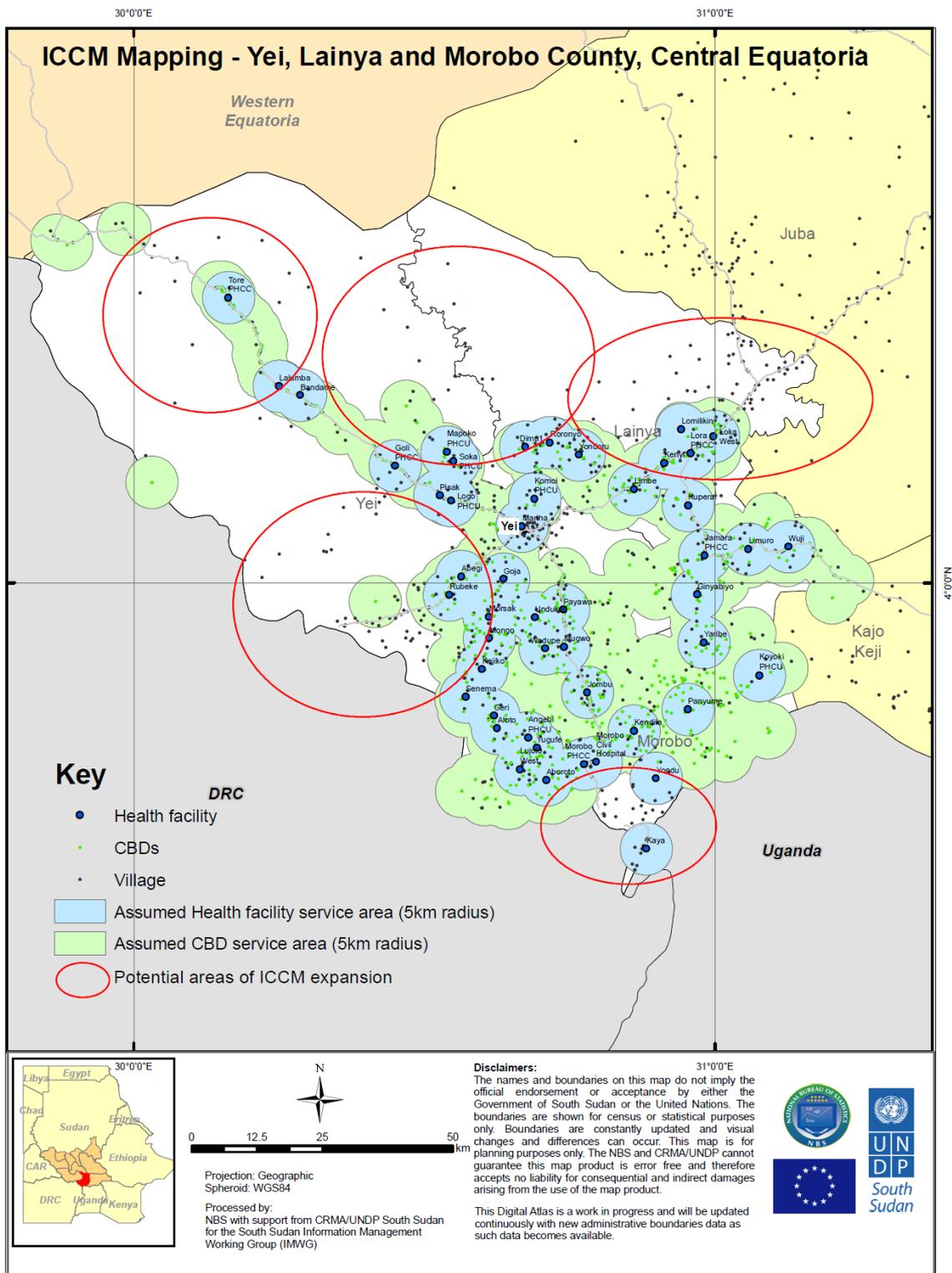
### Gender distribution of CBDs and CBDSS

**Figure 4** demonstrates that two thirds of the CBDs surveyed are women. This is in line with the standardized recommendations in South Sudan, as women are the primary

**Table 1.** Mapping of community-based distributors (CBD) quantities across three program areas

	CENTRAL EQUATORIA	WESTERN EQUATORIA	WESTERN BAHR EL-GHAZAL	TOTAL
Number of CBDs mapped	646	539	90	1275
Number of CBDs not mapped	29	10	2	41
Total CBDs	675	549	92	1316
Number of mapped CBDs within 5 km of HFs	499	310	71	880
Assumed number of unmapped CBDs within 5 km of HFs	22	6	2	30
Total number of CBDs within 5 km of HFs	521	316	73	910
% of mapped CBDs within 5 km of HFs	77%	58%	79%	69%

HF – health facility



**Figure 2.** iCCM mapping: Yei, Morobo and Lainya Counties, Central Equatoria.

caregivers and most often remain in or close to the home. There are a few areas, such as Lainya, where the gender distribution is more balanced.

**Figure 5** shows that only 10% of CBD supervisors are female. The role of the CBD Supervisor includes a number of responsibilities beyond those required of the CBDs. su-

pervisors are required to move long distances between CBDs for support supervision visits, either by foot, by bicycle and occasionally by motorbike. Supervisors are responsible for the quality assurance of CBD patient assessments and reporting, the latter requiring strong literacy skills. The supervisors are also salaried, in this particular

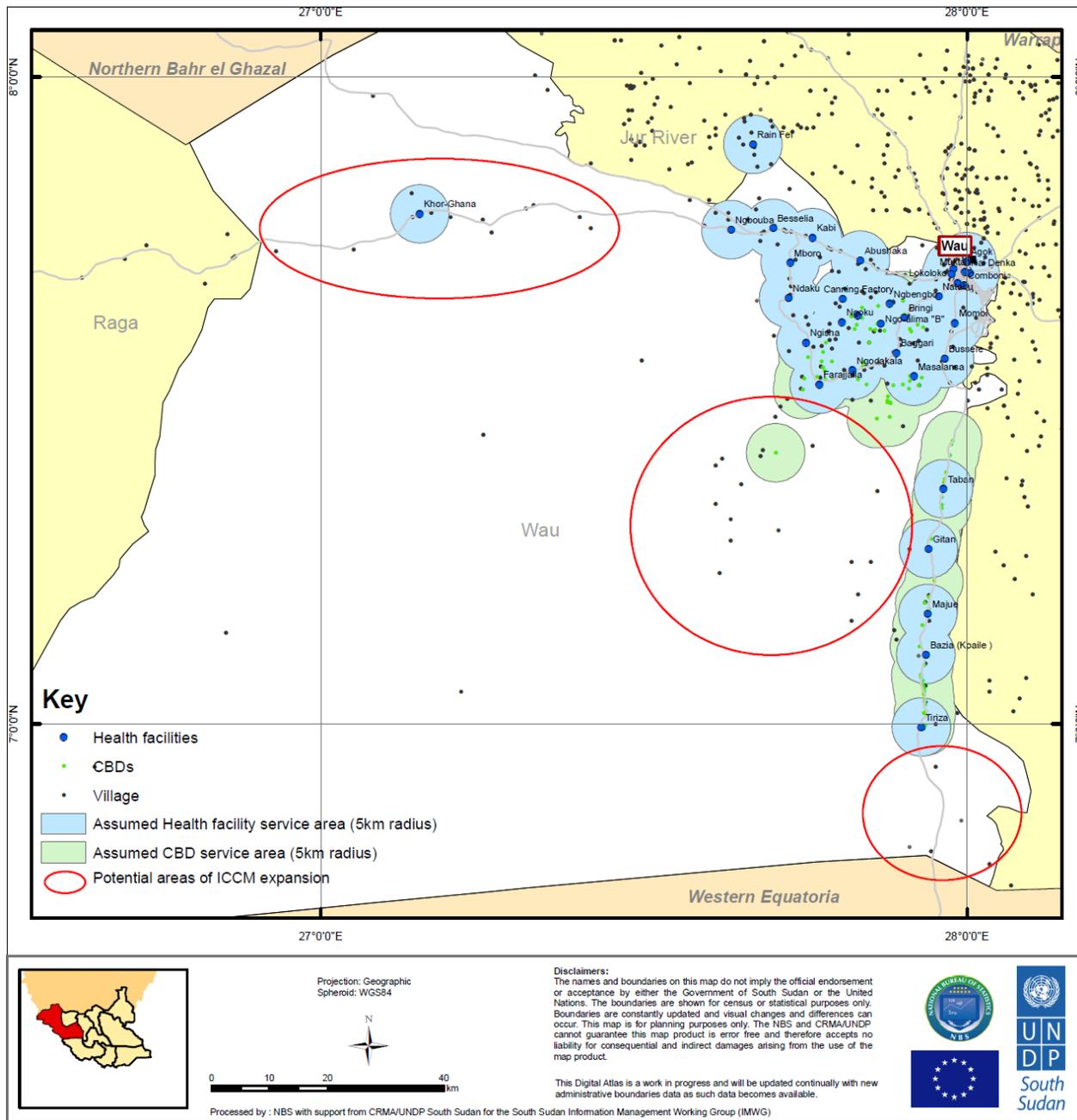


Figure 3. iCCM mapping: Wau County, Western Bahr el-Ghazal.

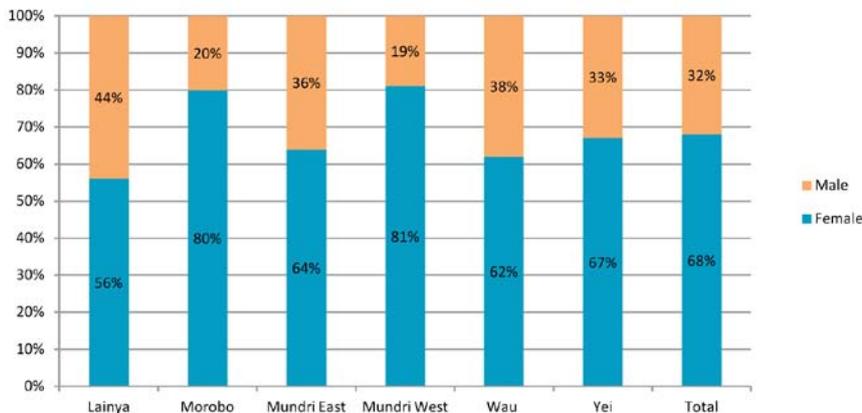


Figure 4. Ratio of male to female CBDs operating in the program areas.

instance, and it makes the position more competitive. There are also strong cultural considerations that impact this specific gender ratio. All of these different components seem to draw younger men into the position, though the feasibility of improving the gender balance should be explored prior to recruitment of new supervisors.

### Age, education and literacy

While there is no specific guidance for the optimal age cohort of CBDs, this

study found that the average age is between 26–35 years, given that there is a higher rate of attrition in the younger cohort, and the older cohorts tend to be of lower literacy. This age range also corresponds with some of the more mature mothers, (ie, women who have had experience as caretakers or who have been trained in other health areas). Supervisors show a similar age profile.

While the focus of this research was spatial deployment of health workers, it is interesting to note that at least four out of five CBDs have been exposed to some level of education, higher than originally suspected. Training, assessment skills and recordkeeping have been tailored for low-literacy adults with minimal traditional education. Literacy rates are nearly 70% in five out of the six counties implementing iCCM activities. The low literacy rates reported in Wau have been flagged, as supervision visits should reflect increased support given that these CBDs may struggle to complete patient registers. Over three quarters of CBD supervisors have some degree of secondary education, as per the minimum requirement during recruitment. CBDs are occasionally promoted to supervisors without meeting this requirement, based on performance.

## DISCUSSION

The Results outlined the pilot findings, highlighting overlaps in programming and suggesting inefficiencies, but the essential next steps involve understanding how these factors impact program outcomes, and tailoring program design and implementation.

### Resulting management actions

In early 2013, PSI South Sudan took decisive management action in response to the high density of CBDs operating within the 5 km catchment area of public health facilities and other CBDs. The proposed response was a downsizing of CBDs in overlapping areas, from 69% to 49%, which freed up available funding to expand into underserved areas. Because the mapping research was aimed at improved CBD deployment, the results were used to make concrete management decisions to expand coverage through three principle steps.

The first step was the identification of superfluous CBDs for dismissal. This decision was based on a two-pronged strategy involving central-level analysis and a more nuanced performance-based field analysis. The centralized

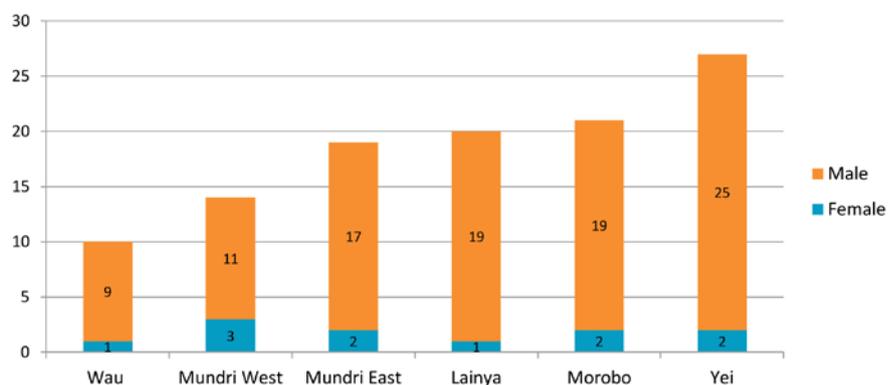


Figure 5. Ratio of male to female CBD supervisors operating in the project areas.

analysis included the use of an algorithm that took into account mapped CBD clustering, geographical overlap with operational health facilities and the caseloads of individual CBDs. This algorithm resulted in a list of CBDs for potential dismissal from the program. The field-based analysis took a closer look at facility service provision in catchment areas (for example hours of operation, continuity of supply, staffing capacity) as well as the capacity of CBDs to perform the required tasks and report in a timely manner. These ground-level considerations enabled the short-listing of low-performing CBDs for dismissal. The two lists were compared and a list of 72 CBDs was drawn up.

The second step was to hold sensitization meetings with communities that had excess CBDs, or CBDs that were clustered too close to the health facilities, to explain to them that those CBDs would be dismissed and that new CBDs would be selected in areas with greater need.

The final step in the reallocation and redistribution process was the dismissal of those 72 CBDs and the recruitment, training and deployment of 150 new CBDs (Table 2). The intention was to ensure more appropriate distance between independently operating CBDs and from the health facilities. These new CBDs were recruited based on county migration maps, highlighting occupied villages without essential health services.

### General analysis of findings

This mapping exercise and subsequent redeployment intervention raised several critical issues and challenges associated with planning and implementation.

**Proximity of CBDs to health facilities – complementing or competing?** Standard iCCM programming encourages close supportive links between CBDs and their referral Health Facilities. In a mature system, CBDs are supported entirely by the corresponding Health Facility through training, re-supply and data exchange. In the fledgling South

**Table 2.** Redistribution of community-based distributors (CBDs) following mapping exercise

	CENTRAL EQUATORIA	WESTERN EQUATORIA	WESTERN BAHR EL-GHAZAL	TOTAL
Total CBDs	675	549	92	1316
Proposed allocation of new CBDs	150	115	35	300
Total incl. new CBDs	825	664	127	1616
% of all CBDs within 5 km of HFs if new CBDs are outside HF coverage	60%	47%	56%	54%
Proposed reduction in CBDs within 5 km of HFs	72	30	10	112
% of all CBDs within 5 km of HFs	52%	42%	48%	48%

HF – health facility

Sudanese system, non-governmental organizations have stepped in as needed, to bridge the two service provision levels. This mapping exercise has indicated that 69% of PSI's CBDs were operating within the 5 km catchment area of a functional health facility (HF), clearly visible on the maps. Through the comparison of proximity to health facility, functionality of the facility itself (operational hours, staffing, and caseload data) and CBD caseload data, program managers can get a sense of the complementary or competitive nature of the CBDs.

Anecdotally, CBDs were reporting a high incidence of referral from Health facilities, known as 'reverse referral'. For example, facilities were documenting cases of fever and referring caregivers to CBDs operating in the surrounding areas, as stocks of ACTs and RDTs at facilities were low. The phenomenon highlights the need for national level supply chain support and analysis, to identify breaks or bottlenecks in the system and generate solutions or means to fill this gap. CBDs are meant to extend the reach of the public health system, not replace the existing structures. Continued reliance on donor-funded community-based health providers also raises the important question of sustainability.

**Volunteer selection process.** The CBD nomination or voluntary process also appears to contribute to the geographical clustering. While involved in the preparation and sensitization surrounding the CBD selection process, PSI Field Officers do not select, approve or disqualify CBDs that have been chosen or put forward by the community. According to the guidelines, CBDs are volunteers, endorsed by the community as respected, upstanding and primarily stationary members. Women are encouraged to participate as CBDs, though this is not always reflected in the CBD cadre.

Because the program is community-based and community-led, there is always uncertainty as to whether or not volunteer nomination will adhere to selection criteria. The findings here demonstrate that while the majority of personal characteristics match the desired profile, the physical location of these CBDs and their relative proximity to a health facility is not a disqualifying factor. This begs the question, is there a requirement to redeploy/reallocate CBDs, or is the need being adequately met, and the recommendations should include a greater degree of flexibility?

The visual mapping of CBDs indicates that coverage by community health programming is ultimately affected by local recruitment and selection/nomination proceedings. As recommended by Jacobs et al., "examination of an individual or household's ability to access services, and elements within the health sector or program that prevent uptake, [allows for the development] of context-appropriate improvements to the intervention and maximize coverage and uptake." [8]. This information about community access, paired with CBD/facility caseload data, would create a more thorough picture of the health system. Currently, it is difficult to know if the systems are supporting each other, dividing the work and providing triage, or if one or both sides are dysfunctional.

#### Underserved communities – where are all the CBDs?

The red circles on the maps indicate large swaths of each county that, at the time of mapping, were not supported by a CBD. This showcases a gap in program implementation and depending on the community needs, these villages should have been prioritized in the reallocation and subsequent round of CBD selection and training. This component of the exercise highlights the need for precise and comprehensive program planning, along with a strong coordinated effort from the county level health officials and the implementing partners. Improved coordination between these two groups can improve coverage of potentially underserved areas.

#### Mapping limitations

Outdated maps of states and counties of South Sudan mean scant information about the "operational status" of primary health care units and centers (including referral hospitals, hospitals, primary health care centers and primary health care units) as well as real-time land use by populations. It is also possible that some of the more traditional nomadic communities were not included in the mapping exercise, though every attempt was made to include these mobile groups. Population distribution at the time of the exercise relied on information from the South Sudan National Bureau of Statistics. This meant that repositioning/redeployment of CBDs required additional time, surveying and coordination to ensure that they were being chosen in the areas of greatest need.

Lessons learned and study methods from such a deployment case study are practical and useful for others wishing to conduct similar operational research, but it must be noted that results and conclusions may not be widely generalizable. GPS mapping can and has worked in other contexts, but regulations and policies developed as a result need to be tailored to the area of operation.

## Challenges

The programmatic decision to reduce CBDs in some areas, and increase in other areas was highly sensitive, despite the clear inequity in access, imbalance in CBD density, redistribution of resources, and potential to improve the quality of programming. Re-deployment also meant the training of new CBDs, establishment of new relationships with health facilities and this may have been interpreted as a step backwards programmatically, despite improvements to the quality of the program.

The current political situation also presents challenges to the continuation of many public health programs, including iCCM. Although these community-based programs are the principle mechanism of reaching remote and underserved areas, they rely heavily on the national supply chain for commodity management, in addition to program implementing agencies for funding and monitoring. Internal displacement and high rates of attrition add to the challenges of this already complex program.

## Recommendations

**mHealth solutions.** This initial mapping exercise was the first step in shifting towards a more advanced and practical data management system. Further down the line, as mobile network coverage improves across the country, it will be feasible to create a mobile health (mHealth) system that collects caseload data instantly from CBDs. This data can be sent to a centralized server by SMS and seamlessly uploaded into DHIS2, where constant monitoring can alert implementing teams, as well as national level decision makers, to make evidence-based policy and action plans.

The mapping of CBD and use of mapping technology fits in very nicely with other mHealth programming, particularly in the areas of data access and monitoring and compliance [9]. When paired with a Quality Assurance component, generated through Provider Assessments, it also has the potential to empower PSI Field Officers to

monitor providers' performance and allocate supportive supervision according to need as opposed to a generic schedule.

### Improved quality of programming through retention.

Quality Assurance programming should be implemented and management decisions should be driven by caseload data and quality of care provided by the CBD. Program quality can also be improved by maintaining the strong individuals among the CBD and CBD Supervisor cadre through varying types of motivation. Young men are primarily CBD supervisors, and yet they often leave the cadre in search of higher paying work, to the detriment of the program.

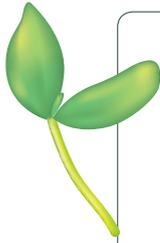
## CONCLUSION

The results of this mapping exercise provided a valuable insight into the contradictions found between a program "deployment plan" and field implementation. It also highlights an important need for program implementers and national-level strategy makers to consider the natural and community-driven diffusion of CBDs, and take into consideration the strength of the local health facilities when establishing catchment areas.

The results from this mapping exercise demonstrate that the process can be employed as a low-cost management tool for the distribution and deployment of community health workers or health services, for many different disease areas in addition to malaria, as it simple to use, affordable and accessible through different global funding sources, and it can aid in both effective implementation and planning.

The system can improve allocation of scarce resources, and with additional technology and quality assurance measurements, it increases the ability to "keep" high performing CBDs and CBDs that are valued in the community for providing a quality service to their patients.

Additional research and funding will be required to go to scale in South Sudan, but there are organizations investing heavily in building the capacity of the community health worker, by equipping them appropriately, using adult training techniques and providing a network of supportive supervision and continuous training that will give CBDs the confidence to do their jobs well.



**Acknowledgements:** The authors greatly appreciate the support and operational involvement of the Ministry of Health, South Sudan and particularly the efforts of the National Malaria Control Program. The authors thank colleagues at PSI, namely the fifteen Field Officers who single-handedly mapped all CBDs and the iCCM consortium in South Sudan for their contributions to the success of Global Fund grant. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the key informants, partners or reviewers.

**Funding:** This work was funded by the Global Fund to Fight AIDS, Tuberculosis and Malaria. AVP, MD, EO and JM were employed by PSI during the implementation of this pilot program.

**Ethical approval:** Not required.

**Authorship declaration:** AVP, MD, and EO provided pilot study ideas, implemented the project, managed the program overall, and provided critical input required for the final version of the article. MD assembled developed the mapping criteria and conducted the spatial analysis and maps. EO developed the tables. AVP wrote the paper with guidance and input of JM.

**Competing interests:** The authors declare no financial relationships with any organizations that might have an interest in the submitted work in the previous 36 months; and no other relationships or activities that could appear to have influenced the submitted work; apart from that declared under Funding.

## REFERENCES

- 1 Ministry of Health, Government of the Republic of South Sudan, a South Sudan Commission for Census, Statistics and Evaluation. 2010 South Sudan Household Health Survey. Available at: <http://www.southsudanembassydc.org/PDFs/others/SHHS%20I%20Report%20Final.pdf>. Accessed: 1 October 2014.
- 2 Ministry of Health. South Sudan. The Basic Package of Health and Nutrition Services in Primary Health Care. Juba, South Sudan: MOH, 2011. p. 60.
- 3 World Health Organization, United Nations Children's Fund. WHO/UNICEF Joint Statement on integrated community case management: An equity-focused strategy to improve access to essential treatment services for children. New York: UNICEF, 2012. p. 8. Available at: [http://www.unicef.org/health/files/iCCM\\_Joint\\_Statement\\_2012.pdf](http://www.unicef.org/health/files/iCCM_Joint_Statement_2012.pdf). Accessed: 1 October 2014.
- 4 Global Fund. Performance Framework Targets, South SUD-708-G09-M Phase II PE PSI – South Sudan Principle Recipient, March 2011. Geneva: Global Fund, 2011.
- 5 Strachan DL, Källander K, Ten Asbroek AH, Kirkwood B, Meek SR, Benton L, et al. Interventions to improve motivation and retention of community health workers delivering integrated community case management (iCCM): stakeholder perceptions and priorities. *Am J Trop Med Hyg.* 2012;87(5 Suppl):111-9. Medline:23136286 doi:10.4269/ajtmh.2012.12-0030
- 6 McCord GC, Liu A, Singh P. Deployment of community health workers across rural sub-Saharan Africa: financial considerations and operational assumptions. *Bull World Health Organ.* 2013;91:244-53B. Medline:23599547 doi:10.2471/BLT.12.109660
- 7 Nsona H, Mtimuni A, Daelmans B, Callaghan-Koru JA, Gilroy K, Mgalula L, et al. Scaling up integrated community case management of childhood illness: update from Malawi. *Am J Trop Med Hyg.* 2012;87(5 Suppl):54-60. Medline:23136278 doi:10.4269/ajtmh.2012.11-0759
- 8 Jacobs B, Ir P, Bigdeli M, Annear PL, Van Damme W. Addressing access barriers to health services: an analytical framework for selecting appropriate interventions in low-income Asian countries. *Health Policy Plan.* 2012;27:288-300. Medline:21565939 doi:10.1093/heapol/czr038
- 9 Källander K, Tibenderana JK, Akpogheneta OJ, Strachan DL, Hill Z, ten Asbroek AH, et al. Mobile health (mHealth) approaches and lessons for increased performance and retention of community health workers in low- and middle-income countries: a review. *J Med Internet Res.* 2013;15:e17. Medline:23353680 doi:10.2196/jmir.2130

# Training, supervision and quality of care in selected integrated community case management (iCCM) programmes: A scoping review of programmatic evidence

Xavier Bosch–Capblanch<sup>1,2</sup>  
 Claudine Marceau<sup>3</sup>

<sup>1</sup> Swiss Tropical and Public Health Institute, Basel, Switzerland

<sup>2</sup> University of Basel, Basel, Switzerland

<sup>3</sup> Freelance consultant, attached to the Swiss Tropical and Public Health Institute, Basel, Switzerland

**Aim** To describe the training, supervision and quality of care components of integrated Community Case Management (iCCM) programmes and to draw lessons learned from existing evaluations of those programmes.

**Methods** Scoping review of reports from 29 selected iCCM programmes purposively provided by stakeholders containing any information relevant to understand quality of care issues.

**Results** The number of people reached by iCCM programmes varied from the tens of thousands to more than a million. All programmes aimed at improving access of vulnerable populations to health care, focusing on the main childhood illnesses, managed by Community Health Workers (CHW), often selected by communities. Training and supervision were widely implemented, in different ways and intensities, and often complemented with tools (eg, guides, job aids), supplies, equipment and incentives. Quality of care was measured using many outcomes (eg, access or appropriate treatment). Overall, there seemed to be positive effects for those strategies that involved policy change, organisational change, standardisation of clinical practices, and alignment with other programmes. Positive effects were mostly achieved in large multi–component programmes. Mild or no effects have been described on mortality reduction amongst the few programmes for which data on this outcome was available to us. Promising strategies included teaming–up of CHW, micro–franchising or social franchising. On–site training and supervision of CHW have been shown to improve clinical practices. Effects on caregivers seemed positive, with increases in knowledge, care seeking behaviour, or caregivers’ basic disease management. Evidence on iCCM is often of low quality, cannot relate specific interventions or the ways they are implemented with outcomes and lacks standardisation; this limits the capacity to identify promising strategies to improve quality of care.

**Conclusion** Large, multi–faceted, iCCM programmes, with strong components of training, supervision, which included additional support of equipment and supplies, seemed to improve selected quality of care outcomes. However, current evaluation and reporting practices need to be revised in a new research agenda to address the methodological challenges of iCCM evaluations.

## Correspondence to:

Xavier Bosch–Capblanch  
 Swiss Tropical and Public Health Institute  
 Socinstrasse 57  
 Basel, Switzerland  
 x.bosch@unibas.ch

It is widely recognized that there are effective interventions to prevent, detect, control and manage the most common diseases in poorly developed contexts, such as those affecting children in low- and middle-income countries [1]. However, it is equally acknowledged that the delivery of these interventions is severely hampered by rudimentary or decayed health systems, where essential dimensions of quality of care, such as availability, access and utilisation of services [2], are hardly fulfilled [3].

Innovative approaches do exist to address health care delivery faults, ultimately aiming at addressing quality of care shortcomings. The Integrated Community Case Management (iCCM) promoted by the World Health Organisation (WHO) / United Nations Children Fund (UNICEF) [4], encompasses a series of strategies and activities taking health care closer to communities. In this approach, Community Health Workers (CHW) typically serve as the first point of contact between communities and services.

As any other intervention or strategy, iCCM programmes have to be tested or evaluated in order to describe successes, failures and factors related to them. Rigorous research evidence on the effects of iCCM is scanty [5,6]. Furthermore, iCCM programmes often encompass multiple components which complicates their evaluations. Often, evidence on iCCM programmes has to come from programmatic documents supported by operational research of varying quality.

The aims of this article are to report on the components of selected iCCM programmes and to draw lessons learned from existing evaluations of those programmes, through a scoping literature review of programmatic documentation. We will not attempt to estimate or synthesise the effects of iCCM interventions in primary or secondary programmatic or health-related outcomes, but will provide illustrative examples.

## METHODS

A scoping, structured literature review of programmatic information evidence was carried out. 'Structured review' refers to a review of the literature which pragmatically adapts standard systematic reviews' methodology, such as the one used for Cochrane Review [7], yet remains transparent in relation to its methods and rationale for adaptations. This review was based on documents provided by stakeholders since UNICEF defined the focus and scope of the review. Outcomes were only generically predefined as human resources and quality of care related outcomes.

Included documents referred to programmes reported by selected partners proposed by UNICEF. There were no restrictions based on the types of documents, types of stud-

ies or types of evidence within them. Quality of evidence was no formally assessed and therefore there were no exclusions based on this criterion. However, three levels of quality of evidence were defined to support the interpretation of findings on the effects of the programmes: low quality when the source of evidence was based on qualitative data or opinions; moderate quality when quantitative methods were used and described in the source documents; and high quality when findings were presented with some measure of statistical significance ('+', '++' and '+++', respectively).

Twenty nine programmes were proposed and provided by UNICEF and partners. Three types of data were extracted: (a) features describing the programmes (eg, name, funding, objectives, time frame); (b) programme tools highlighted as promising approaches to improve health care; (c) evidence on the effects of tools and approaches. This information was synthesised across programmes into two thematic areas: human resources and quality of care (only the latter is reported in this article).

Descriptions of iCCM programmes and their features are presented narratively and, where data are available, quantitative information is also included in the text or as tables. Due to the large variability in the amount and in the types and quality of evidence across iCCM programmes, no attempt has been made to carry out meta-analyses of quantitative estimates across iCCM programmes. References to particular iCCM programmes are made within brackets with the terms used in the documents and the country names as appropriate.

There was no overreaching quality of care framework across all programmes and authors accepted an estimate or an indicator to be related to quality of care if it referred to the events in the delivery of care (from availability of care to effective coverage) and health related outcomes. Since this is not a review on the effects of iCCM interventions, we have selected only some indicators best related to quality of care or serving as illustrative examples, from the very large amount of indicators reported in some programmes.

## RESULTS

### Overview of iCCM programmes' objectives and strategies

A total of 29 iCCM programmes were included in this review. All programmes were implemented in African countries, but one, in Myanmar. **Table 1** lists the included programmes alongside the main implementing organisation, partners and programmes' start and end years. The documentation scrutinised referred to programmes or phases

**Table 1.** Programmes included in the review, partners and duration

PROGRAMME REFERENCE	MAIN ORGANISATION	PARTNERS	YEAR START	YEAR END
CHW Backpack Plus	Frog	UNICEF; MDG; Save the Children	2013	2013
Concern Burundi	Concern; USAID;	MOH National Malaria Program (PNILP), WHO, UNICEF, the Global Fund, Pathfinder/MSH, and World Relief	2012	NA
Concern Niger	USAID; Concern	NA	NA	NA
Concern Rwanda KabehoMwana	USAID; Concern	International Rescue Committee; World Relief; Health Grants Program	2006	2011
CORE group	CORE	Plan; USAID; Save the children	NA	NA
CORE group – Cameroon	Plan	USAID; Child Survival and Health Grants Program (CSHGP)	2000	2008
CORE group – Malawi	World Relief	USAID	2000	2005
IRC Sierra Leone	International Rescue Committee	CIDA (funding)	2005	NA
Living Goods Uganda	Living Goods	BRAC	2006	2013
MC South Sudan	Malaria Consortium	UNICEF; WHO; PSI; Save the Children; IRC; Catholic Diocese of Torit; BRAC	2010	2013
MC Uganda	Malaria Consortium	CIDA; MOH Uganda; UNICEF; WHO; ACCORDIA; Global Health Foundation; USAID	2010	2015
MOH Ethiopia	MOH Ethiopia	Johns Hopkins Bloomberg School of Public Health (IIP–JHU); iCCM evaluation: IIP–JHU, ABH Services, PLC	2011	2013
MOH Madagascar	MOH Madagascar	UNICEF; USAID/Santénet2 (SN2); Malaria National Strategic Application (NSA) Grant of the Global Fund for HIV/AIDS, TB and Malaria (GFATM)	2008	2013
MOH Malawi	MOH Malawi	Global Fund grant for scale-up; WHO/UNICEF Training material	2008	2011
MOH Mozambique	MOH Mozambique	Evaluation: UNICEF, USAID/TRAction, UEM and JHSPH. UNICEF, WHO, USAID, Save the Children and Malaria Consortium.	2012	2013
MOH Uganda	MOH Uganda	UNICEF; WHO; USAID	NA	2010
PSI Cameroon CIDA	CIDA; PSI	CIDA	2009	2013
PSI DRC CIDA	CIDA; PSI	NA	2009	2013
PSI Malawi CIDA	CIDA; PSI	2 other partners	2009	2013
PSI Mali CIDA	CIDA; PSI	NA	2009	2013
PSI Madagascar	PSI	NA	NA	2011
PSI Myanmar SPH Franchise	PSI/Myanmar	Global Health Group	2008	2010
PSI South Sudan	PSI	Global Fund and CIDA; IRC; Save the Children; Malaria Consortium	2009	2013
PSI Uganda Five & Alive Franchise	PSI	PACE	2010	2013
Save Malawi	Save the Children	CIDA; MOH; (for study: JHU, NSO, Save the Children); (for medicine: CIDA, Everyone campaign, Bank of America)	2009	2012
Save Mozambique	Save the Children	CIDA; INE Mozambique	2010	2012
Save South Sudan	Save the Children	Global Fund & CIDA	2009	2013
Save Zambia	Save the Children	NA	2008	2012
USAID BASICS DRC (tools only)	USAID/BASICS, the DRC, MOH	UNICEF, WHO, GTZ, IRC and MSH	NA	NA
IRC Ethiopia	IRC	NA	NA	NA
Last Mile Health Liberia	Tyaten Health	NA	NA	NA

CHW – community health worker, BRAC – Bangladesh Rural Advancement Committee, CIDA – Canadian International Development Agency, DRC – Democratic Republic Congo, GTZ – Deutsche Gesellschaft für Technische Zusammenarbeit, INE – Instituto Nacional de Estadística, IRC – International Red Cross, MC – Malaria Consortium, MDG – Millennium Development Goals, MOH – Ministry of Health, MSH – Management Sciences for Health, NSO – National Statistics Office, PNILP – Programme National Intégré de Lutte contre le Paludisme, PSI – Population Services International, SPH – Sun Primary Health, UEM – Universidade Eduardo Mondlane, NA – not applicable

ending between 2010 and 2013 (66% of programmes), two others were older (2005 and 2008), another one was ongoing (ending in 2015) and for the remaining seven dates were missing

All programmes shared a common objective, which had to do with increasing access to good quality health services by poor populations, with a special focus on infants' and children's diseases, through the deployment of CHW, im-

plementing Integrated Management of Childhood Illnesses (IMCI). 11 (40% of the 28 programmes with this information) included in their objectives morbidity and mortality targets (eg, 'Backpack plus', 'Concern Niger').

Basic clinical care was often complemented with other strategies (eg, 'Backpack plus', 'MC Sudan South'), such as policy influence or advocacy (eg, 'CORE-group'), health systems strengthening (eg, 'Concern Niger'), provision of

supplies and supply management (eg, 'MC Uganda'), good clinical practices (eg, 'MC Uganda') or improve data transmission (eg, 'Sizika'). The most common conditions addressed were, by far: malaria (or fever), diarrhoea and pneumonia (or respiratory symptoms), in children.

Programmes were often rooted in the communities themselves, but there were also examples where at least some services were integrated into the formal health sector at primary health care level (eg, 'MOH Ethiopia', 'MOH Mozambique', 'PSI Uganda').

The size of the programmes in terms of the number of population reached varied across programmes, phases within the same programme, population counted (ie, whole population or children of different age groups) and ways of measuring it (ie, as population in the catchment area or as population effectively treated). Median population (sometimes whole population, sometimes under-fives) was 304 245 (interquartile range: 108 484 to 536 616), ranging from a few thousands (eg, 'Concern Burundi' 37 379 children; 'CORE-Cameroon' 38 009 children) to the hundreds of thousands ('Save South Sudan' 125 035 children; 'PSI-Cameroon' 372 460 children; 'Concern Burundi' 310 129 vulnerable women; 'PSI Malawi' 304 245 children; 'IRC Sierra Leone' 605 981 population; 'PSI DRC' 636 000 population; 'PSI South Sudan' 722 708 population, 'Save Mozambique' 953 959 population); and beyond the million in 'Save Malawi' (1 435 219 population) and 'PSI Malawi' (2 336 255 population). In 14 programmes this piece of data was not retrievable. It is worth noting that studies evaluating iCCM strategies often used sub-samples of the covered population.

### Community health workers

CHW are at the core of iCCM. They are designated in different ways depending on the iCCM programme (Table 2). Names are in part descriptive of the functions CHW carry out but also respond to the names that may have been used in the past in certain countries (eg, Health Extension Workers in Ethiopian programmes). For the sake of clarity and simplification, we use the generic term CHW in this article.

Activities carried out in the programmes (mainly by CHW) could fall into two main groups as identified in the programmes documents:

- 1) provision of clinical care (with or without other components, such as health promotion and prevention);
- 2) provision of supplies, mainly medical supplies (eg, drugs), through social franchising schemes (eg, 'PSI Myanmar', 'PSI Uganda – Five & Alive', 'Living goods Uganda') or using regular procurement schemes

(Social franchising is the provision of affordable services by the non-profit health sector, complying with franchise stan-

dards targeting underserved communities [8]; micro-franchising refers to small scale entrepreneurship by CHW [9]).

Treatment conditions included: malaria, diarrhoea and respiratory diseases assessment and early treatment, conjunctivitis, malnutrition, new-born at risk, ear infections, sexually transmitted infections and HIV testing.

Health promotion and disease prevention focused on malaria, diarrhoea and respiratory diseases recognition and health seeking behaviours, immunisation, nutrition, water and sanitation, maternal and new-born care, reproductive health and family planning, breastfeeding, complementary feeding, insecticide treated nets, malaria preventive treatment, TB prevention and treatment.

CHW were selected using a wide range of different criteria. For example, the main cadres selected in 'CHW Backpack plus' were supervisors of primary care facilities. Some CHW had basic education (O-level graduates in 'CORE – Malawi'), or a minimum of five years of formal education ('MOH Madagascar'), grade 10 junior certificate ('MOH Malawi', 'Save Malawi'), minimal literacy with basic numerical competence ('MOH Mozambique', 'PSI Cameroon CIDA', 'PSI DRC CIDA', 'Save Mozambique') or even it might not be required any level of literacy ('IRC Sierra Leone'). Occasionally, eligibility criteria could include already being a CHW, Traditional Birth Attendant (TBA), drug distributors or alike, in order to become member of Villages Health Teams ('MOH Uganda'). In 'Concern Rwanda KabehoMwana' CHW selected themselves a cell coordinator. More rarely, CHW were staff from the MOH (eg, PSI Malawi CIDA, where the lowest rank of MOH employees are eligible).

CHW were selected by community members (10 programmes), community leaders (4 programmes), by the MOH (2 programmes), or by governments (1 programme) or NGOs (1 programme). In detail, CHW were selected by: MOH ('MOH Malawi'), communities (Community Based Distributors in 'IRC Sierra Leone'; 'MC South Sudan'; 'Save South Sudan'; by popular vote in 'MOH Uganda'), both ('PSI Cameroon CIDA'; in this case, though, the choice was made by their peers; 'Save Mozambique'), government ('Save Malawi'), or MOH and a local NGO ('PSI DRC CIDA', the final selection being made by the head nurse in collaboration with community leaders). In 'MOH Madagascar' most CHW were selected by their communities with some involvement of the traditional chieftaincy or the Community Health Committee. Involvement of villagers and chieftaincy was also reported in 'PSI Madagascar' and in 'PSI South Sudan'. In 'PSI Myanmar SPH Franchise' CHW were recruited among auxiliary midwives, already existing CHW, farmers, or from other areas of activity. Additional criteria included being residents in the villages they were meant to

**Table 2.** Designation of community health workers (CHW) as documented in the programmes

PROGRAMME	DESIGNATION OF CHW
CHW Backpack Plus	Community Health Worker
Concern Burundi	Community Health Worker Agents de Santé Communautaire
Concern Niger	Community Health Worker
Concern Rwanda KabehoMwana	Community health workers; Community Based Distributors
CORE group – Cameroon	Community Health Worker
CORE group – Malawi	Health Surveillance Associates
IRC Sierra Leone	Community Based Distributors
Living Goods Uganda	Sales Representatives or Health Promoters
MC South Sudan	Community Drug Distributors; Community Based Distributor ; Community Health Workers
MC Uganda	Village Health Team
MOH Ethiopia	Health Extension Workers
MOH Madagascar	Community Health Volunteers; Agents Communautaires
MOH Malawi	Health Surveillance Associates; Community Health Based Workers;
MOH Mozambique	Community Health Workers; Agente Polivalente Elementar; Traditional Birth Attendants
MOH Uganda	Village Health Team members
PSI Cameroon CIDA	Community relais
PSI DRC CIDA	Community relais
PSI Malawi CIDA	Health Surveillance Agents
PSI Mali CIDA	Community Relais
PSI Madagascar	Agent de Santé Communautaire
PSI Myanmar SPH Franchise	Sun Primary Health
PSI South Sudan	Community Based Distributors; front line workers; Home Health Promoters; Community Health Workers
PSI Uganda Five & Alive Franchise	Community-based Village Health Team
Save Malawi	Health Surveillance Assistants
Save Mozambique	Agente Polivalente Elementar
Save South Sudan	CBDs= Community Based Distributors
Save Zambia	Community Health Workers
USAID BASICS DRC (tools only)	Community Health Workers
IRC Ethiopia	Health Extension Workers

CIDA – Canadian International Development Agency, DRC – Democratic Republic Congo; IRC – International Red Cross, MC – Malaria Consortium, MOH – Ministry of Health, PSI – Population Services International, SPH – Sun Primary Health

serve ('PSI Cameroon CIDA', 'PSI DRC CIDA', 'Save Malawi', 'Save Mozambique') or being married ('PSI DRC CIDA'). Interestingly, there was some information on exclusion criteria (ie, candidates who were NOT eligible); eg, political leaders or those imposed by political leadership ('MOH Uganda').

The number of CHW involved was difficult to assess because depended on the time–span of the programme, the degree of scaling up and the different types of health care workers reached. **Table 3** shows the approximate number of CHW involved in the programmes, when available in the source documents (median 1441, interquartile range 732 to 2582).

Disaggregation by CHW gender was only possible for a few programmes. For example, in 'IRC Sierra Leone' (26% females and 74% males of 2207 trained CHW), 'MOH Ethiopia' and 'Save Mozambique' (all females in both programmes, 137 and 273, respectively), 'MOH Madagascar' (half females and half males, of 4800), 'PSI DRC CIDA' (4% females and 96% males of 748 CHW), and in 'Save Malawi' (25% females and 75% males of 838 CHW).

Programme documents described several types of incentives. The majority of incentives were goods and even work equipment and tools (9 of the 17 programmes with data, 53%). Only in Malawi did CHW receive proper salaries. Incentives also included intangibles such as recognition and reputation. In detail:

- 'incentives architecture', similar to a career path ('CHW Backpack plus');
- reputation and recognition: 'MOH Madagascar', 'PSI DRC CIDA'; increase in client flow using services ('PSI Uganda Five & Alive Franchise');
- performance-based financing mechanisms ('Concern Rwanda KabehoMwana', 'PSI Myanmar SPH Franchise');
- goods: soaps and batteries ('IRC Sierra Leone'); T-shirt ('Living Goods Uganda'); cap, T-shirt, torch, jerry cans, certificates, soap ('MC Sudan South'); bicycles and T-shirts ('MC Uganda'); bicycles, uniforms, T-shirts ('PSI Malawi CIDA'); cellphone ('PSI Mali CIDA'); sugar, salt, soap, bicycles, gumboots, clear bags and rain jackets ('PSI South Sudan'); cycles, stainless steel spoons, medicine cups, water cups, plastic medicine bags, basins and a wa-

**Table 3.** Number of community health workers (CHW) involved\*

PROGRAMME	NUMBER OF CHW
Concern Burundi	317
Concern Rwanda KabehoMwana	6100
CORE group – Malawi	2400 to 3060
IRC Sierra Leone	12 000
Living Goods Uganda	50 per district
MC South Sudan	715 to 1683
MC Uganda	5800 Village Health Teams, 800 CHW
MOH Ethiopia	137 under study; total 35 000
MOH Madagascar	4800
MOH Malawi	2709 to 10 000
MOH Mozambique	240
MOH Uganda	5 per village
PSI Cameroon CIDA	2454
PSI DRC CIDA	748
PSI Malawi CIDA	1639
PSI Mali CIDA	1936
PSI Myanmar SPH Franchise	1169
PSI South Sudan	1283
Save Malawi	838
Save Mozambique	273
Save South Sudan	1474
IRC Ethiopia	671

CIDA – Canadian International Development Agency, DRC – Democratic Republic Congo; IRC – International Red Cross, MC – Malaria Consortium, MOH – Ministry of Health, PSI – Population Services International, SPH – Sun Primary Health

\*Not all programmes reported information on this area.

ter container ('Save Malawi'); soap, jugs, spoons, jerry cans, pair of scissors, medicine bag, pens, lunch and transport during refresher trainings ('Save South Sudan');

- percentage of benefits: loan start-up bag with US\$ 60 worth of merchandise and 15% to 20% percent of whatever they sell ('Living Goods Uganda');
- per diem and allowances: for training ('MOH Madagascar'); for reporting ('PSI Cameroon CIDA'); travel allowance ('PSI DRC CIDA');
- cash: 1575 to 3150 South-Sudan pounds for staff; 'MOH Madagascar' (some CHW); 'PSI South Sudan'; 'Save Mozambique';
- salaries: 'MOH Malawi', 'Save Malawi'.

Besides, in some programmes, the training itself ('PSI Malawi CIDA') or certificates ('PSI Madagascar'), supervision ('PSI DRC CIDA'), supplies and working tools were mentioned as motivators or incentives to improve CHW performance ('MOH Uganda', 'PSI Madagascar').

### Training and supervision

Training schedules, length and approaches varied greatly across programmes. Table 4 details the length of training for those programmes which had this information avail-

able. Median training length was 2 weeks (interquartile range from 6 to 43 days), depending on the contents and competences to be achieved.

Training was mainly formal in 8 out of 15 programmes (53%) with information on this area. Other approaches were present in 1 or 2 programmes as detailed below: formal training courses or refreshments (eg, annual in Concern Rwanda KabehoMwana and IRC Sierra Leone; biannual in 'PSI Cameroon CIDA'; monthly in 'PSI DRC CIDA'; 'MC Uganda', 'Save Mozambique', 'MOH Ethiopia' or 'Save South Sudan'), mentorship programmes ('MOH Madagascar'), including both theory and practical on-the-job training (eg, 'CHW Backpack plus'). Other approaches included ('Concern Burundi'): interactive lessons where CHW learned to fill the tools and used their experience, exercises, demonstrations and role plays; similarly in 'MC South Sudan', 'PSI DRC CIDA'; or even practical cases in in-patient health facilities ('MOH Malawi', 'Save Malawi'). Only in 'PSI DRC CIDA' and 'PSI Mali CIDA' documentation it was mentioned that training was conducted using local languages as well.

Training focused on CHW but included other personnel as well (eg, health facility staff and district-level officials in 'Concern Niger'; caregivers in individual households in 'CORE-Malawi'); and might have the active involvement of

**Table 4.** Duration of training of community health workers (CHW)\*

PROGRAMME	TRAINING DURATION
Concern Burundi	3 weeks
IRC Sierra Leone	6 days
Living Goods Uganda	4 weeks
MC South Sudan	6 days
MC Uganda	5 days
MOH Malawi	10 weeks
MOH Uganda	6 days
MOH Ethiopia	1 year
MOH Madagascar	8 months
PSI Cameroon CIDA	3 days
CORE group – Malawi	8 weeks
PSI DRC CIDA	From 2 to 3 days (depending on type of CHW)
PSI Malawi CIDA	6 days to 10 weeks (depending on competences)
PSI South Sudan	6 days
Save Malawi	6 days to 12 weeks (depending on competences)
Save Mozambique	6 days to 4 months
Save South Sudan	7 days
USAID BASICS DRC	6 days

CIDA – Canadian International Development Agency, DRC – Democratic Republic Congo; IRC – International Red Cross, MC – Malaria Consortium, MOH – Ministry of Health, PSI – Population Services International

\*Not all programme reported information on this area.

supervisors in the training (USAID BASICS DRC). A cascade training approach was implemented in ‘Concern Burundi’ where MOH staff trained programme staff and the District Health Team, and then those trained CHW and health centre staff. In ‘MC Sudan South’, ‘MOH Uganda’ and ‘PSI DRC CIDA’ a cascade training was also implemented.

The contents of the training were mainly around clinical care; for example: to assess, classify, refer or treat sick children; to counsel the caretaker on home management follow up; to recognize and treat sick children aged 2 to 59 months with fever, diarrhoea, and pneumonia; to refer children to health facilities if they were less than 2 months, if they presented with illnesses other than fever, diarrhoea or pneumonia or if they showed any “danger signs”; if there were stock-outs, or if after treatment, the child’s condition failed to improve or worsened (IRC Sierra Leone). Similar skills were targeted in other programmes. Training included also the use of equipment (eg, respiratory timers in ‘MC Uganda’), Behaviour Change Communication (‘Concern Rwanda KabehoMwana’), reproductive health and family planning (‘MOH Madagascar’), managerial competences and supplies management (‘MOH Uganda’, ‘PSI Cameroon CIDA’, ‘PSI Malawi CIDA’) or gender based violence (‘PSI Malawi CIDA’).

Tools used in the training initiatives included full curriculums for clinical care, trainers-of-trainers manuals, facilitators’ guides, job aids, algorithms or lists of supplies. Two programmes explicitly reported that materials were based on WHO/UNICEF or MOH materials which were adapted to local situations (eg, ‘MC Sudan South’, ‘MOH Malawi’).

Supervision was designated or assimilated to several human resources management strategies (eg, managerial supervision, clinical supervision, mentorship). In some programmes, several cadres could be responsible for CHW supervision: for example, in ‘Concern Burundi’ supervisors included Concern staff, District Health Teams and health centre staff; in ‘MC Uganda’ included health centres’ staff, Community Development Officers, Health Assistants or Health Inspectors; senior CHW, environmental officer or community nurses (‘MOH Malawi’); community based Health Area focal points and Animateurs District CCM focal points (‘PSI Cameroon’); senior CHW, Environmental Health Officers or Health Facility Staff (mentors) (‘PSI Malawi’); senior CHW (routine supervision) and health centres’ clinical staff (clinical mentors) (‘Save Malawi’)

In other programmes, supervision was assigned to a single cadre: a community health in-charge (‘Concern Rwanda KabehoMwana’), a senior CHW (‘CORE Malawi’), health centre staff (‘IRC Sierra Leone’), programme officers (‘MC Sudan South’), nursing holders of health areas (‘PSI DRC’), or even community members (‘MOH Uganda’); centre technical director (‘PSI Mali’); field leader of township (‘PSI Myanmar’); CHW supervisors (‘PSI South Sudan’, ‘Save

South Sudan’); chief nurse (or medical technician) (‘Save Mozambique’, ‘USAID BASICS DRC’). No information data was available regarding the gender mix of supervisors.

Supervisors undertook a specific training, which ranged from two to nine days, in the six programmes where this information was available. Tools used included guidelines, checklists and training manuals.

The supervisors: CHW ratios varied: 1:2 (‘PSI Malawi’), 1:6 (‘PSI DRC’), 1:6 to 7 (‘Save Mozambique’), 1:8 to 16 (‘IRC Sierra Leone’), 1:10 (‘PSI Cameroon’), 1:11 (‘Save Malawi’) or 1:18 (‘Save South Sudan’).

The frequency of supervisory visits ranged from once a year to three times a month (‘PSI South Sudan’); although in some cases there are reports of CHW not having received a single supervisory visit (eg, ‘MOH Madagascar’). Meetings were also mentioned as supervision-like strategies in seven programmes (37% of the 19 programmes with this information available) (eg, ‘MOH Ethiopia’ with biannual meetings; ‘PSI DRC’ monthly monitoring meetings).

Supervision activities could include any mix of the following areas of work: clinical skills, submission of reports, analysis of reports and feedback, medical supplies, logistics, site management, relations with the community, recommendations or corrective actions.

Interestingly, there were programmes where CHW were working within a more or less formal network of CHW and other providers. For example, teams and team-work was heavily emphasised in ‘Save Zambia’; ‘Care Group Volunteers’ were reported by ‘Concern Burundi’; and peer support groups based on the Care Group model were implemented by ‘Concern Rwanda KabehoMwana’.

Several tools were identified across the documents, sometimes clearly highlighted in programmes reports and some other times identified by the reviewers as potentially innovative or particularly important programme components. A total of 114 tools have been identified across the whole set of programmes. In summary, they included equipment (eg, a backpack and storage box, a drug calculator, supplies, as complements to CHW activities and to support motivation as well); guides (describing procedures or tasks, such as clinical tasks, assessments or supervision); job aids (eg, home-based management; peer-support groups; case management; counselling cards, mother reminder cards); templates for reporting (eg, register and referral forms; CCM register; CCM supervision form; follow-up visit form; medication stock management form); communication tools (eg, home and community boards; flip charts). Other tools included an integrated analogue and digital mobile phone application for real-time stock tracking and reporting or an integrated toolkit map to facilitate the planning of activities within the catchment area of CHW.

## Quality of care

Eventually all programmes implemented IMCI care protocols in one way or another, which served as an overarching framework for a number of activities with the main components being guidelines, expansion and training of CHW, supervision and often supplies.

Programmes were not uniform in their underlying 'quality of care' concept or framework, which was in most cases implicit. Therefore, 'quality of care' was approached under different perspectives and dimensions of care across programmes. We extracted information on a limited number of outcomes related to access (ie, utilisation, coverage), appropriateness of care (eg, adherence to guidelines) and health outcomes. Programmes reported very different outcomes and there was no full consistency in measurements and reporting approaches.

As shown in **Table 5**, we extracted and grouped reports on outcomes, selecting those that seemed to be better related to quality of care indicators and better reported. 43% were categorised as qualitative ('+'), 30% as quantitative ('++') and 26% as quantitative with some estimation of statistical significance.

The synthesis of effects on quality of care suggested that there were positive effects for those strategies that involved policy change ('CORE Cameroon'), organisational change (eg, C-IMCI framework 'CORE Cameroon'), standardisation ('Concern Rwanda'), integration with existing health care services and alignment with other programmes which may ease implementation and scaling up ('CORE Malawi', 'PSI Mali').

Quality changes seemed more remarkable in large multi-component programmes which included training of CHW, strengthened supervision and improvement of supply change management. Improvements in monitoring and evaluation procedures seemed to have had positive effects on utilisation rates ('MOH Ethiopia'). Interestingly, access improved in most programmes, yet achievements were moderate in absolute terms or compared with formal health care ('Save Malawi'). Geographic and effective access to care increased ('Save Malawi'). A programme with a component of improvements of information transmission through mobile telephones seemed to have increased utilisation of CHW and more prompt management of illnesses.

Other strategies aimed at reinforcing the relations between CHW either with peers or supervisors. Peer-support groups provided a platform for more effective human resources interventions (eg, supervision, trust, accountability; 'Concern Rwanda'); social franchising ('PSI Myanmar') seemed to strengthen networking of providers, alongside an increase in reputation of CHW. Micro-franchising seemed

to achieve affordable improvements in the availability of good quality medical products ('Living Goods Uganda'). Social franchising increased the availability of services at equal or lower costs than regular formal services and supplies with specific data on Oral Rehydration Salts (ORS) distribution ('PSI Myanmar'). Equity (differentials in access from different economic strata) was reported in terms of access to CHW, Artemisinin-based Combination Therapy (ACT) and treatments of diarrhoea ('PSI Cameroon'); social franchising also seemed to improve equity, focusing on the most vulnerable populations ('PSI Myanmar', 'PSI Uganda'). Yet, at least one programme ('Save Malawi') could not find differences in accessing CHW according to wealth.

Effects on caregivers seemed positive, with increases in knowledge, changes in care seeking behaviour ('PSI Malawi', 'PSI Mali') and caregivers' basic disease management ('Concern Rwanda'); clients' satisfaction with availability of medicines and care increased ('PSI Cameroon'); and there were some indications that community ownership and accountability were strengthened.

Effects of iCCM interventions may not be sustained over time everywhere since there were examples of declining coverage of services ('PSI Cameroon') with time. Social franchising showed examples where coverage of services did not seem to increase ('PSI Uganda').

In contrast, some of the poor outcomes (eg, clinical management) were related to the shift of care seeking between different types of providers; for example, from formal governmental services to CHW community based care. Training large numbers of CHW led to the reduction in the use of traditional healers, although this was seen as a positive effect of the programme ('CORE Malawi'). Introduction of an iCCM programme in an area where care seeking appeared generally high resulted in shifting of care from government health centres, private health facilities and shops to village health clinics.

Although the aims of this review did not include reporting on mortality, it is worth noting that reductions in mortality were occasionally reported with findings suggesting reductions in some geographical areas but not in others, within the same programme ('PSI Cameroon'), or not statistically significant reductions ('IRC Sierra Leone').

## DISCUSSION

We have reviewed 29 iCCM programmes in Sub-Saharan Africa and Myanmar. All programmes were based on iCCM guidelines and principles implemented by CHW, although the way programmes were implemented varied greatly. This review had some limitations: it is likely that more programmatic or research information could have been found with



Table 5. Continued

PROGRAMME	ACCESS, QUALITY OF CARE, HEALTH OUTCOMES	QUALITY OF EVIDENCE†
Save Mozambique	Health seeking for fever: higher in intervention areas for the formal sector (intervention clusters 83.2% (CI 76.3 to 90.0); comparison areas 66.3% (95% CI 57.8 to 74.9)); CWH were the main source; pneumonia: lower in intervention areas in the formal sector; diarrhoea: CHW main source in intervention areas; first-line antimalarials: CHW preferred in intervention areas and formal sector in comparison areas. Improve of early treatment for malaria and diarrhoea (significant) and pneumonia (hardly significant). 2/3 RDT and less used timer for breathing. Provision of correct drugs (80%). Increased knowledge by mothers in intervention areas.	+++
IRC Ethiopia	Some practices not followed (check for danger signs, correct assessments).	+
Sizika	100% completeness in electronic data upload; 98.44% of promptness of treatment; 57% of treated children; 70% of relay/CHW were supervised; 75.5% to 98.44% of early malaria treatments (depending on month).	++

CI – confidence interval, CIDA – Canadian International Development Agency, DALY – disability adjusted life years, DRC – Democratic Republic Congo, HBM – home based management of malaria, IRC – International Red Cross, MC – Malaria Consortium, MOH – Ministry of Health, ORS – oral rehydration salts, PSI – Population Services International, RDT – rapid diagnostic test

\*Not all programme reported information on this area.

†Sources of evidence are qualitative data or opinions (+), quantitative methods described in the source documents (++), or findings are presented with some measure of statistical significance (+++).

‡Two similar documents sharing a common author and similar sources were available on the Peer Support Group topic specifically so the outcomes were captured from the most comprehensive document (PSG Review paper). Case study on Peer Support Group drawing from primary and secondary data collected as part of the KabehoMwana project final evaluation, prepared for the iCCM Symposium evidence review; consists of an adaptation of a longer paper describing experiences from the USAID-funded KabehoMwana project in Rwanda. Review paper on Peer Support Group combining participant observations from designers and implementers of the CHW PSG model, with project monitoring and routine monitoring data, findings from primary and secondary data collected as part of the KabehoMwana final evaluation; and other available studies in the grey literature.

§Final project external evaluation (2011) with a knowledge, practice and coverage survey, comparison with 2007 baseline. Interviews were conducted with 120 mothers of children 0 to 23 mo, and 395 mothers of children 0 to 59 months who had been sick in the last two weeks with at least one the following conditions: fever or malaria, diarrhoea, respiratory symptoms. In total, 120 villages were sampled, and 473 households were interviewed. Household selection was made according to an algorithm.

#Demographic and Health Surveys 2005 and 2010.

more time and resources; information was typically retrieved from evaluation studies or programmatic documents rather than experimental, controlled research studies providing moderate to low quality evidence; finally, reporting bias could not be excluded since only reports provided by a selection of stakeholders were included in this review. While programmatic information provides invaluable evidence on processes, the lack of more robust evidence on the effects of the programmes precludes any attempt to relate processes with outcomes. Findings from this review are not and cannot be representative of iCCM programmes and cannot be extrapolated to any particular setting. However, they are meant to help to draw lessons from those programmes proposed included in this review.

iCCM was defined by its objectives by WHO/UNICEF in 2012: “to train, supply and supervise front-line workers to treat children for both diarrhoea and pneumonia, as well as for malaria in malaria-affected countries, using ORS and zinc, oral antibiotics, and artemisinin-based combination therapy (ACT) ... iCCM also enables community health workers to identify children with severe acute malnutrition through the assessment of mid-upper-arm circumference (MUAC)” [4]. This definition shares the objectives and resembles the old definition of selective primary health care (PHC) (1979): “a circumscribed number of diseases are se-

lected for prevention in a clearly defined population ... The principal recipients of care would be children up to three years old and women in the childbearing years. The care provided would be measles and diphtheria-pertussis-tetanus (DPT) vaccination for children over six months old, tetanus toxoid to all women of childbearing age, encouragement of long-term breast feeding, provision of chloroquine for episodes of fever in children under three years old in areas where malaria is prevalent and, finally, oral rehydration packets and instruction” [10]. Similarities between both approaches suggest that iCCM is not an entirely new strategy, but rather it shares and it may be inspired by key features of selective PHC.

In this article we focused on the description of programmes and quality of care issues. iCCM programmes are composed by a mix of multiple interventions or strategies; namely, disease portfolios, CHW arrangements, clinical skills, supplies, referral systems, training, supervision, community support and policy changes. These components are implemented in different combinations and intensities depending on the country or setting where programmes operate, donors' preferences and country health related policies, among other factors. It was appealing to us that, in fact, the term ‘iCCM’ embraced a large plethora of very different programmes which may have limited com-

monalities between them in some cases. Most studies, trials or evaluations clearly deal with key factors affecting the performance of CHW, the quality of care they provide and, eventually, clinical outcomes. These factors included supplies, CHW supervision, training, quality of care and retention of CHW [11], among others.

A contribution of this review of iCCM programmes has been to systematically identify and present innovative or promising approaches; such as: integration with other programmes to boost effectiveness; integration with the private, public and traditional sectors, coordination with stakeholders to align resources and expertise in different areas of work. Stock management and availability of medicines seemed to be key in several programmes in effectively supporting CHW activities and ensuring credibility.

Measuring quality of care in the context of CCM is challenging and different approaches and measurement methods may lead to different descriptions of the same situations [12]. The number of quality of care indicators is very large and their types extremely varied, for example from the availability of inputs to the achievement of outputs and outcomes, from knowledge to health status outcomes, and the perspectives of supply- and demand-side. Therefore, one could argue that it is easy to find examples of positive effects when a large number of indicators are measured, as was the case in the programmes we have reviewed. As in other reviews, care seeking behaviour and utilisation of treatments tended to show positive, albeit variable, effects across the different programmes [5]. Not so often, examples of no effect were found; even less frequently, negative effects were identified (reporting bias of positive outcomes could not be investigated nor ruled out). Interestingly, the shift of utilisation from traditional healers to CHW was reported as a positive outcome, when actually this might not necessarily be seen as a desirable outcome ('Core Malawi').

We acknowledge, that quality of care is a means to achieve better health related outcomes, such as morbidity and mortality [13]. Only limited evidence on morbidity and mortality has been included in the documents of the programmes we have scrutinised. Interestingly, there are variations in the effects of community based management across conditions. For example, a review of the evidence on the effects of community based management of pneumonia in Africa, which included published studies in English or French (excluding non-published reports), using any primary study design, could not find evidence of impact on morbidity and mortality and raised several implementation concerns related to CHW capacity to manage pneumonia [6]; although more promising findings were reported in another review which included studies from Asia [5]. More positive findings were reported in a systematic review of experimental or quasi-experimental studies

in Sub-Saharan Africa on the effects of CCM on malaria outcomes [14]; for example, significant reduction of malaria deaths in Ethiopia and Uganda, although no effects were observed on other clinical outcomes (eg, hospitalisations, anaemia). Often, though, the quality of evidence is not optimal [15]. An additional issue to consider is the role of programme characteristics (ie, the specific implementation approaches) and the context. The scope of our review does not allow to drawing conclusions about differences on iCCM performance in different geographical areas (eg, Africa or Asia); however, where evidence exists, these differences have not stood out [5].

## CONCLUSIONS

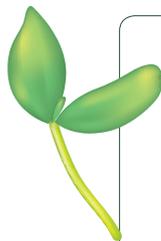
We attempted to provide some insights on the effects of iCCM intervention in quality of care indicators, despite the fact that scoping reviews do not aim at establishing effects of interventions. Large, multi-faceted, integrated iCCM programmes, with strong components of training, supervision, which included additional support of equipment and supplies, provided examples of improvements in selected quality of care outcomes. However, examples of modest, null and somehow adverse effects were also shown.

We could not establish which mix of interventions or strategies (eg, supervision, training and incentives) produced which effects on quality of care. Evidence on the main components exists; for example, on lay health workers [16], supervision [17], training or job aids [18]; but not on the mix of those interventions which lead to better outcomes and under which conditions. We are afraid that this is also the case for the reviews and studies we have recently accessed. Inevitably, the effects of innovative approaches (eg, networking between CHW peers, mentorship), which were used and seemed promising in some cases, remained diluted in the body of low quality evidence that could be extracted from programmatic documents. The lack of good quality evidence is not only a concern for the international health community, but also for policy makers [19] who may not recognise the value of an approach which may not have been robustly evaluated and reported. May be evidence on the strengths and limitations of selective PHC could have also informed more recent initiatives to implement iCCM.

In the absence of good quality evidence, research evidence has to be produced [20] and, in the meantime, good quality global guidance on what iCCM 'formula(s)' are more promising under different circumstances, needs to be elaborated with tools to adapt it to local settings [21]. A research agenda, and eventually guidance developers, would benefit from a series of actions spearheaded by the iCCM task force; namely: (i) standardisation of iCCM concepts,

strategies and tools; (ii) establishment and reinforcement of evaluation methodological standards, including protocols for selecting and reporting on primary outcomes, harms and costs; (iii) mapping existing research to avoid duplications and search synergies, emphasising pragmatic

research of integral approaches rather than for individual diseases; (iv) establishing a few manageable priority research areas; (v) creating an open, structured, transparent and comprehensive online platform to share evidence on iCCM with quality assessments of the evidence presented.



**Acknowledgements:** To Helen Counihan (Malaria Consortium), Michelle Geiss, Abigail Pratt (PSI), Alyssa Sharkey (UNICEF) and Alexa Wharton-Smith, for their support and assistance in several phases of the review; their insights were instrumental to complete this work.

**Funding:** The study was funded by UNICEF, through the Swiss TPH.

**Disclaimer:** The views and ideas expressed herein are those of the author(s) and do not necessarily imply or reflect the opinion of the Institute.

**Authorship declaration:** XBC drafted the protocol, set up and supervised the data extraction tools, led the analyses and drafted the manuscript. CM contributed to the protocol, extracted the data, contributed to the analyses and commented on the manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). Dr. Bosch-Capblanch reports grants from Swiss TPH, during the conduct of the study.

## REFERENCES

- 1 Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS; Bellagio Child Survival Study Group. How many child deaths can we prevent this year? *Child survival II. Lancet*. 2003;362:65-71. Medline:12853204 doi:10.1016/S0140-6736(03)13811-1
- 2 Donabedian A. Evaluating the quality of medical care, 1966. *Milbank Q*. 2005;83:691-729. Medline:16279964 doi:10.1111/j.1468-0009.2005.00397.x
- 3 Van Lerberghe W, Matthews Z, Achadi E, Ancona C, Campbell J, Channon A, et al. Country experience with strengthening of health systems and deployment of midwives in countries with high maternal mortality. *Lancet*. 2014;384:1215-25. Medline:24965819 doi:10.1016/S0140-6736(14)60919-3
- 4 Young M, Wolfheim C, Marsh DR, Hammamy D. World Health Organization/United Nations Children's Fund Joint Statement on integrated community case management: An equity-focused strategy to improve access to essential treatment services for children. *Am J Trop Med Hyg*. 2012;87(5 Suppl):6-10. Medline:23136272 doi:10.4269/ajtmh.2012.12-0221
- 5 Das JK, Lassi ZS, Salam RA, Bhutta ZA. Effect of community based interventions on childhood diarrhea and pneumonia: uptake of treatment modalities and impact on mortality. *BMC Public Health*. 2013;13(Suppl 3):S29. Medline:24564451 doi:10.1186/1471-2458-13-S3-S29
- 6 Druetz T, Siekmans K, Goossens S, Ridde V, Haddad S. The community case management of pneumonia in Africa: a review of the evidence. *Health Policy Plan*. 2013. Epub ahead of print. Medline:24371218 doi:10.1093/heapol/czt104
- 7 Higgins JPT, Green S, editors. *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0* [updated March 2011]. The Cochrane Collaboration, 2011. Available from: [www.cochrane-handbook.org](http://www.cochrane-handbook.org). Accessed: 5 October 2014.
- 8 Population Services International. What is social franchising? Available at: <http://www.psi.org/social-franchising-solution-inadequate-health-care-coverage-developing-world>. Accessed: 5 October 2014.
- 9 Living Goods. Micro-franchising. Available at: <http://livinggoods.org/what-we-do/micro-franchise-business-model/>. Accessed: 5 October 2014.
- 10 Walsh JA, Warren KS. Selective primary health care: an interim strategy for disease control in developing countries. *N Engl J Med*. 1979;301:967-74. Medline:114830 doi:10.1056/NEJM197911013011804
- 11 United Nations Children's Fund. Review of systematic challenges to the scale-up of integrated community case management emerging lessons & recommendations from the catalytic initiative (CI/HSS). New York: UNICEF; 2012. Available at: [http://www.unicef.org/infobycountry/files/Analysis\\_of\\_Systematic\\_Barriers\\_cover\\_1163.pdf](http://www.unicef.org/infobycountry/files/Analysis_of_Systematic_Barriers_cover_1163.pdf). Accessed: 10 October 2014.
- 12 Cardemil CV, Gilroy KE, Callaghan-Koru JA, Nsona H, Bryce J. Comparison of methods for assessing quality of care for community case management of sick children: an application with community health workers in Malawi. *Am J Trop Med Hyg*. 2012;87(5 Suppl):127-36. Medline:23136288 doi:10.4269/ajtmh.2012.12-0389

- 13 Marsh DR, Hamer DH, Pagnoni F, Peterson S. Introduction to a special supplement: Evidence for the implementation, effects, and impact of the integrated community case management strategy to treat childhood infection. *Am J Trop Med Hyg.* 2012;87(5 Suppl):2-5. Medline:23136271 doi:10.4269/ajtmh.2012.12-0504
- 14 Smith Paintain L, Willey B, Kedenge S, Sharkey A, Kim J, Buj V, et al. Community health workers and stand-alone or integrated case management of malaria: A systematic literature review. *Am J Trop Med Hyg.* 2014;91:461-70. Medline:24957538 doi:10.4269/ajtmh.14-0094
- 15 Ruizendaal E, Dierickx S, Peeters Grietens K, Schallig HD, Pagnoni F, Mens PF. Success or failure of critical steps in community case management of malaria with rapid diagnostic tests: a systematic review. *Malar J.* 2014;13:229. Medline:24924295 doi:10.1186/1475-2875-13-229
- 16 Lewin S, Munabi–Babigumira S, Glenton C, Daniels K, Bosch–Capblanch X, van Wyk BE, et al. Lay health workers in primary and community health care for maternal and child health and the management of infectious diseases. *Cochrane Database Syst Rev.* 2010;(3):CD004015. Medline:20238326
- 17 Bosch–Capblanch X, Liaqat S, Garner P. Managerial supervision to improve primary health care in low- and middle-income countries. *Cochrane Database Syst Rev.* 2011;(9):CD006413. Medline:21901704
- 18 Jennings L, Yebadokpo AS, Affo J, Agbogbe M. Antenatal counseling in maternal and newborn care: use of job aids to improve health worker performance and maternal understanding in Benin. *BMC Pregnancy Childbirth.* 2010;10:75. Medline:21092183 doi:10.1186/1471-2393-10-75
- 19 Bennett S, George A, Rodriguez D, Shearer J, Diallo B, Konate M, et al. Policy challenges facing integrated community case management in Sub-Saharan Africa. *Trop Med Int Health.* 2014;19:872-82. Medline:24750516 doi:10.1111/tmi.12319
- 20 Hamer DH, Marsh DR, Peterson S, Pagnoni F. Integrated community case management: next steps in addressing the implementation research agenda. *Am J Trop Med Hyg.* 2012;87(5 Suppl):151-3. Medline:23136291 doi:10.4269/ajtmh.2012.12-0505
- 21 Lavis JN, Rüttingen JA, Bosch–Capblanch X, Atun R, El–Jardali F, Gilson L, et al. Guidance for evidence-informed policies about health systems: linking guidance development to policy development. *PLoS Med.* 2012;9:e1001186. Medline:22427746 doi:10.1371/journal.pmed.1001186

# Integrated community case management of malaria, pneumonia and diarrhoea across three African countries: A qualitative study exploring lessons learnt and implications for further scale up



Clare Strachan<sup>1</sup>, Alexandra Wharton-Smith<sup>1</sup>, Chomba Sinyangwe<sup>2</sup>, Denis Mubiru<sup>3</sup>, James Ssekitooleko<sup>3</sup>, Joslyn Meier<sup>3</sup>, Miatta Gbanya<sup>4</sup>, James K. Tibenderana<sup>1</sup>, Helen Counihan<sup>1</sup>

<sup>1</sup> Malaria Consortium Africa Regional Office, Kampala, Uganda

<sup>2</sup> Malaria Consortium Zambia, Mansa, Luapula Province, Zambia

<sup>3</sup> Malaria Consortium Uganda, Kampala, Uganda

<sup>4</sup> Malaria Consortium South Sudan, Juba, South Sudan

Numerous studies highlight the effectiveness of an integrated approach for the management of malaria, pneumonia and diarrhoea at the community level. There has however been little study on lessons learnt from implementation in practice and stakeholder experiences which could inform future programmatic planning and evaluation frameworks. A participatory, qualitative evaluation was conducted in the three varied settings of South Sudan, Uganda and Zambia, which have seen the scale up of integrated community case management (iCCM) over the last five years. All key in-country stakeholders were consulted on study design, with a particular focus on scope and methodology. Data collection methods included stakeholder consultations (key informant interviews, focus group discussions), and a review of project and Ministry of Health documentation. Data analysis followed the Framework Approach. Results suggest that iCCM implementation generally followed national pre-agreed guidelines. Overarching key programmatic recommendations included: collaboration with implementing partners in planning stages to positively impact on community acceptance and ownership; adoption of participatory training methods adapted to low literacy populations; development of alternative support supervision methods such as peer support groups; full integration of community level data into the health management information system and emphasizing data analysis, use and feedback at all levels; strengthened supply chains through improved quantification and procurement of commodities in conjunction with the national distribution network; community engagement to establish a support system for community health workers to increase their motivation; enhanced sensitisation and behaviour change communication to raise awareness and usage of appropriate health services; and advocacy at the national level for funding and logistical support for the continuation and integration of iCCM. This qualitative study is a valuable contribution in understanding the 'hows' of iCCM implementation with key insights for improved feasibility and acceptability. Main findings show how community support to iCCM and community health workers is necessary for sustained health benefits coupled with a focus on strengthening and 'enabling' the public health system. The participatory study design and methodologies used enabled the scope of the research enquiry to effectively capture various stakeholder perspectives.

## Correspondence to:

Helen Counihan  
Malaria Consortium UK  
Development House  
56-64 Leonard Street  
London EC2A 4LT, UK  
h.counihan@malariaconsortium.org

Integrated community case management (iCCM) delivered through trained community health workers (CHWs) can contribute to the reduction in morbidity and mortality of the three major causes of mortality for children globally under the age of five, specifically pneumonia (18%), diarrhoea (15%) and malaria (8%) [1]. iCCM typically provides free community level treatment for these diseases to children aged two months to five years. In many remote and hard-to-reach areas, this can improve health outcomes, providing a potentially faster clinical response after onset of signs and symptoms. It also saves on caregiver time and transportation costs when seeking medical care [2-4]. Simple diagnostic tools, including rapid diagnostic tests (RDTs) for malaria and respiratory rate counters for pneumonia, can be used by CHWs to identify illnesses which are then treated with artemisinin-based combination therapy, oral antibiotics or oral rehydration therapy and zinc, dependent upon the patient history and test results.

iCCM has been a growing focus of community health care delivery across Sub-Saharan Africa over the last few years and gained momentum in the wake of an increasing body of research [2], which has highlighted the effectiveness of an integrated approach at the community level in reducing under-five morbidity and mortality caused by malaria, pneumonia and diarrhoeal diseases.

Evaluation of iCCM in its formative years has focused on important quantitative outcomes and impact [5], specifically morbidity, mortality and lives saved [6]. Separate work has also been conducted on the financing of iCCM and the implications for larger scale implementation [7]. Qualitative work has tended to explore community acceptability [8], CHW motivation and effectiveness, in addition to the role of community based and technological innovations in improving service delivery [9-11]. It is recognised that more research is needed to determine the best approaches to iCCM implementation, scale up and sustainability and to capture beneficiary experiences [12]. The aim of this participatory evaluation was to capture context specific experiences of a range of stakeholders in South Sudan, Uganda and Zambia, where Malaria Consortium has supported the Ministry of Health (MOH) to introduce and implement iCCM over the past three years.

## METHODS

The study adopted a qualitative approach to enable an in-depth exploration of a range of stakeholder experiences of iCCM implementation, utilising a participatory approach as far as possible. Data was collected through stakeholder consultations and beneficiary assessments, specifically key informant interviews (KIIs) and focus group discussions (FGDs), as well as an analysis of Malaria Consortium and

MOH documentation. Data collection was conducted from November 2012 to March 2013 in South Sudan, Uganda and Zambia. In Uganda, the evaluation was seen as a key contribution to the national iCCM review led by the MOH with main stakeholders.

## Study setting

Since 2010, iCCM has been implemented by Malaria Consortium, according to MOH guidelines, in collaboration with the MOH in the Central and Western regions of Uganda, in the northern Luapula province in Zambia, and in Unity and Northern Bahr el Ghazal states in South Sudan. The majority of beneficiaries across implementation sites reside in rural areas, with very limited access to the formal health service.

## Scope of enquiry and participation selection

Thematic areas of enquiry to guide and structure the data collection process were developed. These were based on the established phases of iCCM start up and implementation (as indicated in most national iCCM guidelines where available), as well as additional thematic categories relating to the relevance of iCCM, namely acceptability, effectiveness and sustainability. Within each theme, specific enquiry explored the implementation process, aspects which worked well, challenges faced and recommendations in relation to continued/future iCCM implementation. The approach used for this was participatory evaluation which is a partnership approach to evaluation where stakeholders actively engage in developing the evaluation and phases of its implementation [13]. As part of the consultative nature of the participatory evaluation, key in-country implementers, specifically MOH staff active at different levels of the health system, CHWs, implementing partners and beneficiaries, were engaged through workshops to discuss and agree the thematic scope relevant to context, data collection methods and specific interview targets of the evaluation. Specific topic guides were developed and piloted with each identified target group.

A maximum variation sampling approach [14] was followed to ensure a sufficient range of respondents were included according to factors which are likely to represent a diversity of views. The participants were categorised into target groups based on their role in iCCM implementation as outlined in **Table 1**. In total, 646 participants were included in the evaluation, (Zambia: 241, Uganda: 217, South Sudan: 188).

Malaria Consortium staff, MOH officials at each level, District Health Management Teams (DHMT) (Zambia), District Health Teams (Uganda) and health facility staff were purposively selected in relation to their involvement in iCCM planning and implementation. In Luapula province,

**Table 1.** Selection criteria for study inclusion by target group

TARGET GROUP	SELECTION CRITERIA
Malaria Consortium staff	Played a key role in iCCM implementation
MOH central level	Supported iCCM planning, implementation
MOH sub-national level (province/state/district/payam)	Supported iCCM planning, implementation
District Health Management Team (DHMT)	District Medical Officers, Pharmacists, DHMT members involved in iCCM
Health facility staff	Clinical staff who are involved in managing referred outpatient and inpatient cases of malaria, pneumonia and diarrhoea and were available on the day of interview from one central and one rural clinic in each district
Community leaders	Village chiefs, headmen, church elders, village committee chairmen, who have been involved in iCCM implementation. In each district, one FGD of purposively selected community leaders from rural and urban areas
Community health workers	iCCM trained CHWs. In each district: one FGD with CHWs attached to each of the two selected health facilities
Beneficiaries	Caregivers of children under the age of five. In each district two FGDs of beneficiaries residing in the catchment areas of the selected health facilities were randomly selected

iCCM – integrated community case management, MOH – Ministry of Health, CHW – community health worker, FGD – focus group discussion

Zambia, Mansa, Kawambwa, Chienge and Samfya districts were sampled; in Uganda, Hoima, Buliisa and Mpigi districts were included; in South Sudan, Aweil West and Aweil Centre counties in Northern Bahr el Ghazal state were sampled. Villages were stratified by distance to health facility (more than five kilometres, less than five kilometres) and their location (hard to reach, rural and peri-urban). In villages where household lists were unavailable, households with caregivers of children under the age of five were chosen by the random walk technique. CHWs, their supervisors and community leaders residing in the selected villages were invited to the FGDs. The number of interviews, FGDs and observations were estimated based on what is required in order to reach data saturation, balanced with the time and resources available.

## Data collection

KIIs were conducted with central and provincial level MOH officials and with Malaria Consortium staff in all three countries, and for community leaders and health facility in-charges (in Uganda), to explore implementation experiences in more depth.

Separate FGDs were considered preferable for District Health Management Teams/District Health Teams, payam administrators (South Sudan), health facility staff, CHWs and their supervisors, community leaders (in South Sudan and Zambia) and beneficiaries to stimulate discussion in groups that would not feel inhibited by power hierarchies.

A total of 72, 20 and 64 CHWs were sampled from South Sudan, Uganda and Zambia respectively. The number of beneficiaries sampled in South Sudan was 72, in Uganda 81 and in Zambia it was 145. In South Sudan, a total of 23 FGDs and 7 KIIs were held, in Uganda there were 36 FGDs and 27 KIIs while in Zambia the numbers were 26 FGDs and 25 KIIs.

The data collectors/transcribers were recruited using criteria which stipulated previous experience in qualitative research data collection. All members of the research team participated in a 2-day training on ethics, data collection methods, transcription and data management.

## Grey literature review

MOH data, guidelines, policies and Malaria Consortium iCCM documents such as baseline survey results, training materials, implementation tools, programme assessments, progress and project reports and evaluations were reviewed to provide insight into the implementation process and to add context to experiences of iCCM planning, implementation and evaluation in practice. Evaluations and documented lessons learned from other iCCM implementing partners were also reviewed. Review of grey literature contributed to informing on the background and context for the research team. Relevant content from selected documentation was analysed and contrasted with accounts from respondents, notably on iCCM implementation processes compared to the national guidelines.

## Data management and analysis

All interviews and FGDs were audio recorded and transcribed verbatim by the researchers in the field as soon as possible after the data had been collected for the purpose of maintaining data validity. The transcription process was quality controlled through field review of all transcripts and additional reviews of purposively selected samples by the wider research team. The transcripts were translated into English (where necessary) by the researchers and quality controlled through translation reviews of sections selected at random. Continuous feedback was provided to the researchers throughout the data collection process to support performance improvement. The data were only accessible

by the research team and once stored electronically, were anonymised and saved in a password-protected folder shared only with key members of the research team to ensure confidentiality.

The Framework Approach [15] was broadly used to analyse the data. This systematic method appreciates the iterative nature of qualitative data analysis and involves deriving themes related to the research objectives, whilst adding new themes that emerge during data collection, within which the data are analysed and organised. Transcripts were reviewed daily or weekly so as to enable revision during the data collection phase of the scope and questions in the topic guides according to different target groups.

The first level of analysis was conducted by an investigator who reviewed and analysed all of the documentation and transcripts in full, with regular additional analysis by a second investigator. The second investigator compared coding decisions and regularly discussed the scope of data, analysis approach and presentation of the data with the first investigator, with further input from a third senior advisor, as required. When discrepancies arose, the investigators reached a consensus on the most appropriate way to code a passage of text or present the data.

The analysis followed four key stages: identification of key themes during a thorough review of the transcripts, construction of a thematic framework in an Excel spreadsheet for each geographically distinct set of data, which was then used to label and group the data in rows according to themes and sub-themes, emergent subthemes were added to the framework under the relevant overarching themes and the data were once again reviewed and re-sorted, finally, each thematic area was compared between target groups and contextualised, associations between themes were identified; the findings were explained and interpreted. The themes were selected as relevant for each target group. The thematic areas of enquiry and the related sub-themes are listed in [Table 2](#).

### Ethical considerations

Care was taken by the research team to communicate information about the evaluation to the communities as they worked, in the language and manner that is understandable to them. Informed consent was granted from all participants.

## RESULTS

The results are presented according to key themes related to iCCM implementation components with an emphasis on findings that have implications for improving feasibility, effectiveness and acceptability for future implementation planning and scale up.

In this paper, the generic term of Community Health Worker (CHW) will be used in reference to the Village Health Teams, Community Drug Distributors and Community Health Workers deployed in South Sudan, Uganda and Zambia respectively.

### Central level preparation

At the time of writing, only Uganda had an official national iCCM policy and guidelines, which were drafted by the MOH in collaboration with key implementing partners prior to launching the programme in mid-2010. In Zambia and South Sudan, iCCM currently falls under the wider Integrated Management of Childhood Illness (IMCI) and Child Survival programmes respectively, however an agreed approach for implementation was defined between the MOH and Malaria Consortium. It is understood that developing a formal iCCM policy remains a priority in South Sudan and Zambia. During the preparation stage, specific iCCM training materials, CHW job aids, support supervision tools and data collection forms were developed to facilitate CHW comprehension and promote quality assurance.

Drug resistance due to potential incorrect prescription of medications and poor adherence at community level were highlighted as concerns from stakeholders during the central level planning stages in South Sudan and Zambia. These fears were assuaged by demonstrating how this issue had been successfully dealt with in other iCCM implementation countries through appropriate training of CHWs and effective support supervision. Dialogue meetings with senior MOH and World Health Organisation officials were also considered instrumental in winning support for iCCM and securing stakeholders' 'buy in'.

### Sub-national level introduction

The importance of formal introduction from central level MOH at sub-national level was highlighted as key to acceptance among provincial, district and state level officials, particularly where the implementing partner may have not previously worked with local health system stakeholders. Sensitising and mobilising partners at all levels of health governance and service delivery on the iCCM concept, guidelines and processes was identified as integral to the initial phase of implementation and led to higher levels of support at health facilities. Collaboration in micro-planning with lower levels of the MOH including regular participatory sessions to strategise how to address challenges related to training, support supervision, supplies and CHW motivation was greatly valued and was felt to encourage sub national level ownership of the programme. Establishing an agreed framework for ongoing collaboration between district level MOH and implementing partners was considered beneficial to successful coordination.

**Table 2.** Thematic areas of enquiry

THEMATIC AREA	SUBTHEME
Central level preparation	<ul style="list-style-type: none"> <li>• Policy and guidelines development process</li> <li>• Introduction of programme to different levels of health system</li> <li>• Other preparation for implementation</li> </ul>
Province/state/district level introduction and start up	<ul style="list-style-type: none"> <li>• Steps of introduction and start up</li> <li>• Issues and proposed solutions</li> <li>• Recommendations</li> </ul>
CHW selection	<ul style="list-style-type: none"> <li>• Process for recruitment of CHWs for iCCM (agreed approach vs practice)</li> <li>• Appropriateness of selection criteria</li> <li>• Issues which arose, proposed solutions, recommendations</li> </ul>
Training and capacity building	<ul style="list-style-type: none"> <li>• Training models including levels of training ie, cascade</li> <li>• Training approaches ie, practical vs theoretical</li> <li>• Training tools</li> <li>• Scope of training in terms of technical content and related learning capacity of CHWs</li> <li>• Evaluation of training</li> <li>• Refresher training</li> <li>• Issues which arose, proposed solutions, recommendations</li> </ul>
Support supervision	<ul style="list-style-type: none"> <li>• Models developed, application at different levels</li> <li>• Support supervision tools used</li> <li>• Effectiveness</li> <li>• Alternative supervision models</li> <li>• Issues which arose, proposed solutions, recommendations</li> </ul>
Routine data collection	<ul style="list-style-type: none"> <li>• Routine data available, scope and gaps</li> <li>• How data has been collected</li> <li>• How data has been cleaned, stored, summarised, analysed</li> <li>• How data has been used</li> <li>• Extent and scope of feedback given to those involved in submitting and compiling data (including feedback system)</li> <li>• Data quality</li> <li>• Issues which arose, proposed solutions, recommendations</li> </ul>
Commodities and supply chain	<ul style="list-style-type: none"> <li>• Push vs pull system</li> <li>• Transport and storage</li> <li>• Packaging</li> <li>• Modes of distribution</li> <li>• Acceptability</li> <li>• Issues which arose, proposed solutions, recommendations</li> </ul>
Community involvement and support	<ul style="list-style-type: none"> <li>• Initial community response and changes over time</li> <li>• Community support for CHWs</li> <li>• Role of CHWs and workload/time spent/ motivation, attrition</li> <li>• Utilisation of community iCCM services</li> <li>• Acceptability aspects</li> <li>• Referral uptake</li> <li>• Issues which arose, proposed solutions, recommendations</li> </ul>
Behaviour change communication (BCC)	<ul style="list-style-type: none"> <li>• BCC strategy, including scope of BCC activities implemented and why</li> <li>• Perceived/measured value/outcome and impact of activities</li> <li>• Issues which arose, proposed solutions, recommendations</li> </ul>
Management and coordination	<ul style="list-style-type: none"> <li>• Project management and staffing structures</li> <li>• Coordination with other projects</li> <li>• Coordination and sharing at the central level and with MOH</li> <li>• Involvement of MOH</li> <li>• Issues which arose, proposed solutions, recommendations</li> </ul>
Integration with health system	<ul style="list-style-type: none"> <li>• How the iCCM programme has been integrated</li> <li>• Management of severe cases at health facility level</li> <li>• Support for iCCM among health facility staff</li> <li>• Other aspects relating to sustainability</li> </ul>
Technical and geographical scope of iCCM	<ul style="list-style-type: none"> <li>• Scope of services offered and perception of how well this integration works</li> <li>• Appropriate number of CHWs per village</li> <li>• Scale up</li> <li>• Issues which arose, proposed solutions, recommendations</li> </ul>
Evaluation	<ul style="list-style-type: none"> <li>• Evaluation methods, process, value</li> <li>• Pilot studies</li> <li>• Other recommendations</li> </ul>
Other	<ul style="list-style-type: none"> <li>• Any other feedback</li> </ul>

CHW – community health worker, iCCM – integrated community case management, MOH – Ministry of Health

*“The involvement of district leaders, it was very important ... if any programme comes, it has to be owned by the district and therefore sustained ... look at ownership and sustainability ... if I am the one at the district to go and train those health workers, they don’t look at the programme as from outside ... therefore they look at it as theirs and work well on it.”* (District health official, Uganda)

*“Involving all stakeholders including local politicians was very good. Working in partnership with the MoH helped to successfully implement the programme.”* (Malaria Consortium staff)

Initial strengthening of local health team capacity to plan the integration of iCCM activities into budgets and workplans and collect, analyse and utilise iCCM routine data was recommended. Additionally, planning the sustainability of iCCM from the outset was encouraged to adequately prepare for handover to the MOH.

### CHW recruitment and selection

The Ugandan iCCM guidelines and CHW selection documentation from Zambia and South Sudan stipulate that communities should be sensitized on the participatory nature of the recruitment process and selection criteria prior to recruitment. Sensitisation was reported by the majority of respondents as occurring through a variety of channels, most frequently during village meetings, church gatherings, through radio broadcasts and health centre community outreach. Messages emphasized community participation as central to the CHW selection process and listed selection criteria for CHWs as: willingness to volunteer, permanent residency, literacy skills (with the exception of South Sudan), fluency in English (where possible) and being of a reliable and trustworthy disposition. Moreover, that proposed CHWs should not be political or community leaders or their relatives.

Selection of CHWs by communities was preceded by sensitisation meetings with health facility staff and local leaders who explained the selection criteria to communities. Depending on the country context, the majority of community leaders and/or health facility staff facilitated a participatory democratic selection process by presenting interested candidates to the community who were then voted on based on the aforementioned criteria and additional characteristics defined by community members – eg, willingness to volunteer, reliability etc. Sometimes the candidates were selected jointly by the community and leaders (eg, in South Sudan) and in Zambia, priority was given to CHWs previously trained by the MoH.

In all three countries, guidelines mandate that community members should play an active role in choosing their CHWs and not have CHWs imposed by local leaders. Generally, the former participatory approach was followed ac-

ording to most respondents across countries. In areas where communities were strongly involved in the selection, respondents anecdotally reported higher utilisation of iCCM services, more community support for CHWs, deeper trust in CHWs’ capacity to treat children and a stronger overall sense of community ownership.

*“We were happy because we did the selection as a community and no one imposed them on us ... it is good for the people to do the selection because they select someone they trust which is good and if you show someone that you trust him he can do the work well.”* (Community leader, Uganda)

*“... the most important thing in the selection of Community Health Workers is openness. If the people are involved and they feel part of the process, then there will be no problems in the selection process.”* (Community leader, Zambia)

Less democratic approaches occurred in a few communities across all countries, where local leaders would appoint themselves, their relatives or preferred candidate in the interest of personal gain, influence associated with the position, or based on tribal or political affiliations. Tribal dynamics affecting CHW selection was a particular issue in Uganda, where biased selection was reported more frequently than in the other countries. The repercussions of undemocratic selection resulted in unqualified CHWs being sent for training, reluctance among caregivers to access CHWs they felt had been “imposed” upon them or who belonged to a rival political party or tribe and overall less community support for CHWs.

*“The VHT selection was not done on the proper set guidelines... Selection was based on tribal dynamics not on credit. The village members were not involved. The chairpersons took it upon themselves and selected their own people.”* (Health facility staff, Uganda)

Recommendations to encourage community selection included enhanced community sensitisation, consultations with community leaders to discuss the importance of adhering to selection criteria and selection guidelines and selection monitoring by district officials. In Zambia, candidates were required to pass a literacy test and verify their age prior to the training, where district officials played an important role in enforcing democratic selection of appropriate candidates by refusing any unqualified candidate and sending them back to the community for a replacement.

*“We put a system in place and we hope that it works ... You have the interesting cases where you have some very old people who are quite influential who will say ‘I will be the Community Health Worker whether people like it or not!’ Nobody would stand up to them and so they would end up coming for the training ...”* (Malaria Consortium staff, Zambia)

## Training and capacity building

A cascade training model for iCCM was followed in each country, with a master trainer present for each session for quality assurance. Training duration was for 6 days in all countries and the trainers were health facility and district MoH staff who had attended a Training of Trainers course conducted by central MoH trainers with Malaria Consortium staff. Each training course of CHWs had central MoH or Malaria Consortium staff in attendance for quality assurance. Participatory methods were widely appreciated by trainees and considered conducive to CHW comprehension and subsequent confidence in case management. “Hands on” and practical approaches including group work and discussions, role-plays, and practice using RDTs and actual CHW registers enabled CHWs to gain a solid understanding of the justification behind and practicalities of testing and treatment, according to many respondents. Video sessions were praised as an effective teaching method which gave CHWs the opportunity to observe danger signs without having to wait at a health facility, particularly as some signs, such as “chest indrawing” are difficult to describe verbally or pictorially. In Uganda, the use of dolls for practising the administration of rectal artesunate was valued by CHWs. Visits to health facilities to witness the danger signs associated with severe malaria, pneumonia and diarrhoea cases also strengthened the CHWs’ capacity to recognise these symptoms.

*“I do not know how to write and read, but I have understood the content of the training.”* (CHW, South Sudan)

*“The practical bit of it helps us learn how to handle patients when they visit us. The way you receive someone matters a lot. You might be a health worker but the way you handle me might send me away and I never return.”* (CHW, Uganda)

CHWs appeared to appreciate that facilitators were able to communicate at an appropriate pace, clarifying aspects which were not well understood, and in local languages, which enhanced their understanding of the content. Health facility staff and CHW supervisors remarked on the benefits of supervisory skills training in addition to the iCCM case management they received. The sick child job aid provided to CHWs during the training was referred to as “the Bible” by CHWs in Uganda and Zambia due to its accessibility and comprehensive content.

*“... in relation to first training us on basic knowledge, it was not just a matter of testing but knowing how to deal with VHTs, know how to communicate, technical know-how, ... supervise them, and train them and documentation as a result the programme went on smoothly.”* (Health facility staff, Uganda)

Counting the respiratory rate/identification of pneumonia vs cough and data collection using the CHW registers were topics that some CHWs struggled with during the training,

according to trainers and CHWs across the countries. Low literacy was commonly mentioned as a challenge for CHWs in South Sudan, however pictorial training materials and CHW registers developed especially for this context facilitated learning and comprehension.

The majority of respondents strongly recommended that the duration of the training be extended to two weeks in order to address some of the more complex topics in more depth, specifically identifying pneumonia, completing CHW registers, correct referral and newborn care. The addition of basic literacy and numeracy skills to the training content was requested by multiple respondents in South Sudan.

Most CHWs and health workers articulated the need for refresher training to consolidate their skills and address any challenges. Several health facility and district level supervisors across the countries indicated that refresher training is motivational for the CHWs. The suggested frequency for refresher training varied widely from monthly to bi-annually.

*“They should bring everything we trained on like rectal [artesunate], drugs so that we can use them because if we don’t practise we can easily forget how to use them.”* (CHW, Uganda)

*“You might find that at first these people were using gloves ... [then] they say, ‘aah aah after all now [I] am an expert I can do a RDT without gloves.’ So you find that they just forget the issue of gloves and use bare hands.”* (Health facility staff, Uganda)

## Support supervision

In Uganda and Zambia, districts supported health centre staff, whilst at health facility level, supervisors were tasked with strengthening CHWs’ skills in case management, drug storage, reporting and promoting community engagement. In South Sudan, where the County Health Department and health facilities did not have the capacity to carry out consistent supervision, Malaria Consortium programme offices provided support to CHWs and their supervisors. In Uganda, “parish coordinators” were introduced as supplementary supervisors to provide support to CHWs on a more regular (usually monthly) basis and to assist with the compilation and submission of CHW data. Parish coordinators were CHWs who were selected by their peers in the same catchment area to fulfil this role. In all countries supervision occurred through quarterly meetings at health facilities and supervisor visits to CHWs’ homes.

The importance of timely support supervision immediately following training to ensure correct practices in the community were demonstrated by multiple respondents. Quarterly meetings at local level and/or at health facilities were identified as key to support supervision; an opportunity for CHWs to share experiences and solutions, build their con-

confidence, raise concerns and refresh their skills. Home visits, especially the first visits conducted within two months after the initial training, were described as an indication of appreciation and particularly motivational for CHWs, and associated with marked improvement in sustaining of CHWs' performance. The visits were also seen as a mechanism for strengthening links between CHWs and health facilities. Community recognition from being visited by supervisors was cited as a source of pride for CHWs.

*"Our supervisors supervise us very well we can't even complain wherever we face any problem they sit us all down and ask about our challenges."* (CHW, Zambia)

*"... I think those [home visits] were also very positive because we were able to go down to the community and see how they are basically doing their work. This motivated the VHTs a lot ... They would see a car parked there and they would say, 'the VHT has been visited,' so it was a big thing."* (Malaria Consortium staff, Uganda)

In areas where there was weaker support supervision, CHWs described feeling discouraged and demoralised.

*"Supervision is not consistent and when they don't come to see what we are doing we become demoralized and sometimes when they don't come we feel that what we are doing is not very important."* (CHW, Uganda)

*"... some of the communities are just hostile. Instead of appreciating, they are just abusing the VHT saying after all you were given drugs to come and treat us. These people [the CHWs] get demoralised."* (District health official, Uganda)

The most commonly mentioned barriers to effective support supervision included: availability of funds/transport allowances, difficulty in accessing CHWs due to poor roads or hard to reach locations, especially in the rainy season and time required, availability of health facility staff. In South Sudan insecurity and flooding were highlighted as additional challenges which affected supervisors' ability to support CHWs. Weak supervisors were less frequently mentioned as a hindrance to strong supervision, which a few respondents attributed to insufficient training on supervisory skills during the initial training.

*"Unfortunately the health workers had a very big load and lack of logistics so they were not able to do it. It was later when the parish coordinators were trained and they came on board that actually supervision started."* (Health facility staff, Uganda)

"Buddying up" weak and strong supervisors and introducing "peer CHWs" (high performing CHWs who could support those who are struggling) were recommendations on how to strengthen support supervision and improve quality of care. In South Sudan, a few CHWs described the latter approach as a mechanism that evolved during implementation when supervisors were not available.

*"When CDDs do not perform well, we call other CDDs to help in assisting in treatment ..."* [All– Agree] (CHW, South Sudan)

## Data management

CHWs in all countries were trained to complete monthly registers detailing patient age, sex, respiratory rate, RDT result (Uganda and Zambia), diarrhoea, treatment given, referral and outcome. The register is submitted to supervisors, collated at health facility level and reported upwards and in some cases, the data included into the national Health Information Management System (HMIS). Generally, the quality of the data according to the majority of respondents was considered to be of an acceptable standard (ranging from "50% accurate" to "excellent"), which had also improved over time.

*"I can say it is good quality because the CHWs are trained and are supervised time and again to make sure the data is complete, correct and consistent."* (District health official, Zambia)

In Uganda and Zambia, inaccuracies in the CHW registers were reportedly due to poor numeracy skills, lack of sufficient training on the tool, CHWs forgetting how to correctly enter the data and human error which was suggested to largely relate to fatigue and, busyness with other activities. Commodity stock outs were cited as the main reason for not completing registers for CHWs in Uganda and Zambia. In South Sudan, low literacy was identified as affecting data quality; in response later versions of the CHW register were redesigned to be pictorial to reduce errors. When gaps were identified in the data, supervisors explained that they would consult with CHWs for clarification. The integration of community level data within the HMIS remains a priority in South Sudan and Zambia.

*"Of course we are human and it is very possible for us to make mistakes. There are times when we attend to clients at night and having come from deep sleep, you record wrong details. All these are corrected until they correspond to what really happened."* (CHW, Zambia)

*"... when we run out of drugs, we also stop writing reports."* (CHW, Zambia)

Challenges cited in relation to data submission frequently referred to insufficient funds/transport availability and distance to health facilities, which for remotely located CHWs was exacerbated during the rainy season. Where supervisors were unavailable, CHWs discussed more reluctance to submit their data. In South Sudan, insecurity affecting Unity state led to extreme measures to collect data and provide CHWs with commodities.

*"Transport is another issue which is making our work very difficult because we are subjected to walking long distances ... for 12 kilometres. Even my shoes are worn out."* (CHW, Zambia)

*“Collecting data on time was affected by inaccessibility and insecurity. One time, one of the counties w[as] cut off... [the road] was mined and it took time to de-mine it.”* (Malaria Consortium staff, Unity state)

Data usage reportedly varied between and within countries. More similarities were identified in Uganda and Zambia where the data was commonly used to identify the general community case load against predicted numbers; to plan outreach activities; and to monitor CHW performance by comparing cases with diagnosis and treatment data. This use demonstrated the value placed on CHW data by health facilities and district health teams. In South Sudan, responses indicated that health facilities lacked the capacity to utilize data.

*“Sometimes, when there is an outbreak of a disease in the community, it’s very easy to bring such information to the health centre and indeed it’s my prime responsibility as a VHT to communicate such information and it’s also our work to ensure that we fight such an outbreak in our community.”* (CHW, Uganda)

*“We use it for analysing disease incidence among villagers or zones. So, we see where we have the heaviest disease burden or areas that need urgent relief... that helps us to plan malaria activities very much so that we can try to mitigate. Whenever reports indicate an outbreak, we also intensify our activities so that people are aware of malaria messages and prevention.”* (Health facility staff, Zambia)

In all countries there was an apparent need to strengthen the competencies of health professionals to improve data analysis and usage whilst also emphasizing value to encourage incorporation of the data into planning activities.

*“...data collection skills and analysis should be improved through capacity building trainings for the iCCM staff [at health facilities] and partners.”* (Health facility staff, South Sudan)

*“When we realised that data was not forthcoming we got [health facility] staff to collect the data so when they saw them they realised the importance of this data for planning purposes.”* (Malaria Consortium staff)

## Commodities and supply chain

The aim of integrating commodities into the public sector supply chain conflicted in practice with the need to distribute a comprehensive package of commodities quickly to lower levels of the health system in Uganda and Zambia during the initial stages of implementation. In South Sudan, it was necessary to deliver commodities directly to CHWs due to the absence of an effective national supply chain. Periods of stock outs were widely reported across countries and were more acute during the rainy season. Community level respondents agreed that stock outs negatively impacted community perceptions of iCCM and

even CHWs, who in some areas bore the brunt of the community’s frustrations, which several CHWs linked to reduced motivation and consequent attrition. Health facility staff observed a significant impact on their workload, which they reported increased when caregivers could not obtain treatment within their communities. Recommendations to strengthen the supply chain discussed basing quantification on consumption data and increasing buffer stock, especially in the rainy season. In Zambia, health facility staff across districts commented that there is an interchange of MOH commodities and iCCM supplies. For instance, if CHWs experience stock outs of anti-malarial drugs, the health centre may ‘top up’ their supplies; equally if health centres run low on RDTs or anti-malarial drugs, they may use iCCM stock.

Drug acceptability over time appeared to be universally high, with beneficiaries commenting on the quality and effectiveness of the medication.

*“When the child gets sick ... and if found with malaria, they give this child a dose and if you follow their instructions, the illness will be treated and that’s why we like this medication.”* (Beneficiary, Uganda)

Community acceptance of RDTs was cautious initially, increasing over time (RDTs were only included as part of iCCM in Zambia and the Western region of Uganda). In Uganda and Zambia this was attributed to a few concerns over the purpose of taking blood, specifically that the sample would be used for HIV testing or “satanic” purposes. CHWs and health facility staff appreciated the introduction of RDTs in identifying malaria cases prior to providing treatment and reducing the amount of anti-malarial drugs administered presumptively.

*“... the results are instant. So, children can start treatment immediately. This has helped us as the children do not become too sick as was the case in the past.”* (Beneficiary, Zambia)

*“...the introduction of iCCM helped us to treat what we are sure of. The use of the RDTs has helped to identify fever and ... has boosted our morale and self-esteem plus confidence before the caregivers ... Here Coartem is not wasted; it’s only given to the proved RDT positive cases.”* (Health facility staff, Uganda)

## Community involvement and support

It was widely reported that beneficiaries embraced iCCM and welcomed the introduction of the programme, which brought “relief” to beneficiaries, especially in remote and hard to reach locations. Most commonly this appreciation was attributed to the reduction in long distances for seeking care, followed by the availability of free treatment accessible at any time of day. Timely treatment, not having to “dress up” or face long wait times or stock outs at clinics were other appreciated aspects.

“The communities welcomed the programme and the selection of CHWs in that it made accessibility to health care possible ... some children used to die because most parents were failing to take them to the clinic due to long distances involved.” (CHW, Zambia)

*“When a child falls sick at night, we are able to rush to a VHT for quick treatment without being bothered by lack of money and distance as it used to be in the past.”* (Beneficiary, Uganda)

Despite what some beneficiaries considered a short training period, generally trust in CHWs increased over time as beneficiaries observed the CHWs’ effective case management and quality of care.

*“The initial response from the community was negative because these were normal community members, how do they start treating our children? ... but the VHTs sensitised the community about the medicine they have and later community accepted them especially when community saw that their drugs can heal their children.”* (Community leader, Uganda)

Across countries utilisation was reportedly high, with respondents in South Sudan commenting on a shift from traditional medicine to accessing CHW services in their communities. In Zambia several CHWs remarked that uptake had increased as awareness of iCCM amongst caregivers grew. Health facility staff in Uganda and Zambia reported that the number of malaria, pneumonia and diarrhoea cases (most commonly malaria) reduced significantly following the introduction of iCCM in their catchment areas. Community level respondents gave anecdotal accounts of a reduction in child deaths.

*“Community Health Workers are doing a good job and this also has reduced the number of deaths in children under the age of five because long before iCCM was introduced children under the age of five used to die a lot due to long distances to health centres but ever since the programme was introduced, the numbers of deaths have reduced.”* (Beneficiary, Zambia)

The majority of respondents across the three countries felt that most beneficiaries heeded CHWs’ referrals to a health facility, often due to concerns over the health complications if the child were not treated. According to community level respondents, caregivers faced a range of barriers to accessing health facilities following a CHW’s referral, including: distance, cost (transport, consultation and treatment); which were the most frequently cited by respondents residing in remote locations. Long waiting times and stock outs at health facilities were considered other challenges, as were tribal differences and language barriers. Consequently, caregivers would alternatively access private pharmacies nearby or traditional healers if unable to travel to a health facility.

CHW workload mostly varied between “manageable” and “heavy” with a few reports that CHWs encountered chal-

lenges in combining CHW service provision with personal duties. Community leadership support for CHWs was identified as influencing overall community support for CHWs, which was manifested most commonly as service utilisation, verbal thanks, followed by recognition, small tokens of appreciation and in Zambia, assistance with cultivating plots of land. In Uganda, a common misconception amongst beneficiaries was the belief that CHWs received a salary, which CHWs explained discouraged caregivers from providing support. CHW attrition was reportedly due to an absence of financial incentives (often referred to in the data as “motivation”) and weak community support. A frequent recommendation was to enhance sensitisation on the role communities can play in supporting iCCM.

*“Only areas where headmen are serious about this programme ... are areas where the headmen are very committed and they make sure that the community helps you.”* (CHW, Zambia)

*“... attrition among CHWs does happen in our community because some of them feel that they are not receiving enough support from the community; especially during farming season. They are failing to provide for their families since they spend much of their time providing health care services to the community at the expense of their families.”* (Community leader, Zambia)

### Behaviour change communication

The role of community leaders in delivering behaviour change communication (BCC) messages was cited as key across countries. Where implemented, community dialogues, which involved providing a platform for beneficiaries to discuss aspects of iCCM, were viewed as successful.

*“I think the most effective communication method was through the LC [community leader] because he is near the community members.”* (Health facility staff, Uganda)

*“[The BCC strategy] has helped in reducing cases of malaria in our communities. Initially, we also did a lot of mobilisation and community programmes, which helped inform people on the purpose and process of the iCCM programme. It has mostly been by community engagement.”* (Community leader, Zambia)

Community level respondents reported the value of BCC activities, specifically in promoting the use of CHWs, encouraging trust in western medicine and boosting CHW motivation. In Zambia and particularly in South Sudan, respondents across target groups observed that BCC had been instrumental in shifting attitudes towards western medicine and ultimately health seeking behaviour amongst caregivers. Several respondents also associated BCC effectiveness with increased service utilisation and in encouraging trust between caregivers and CHWs, who were viewed as successful in implementing change within their communities.

*“The regular meetings have really helped because the people have so much faith and trust in the CHWs now.”* (Community leader, Zambia)

*“... our being announced over the radio is an official introduction to the bigger world beyond our communities and this gives us recognition and morale.”* (CHW, Uganda)

*“Few people were now using traditional herbs for the treatment of children sickness in the villages.”* (Community leader, South Sudan)

Recurrent recommendations were to enhance BCC activities in terms of range and frequency, particularly in the early stages of implementation. Community structures, such as the Village Health Clubs in Uganda as well as community and religious leaders across countries were highlighted as optimal channels to disseminate BCC messages and engage communities.

*“...sensitisation should be widespread in the community and there should be genuine consultation.”* (Community leader, Zambia)

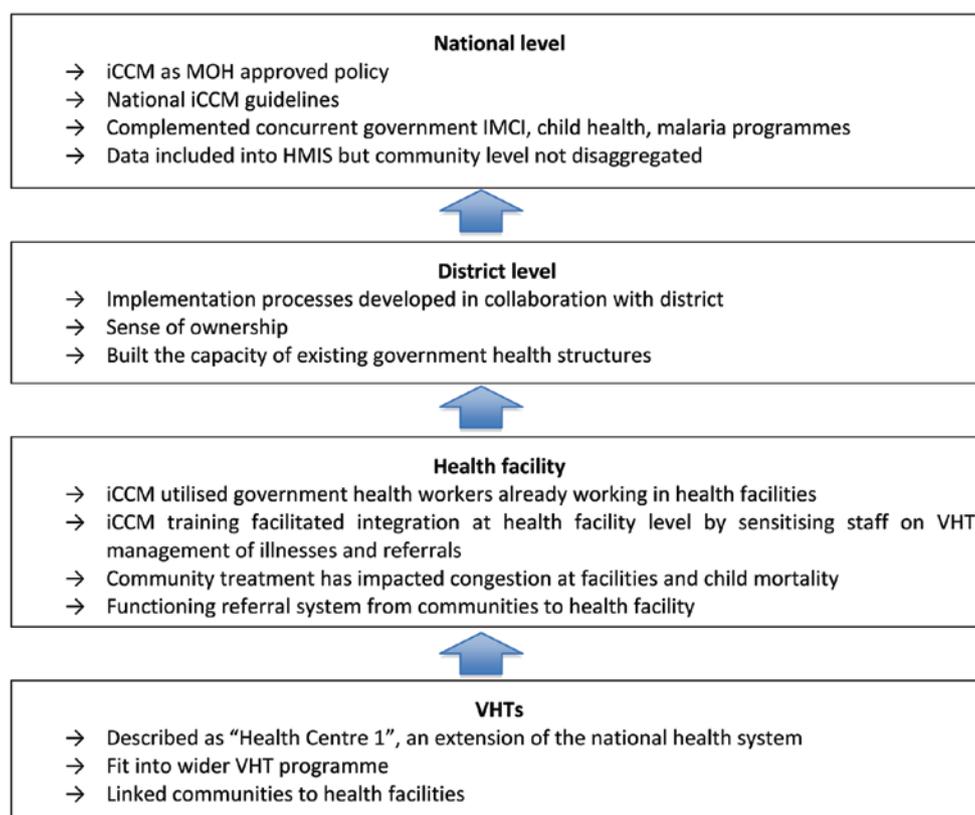
### iCCM integration

The consensus amongst respondents was that iCCM had been well integrated into the health system through implementation within existing health structures and in line with the MOH's objectives to reduce under five morbidity and

mortality. The collaboration between Malaria Consortium and local health teams promoted the transference of skills and implementation processes to the districts, building local capacity and according to several respondents in Uganda, creating a sense of ownership (see **Figure 1** for multi-level iCCM integration as described by respondents in Uganda).

Support from health facility staffs at all levels was reported to be generally high. In South Sudan, one recommendation was to strengthen the capacity of health workers and promote the procurement and distribution of second line treatment for severe cases of malaria, pneumonia, diarrhoea and malnutrition. Discussions around sustainability highlighted challenges such as commodities procurement, supporting the supply chain and motivating CHWs. Respondents at each level recognised that in order for iCCM to become sustainable, communities would need to support CHWs whilst the MOH at local, district, provincial and national levels would need to advocate for continued support of the programme, allocating funding and providing logistical support.

*“iCCM is a novel approach because previously we just used the IMCI. But iCCM encompasses the IMCI principles and also other principles to be able to manage the children. Further, I think this one also involves the use of the iCCM community members or volunteers and it goes a step further by empower-*



**Figure 1.** Multi-level iCCM integration as described by respondents in Uganda.

ing them with medication and skills to be able to treat or manage children at the community level.” (MOH official, Zambia)

“iCCM is using health systems that were already in place since its introduction. At community level, they are using the VHT system which started in 2004. So iCCM is well integrated in the Ugandan health care system . . . What is needed now is taking up the use of iCCM drugs in health facilities. Further, we exchange data with iCCM and this is a sign of integration” (District health official, Uganda)

## DISCUSSION

Respondent experiences overall indicated that implementation followed national guidelines or agreed approach. Deviations from the implementation plans were often in response to operational challenges. New processes such as the introduction of parish coordinators to address gaps in CHW support supervision (in Uganda) and how data are utilised by health facilities and lower level MOH to inform community outreach activities which occurred during implementation (though not specifically described in official guidelines) could be formally incorporated into the iCCM country programmes. Generally, the data from Uganda and Zambia have more commonalities, most likely due to their socioeconomic similarities, compared to South Sudan, which has recently emerged from a protracted conflict.

The overall findings are discussed here around the themes of access, quality, demand, impact and policy, which are based on a results framework adapted by the CCM Operations Research group to assess intermediate results during the outcome of evaluation phase of iCCM implementation<sup>2</sup>.

### Access

As described throughout the data, respondents widely appreciated that health services had been brought to communities, facilitating timely and accessible treatment which they anecdotally reported reduced under-five cases and deaths and lessened the caseload at health facilities. Community level respondents located in remote and hard to reach locations far from health facilities (>5 km) who faced significant barriers in accessing health services, including distance and transportation costs, were even more vocal in their praise of iCCM services, indicating that future implementation should continue to target these communities. However, the success of iCCM in reducing under-five morbidity and mortality in hard to reach communities partly relies on the capacity of health facilities serving these catchment areas to appropriately manage referred cases. The factor that most affected the availability of services was stock outs. Enabling a regular supply, which is quantified based on actual consumption, especially in relation to seasonal increases in disease incidence, should remain a priority.

## Quality

Selecting appropriate CHWs through a democratic, participatory selection process, adopting participatory training approaches to promote sound comprehension of the course content, and providing refresher training and regular support supervision appeared to result in stronger CHW service provision and motivation which has been found by others<sup>16</sup>. This in turn encouraged caregivers to access treatment, and empowered CHWs to effectively deliver community health services to a high quality standard, as well as to improve the quality of the data they submitted. The motivational effect of supervision was identified in a previous study which found that, “Many participants considered supervision to be the most important factor for maintaining a functional cadre of motivated CHWs stressing its potential for conveying a sense of belonging and connectedness to the program” [10].

While there is a need to strengthen a few areas of the programme at community level, particularly CHW use of respiratory timers and the completeness and accuracy of the data amongst weaker CHWs, respondents agreed that the quality of care and specific commodities was generally high. Support supervision was highlighted as an area both in the data and other literature<sup>3</sup> that could be enhanced with regards to frequency and an emphasis on CHW home visits. This would also require stronger support from sub-national levels of the health system, specifically more prioritisation and logistical support, in the form of transport, and funding.

## Demand

There was a high level of acceptability of iCCM and CHWs by communities and health facilities, which led to a high demand for services. This appeared to be closely related to the extent and quality of sensitisation and engagement during the initial phase of implementation. At health facility and district levels, this took the form of collaboration during the planning stages. For health facility staff, acceptability and support seemed to hinge very much on being adequately informed about the programme and financial facilitation for their participation throughout. At the community level, where members selected CHWs through a transparent, participatory process, and were sufficiently sensitised on the CHW role and services, utilisation and demand for services was reportedly higher. The data highlights how iCCM addressed community needs, which in turn affected demand for these services. Initially, although iCCM was generally embraced by communities, there were some concerns around the short duration of the CHW training that community members felt may have been insufficient. Nevertheless, these doubts diminished over time as CHWs proved themselves capable of managing cases. It

was noted that demand was negatively impacted by stock outs, which in some instances altered community perceptions of iCCM, leading to a loss of faith in the programme among community members and decreased morale as identified by a few CHWs. Substantial anecdotal evidence as presented in the Results section indicates an increase in CHWs as the first point of contact for sick children following the introduction of iCCM, which is supported by the findings of the endline surveys from all three countries. The praise and appreciation for iCCM voiced by respondents across communities and numerous requests for the programme to continue further indicate that iCCM services will continue to be in high demand in communities where malaria, pneumonia and diarrhoea remain major threats to the lives of children.

Ownership of the programme contributed to the successful implementation of the programme, community demand for services and has implications for sustainability. Specifically, when communities feel that the CHWs they selected are “theirs”, caregivers were more likely to access and support the programme. When district/county health teams fully own the programme and view activities such as support supervision as their responsibility (rather than a parallel activity conducted by NGO partners), iCCM will be better integrated into the health system and ultimately more sustainable. A sense of ownership at central level (MOH, MCH, NMCP, national drug authorities) can encourage officials to allocate funding for iCCM, whilst at sub-national level officials may be more likely to provide logistical support and prioritise resources to sustain iCCM. Ownership and use of iCCM data at central level would promote incorporation into the HMIS tool, while at lower levels, it could encourage motivation and prioritisation by demonstrating the value of the data at national level. Moreover, this could inspire the sub national level to support consistent data collection as well as data analysis and use, for instance for drug quantification, assessing the performance of CHWs, filling support supervision gaps and planning community health outreach activities.

## Impact

The positive impact of iCCM reverberated throughout the data from anecdotal accounts of reductions in child morbidity and mortality from both community and health facility level respondents; across the board, respondents discussed how iCCM had made a significant difference to community child health in their districts. Health facility staff expressed appreciation over how outpatient departments were less congested, with fewer cases (of the three target diseases) presenting at their facilities. BCC messages on seeking timely and appropriate treatment reportedly led caregivers to favour CHWs over traditional healers as first

point of contact and to follow CHW referrals to a health facility according to respondents in all three countries.

## Policy

The MOHs across countries already recognise iCCM as a priority in the fight against malaria and other fatal childhood illnesses, but support may need to be maintained for a significant allocation of the budget for iCCM commodities and activities, which may inspire the districts to follow suit to sustain the implementation of this lifesaving programme.

The use of mobile phone technology, usually referred to as mHealth, is currently being explored in many countries as a means of facilitating and strengthening core aspects of iCCM including data management, supervision and stock management. It is recognised that this approach has the potential to address many of the commonly encountered bottlenecks to effective implementation of iCCM programmes.

Sustainability was an implicit theme throughout discussions with respondents, with specific reference to procurement, the supply chain, support supervision and CHW motivation (financial and otherwise) and support. If the aim of an iCCM programme is to be integrated into the existing health structure as far as possible, funding and support from the national and sub national level MOH is vital. Through all levels of the health system, recognising iCCM as an important strategy for childrens' health, through sensitisation, regular planning and a clear understanding of roles and responsibilities is key to supporting the programme in the long term. Challenges such as human resource gaps at health facilities, particularly in rural areas, hinder effective support supervision and effective management of referred cases, which in turn affects VHT morale and motivation highlight the need to support peripheral health facilities as an integral part of creating a sustainable and well accepted iCCM programme. The distribution of supplies is another aspect that could be strengthened through collaboration with the public supply chain and the districts to promote timely delivery of supplies to avoid stock outs and maintain strong community support for the programme.

## Recommendations

Experiences of iCCM implementation sourced from the 646 individuals included in this multi-country participatory evaluation provide insight into how iCCM can be strengthened from community to national level. Key programmatic recommendations to enhance the effectiveness, quality and sustainability of future iCCM implementation and scale up for the MOH and implementing partners are presented in **Table 3**. Many of the recommendations that

**Table 3.** Specific recommendations for future iCCM implementation

THEME	RECOMMENDATIONS
<b>Central level preparation</b>	<ul style="list-style-type: none"> <li>• Clear timeframe for the development/ revision of guidelines with multiple stakeholders</li> <li>• Effective collaboration with the MOH at district level in the detailed planning for implementation start up</li> <li>• Contingency funds for unforeseen costs such as health promotion and disease prevention training prior to iCCM training for CHWs who have not received it</li> </ul>
<b>District level introduction</b>	<ul style="list-style-type: none"> <li>• Close collaboration with districts and central level implementers from outset in terms of planning, costing and implementation</li> <li>• Sensitise all health facility staff (where possible)</li> </ul>
<b>CHW selection</b>	<ul style="list-style-type: none"> <li>• Timely and enhanced sensitisation prior to CHW selection to promote familiarity with the guidelines, transparency on the voluntary nature of the role and community participation.</li> <li>• Involve districts, health facility staff in monitoring selection process</li> <li>• CHW selection criteria to include an age range (ie, 18–45)</li> </ul>
<b>Training and capacity building</b>	<ul style="list-style-type: none"> <li>• Maintain a participatory and interactive approach to training, utilise videos, visits to health facilities where possible. Translate key terms into local languages</li> <li>• Adapt training materials to the context and participants' level of comprehension/literacy and numeracy levels</li> <li>• Allocate more time during the training to focus on challenging areas, specifically pneumonia diagnosis and the use of respiratory timers, data management and stock management and for trainers, enhancing supervisory skills</li> <li>• More focus on the newborn care component where this is part of the national policy</li> <li>• Extend the CHW training from six to ten days to enable better digest of content and practice in application, particularly relating to challenging parts of the course</li> <li>• Conduct a standardised test at the end of the training and provide a certificate for those who have passed</li> <li>• Provide refresher training for CHWs which focuses on problem areas identified through supervision</li> </ul>
<b>Support supervision</b>	<ul style="list-style-type: none"> <li>• Supervisors to visit CHWs (home visits) within one month of initial training to review application of new skills/ knowledge in practice and to motivate CHWs</li> <li>• Regular support supervision at frequent intervals (quarterly)</li> <li>• Prioritise support supervision within the MOH so that logistical support is provided and sustained</li> <li>• Promote district ownership and logistical support for supervision activities as far as possible, including integrating with other activities such as data collection/management</li> <li>• Link support supervision to CHW register data to identify gaps in knowledge, stock and assess CHW performance</li> <li>• Move towards competency based supervision and tools</li> <li>• Introduce supervisors for CHW supervisors– ie, another level of supervision</li> </ul>
<b>Data management</b>	<ul style="list-style-type: none"> <li>• Sensitise CHWs, health facility staff and DHMTs on the importance and uses of iCCM data, for instance in quantifying stock, identifying missing data in CHW registers, assessing CHW performance, planning disease control/community health activities</li> <li>• Build the data analysis and management capacity of health facility staff and DHTs</li> <li>• Clarify and communicate roles and responsibilities among health facility staff to support better prioritisation of data management activities</li> <li>• Advocate for, and support the process for, the integration of community level iCCM data into the HMIS tool</li> <li>• Provide equipment to CHWs to facilitate data submission (eg, bicycles, gumboots, rain coats)</li> <li>• Document data submission systems that have worked and share with implementers</li> <li>• Encourage health facilities using data as feedback for mapping trends and quantifying stock, to share their experiences with facilities that do not do this</li> <li>• Create mechanisms and templates for districts to feedback relevant iCCM data summaries to health facilities and CHWs</li> <li>• Scale up mHealth for data management and as a means of supervision and motivation of CHWs in locations where mobile phone networks have sufficient reliability and capacity</li> <li>• Provide CHWs with solar panels where possible to establish a consistent power supply to charge phones</li> </ul>
<b>Commodities and supply chain</b>	<ul style="list-style-type: none"> <li>• Integrate iCCM commodities into national public supply chain from outset</li> <li>• Support for improved commodity flow through the district, with an emphasis on integration with the district supply chain, where this can be properly supported</li> <li>• Adjust quantity of RDTs, artemisinin-based combination therapy and amoxicillin based on actual consumption data and continue to revise in line with data generated to avoid stock outs</li> <li>• Supply health facilities with buffer stock, especially during the rainy season (RDTs, artemisinin-based combination therapy)</li> <li>• Share distribution records with the district as needed to facilitate ownership of the process</li> </ul>

Table 3. Continued

THEME	RECOMMENDATIONS
<b>Community involvement and support</b>	<ul style="list-style-type: none"> <li>• Emphasise sensitisation and regular community consultation through community leaders and community health committees or similar; specifically on the role of CHWs, the scope of iCCM services and the role of the community in supporting CHWs</li> <li>• Encourage a more sustainable mechanism through which communities can support CHWs, for instance cultivating land, assisting with chores, or material contributions— positive examples could be shared with other communities</li> </ul>
<b>Behaviour change communication (BCC)</b>	<ul style="list-style-type: none"> <li>• Roll out BCC activities prior to iCCM implementation in communities to raise awareness about CHWs, iCCM services to promote demand</li> <li>• Contextualise BCC activities as much as possible based on existing information and initiatives; special consideration for hard to reach areas so that the most effective methods for those locations are utilised (ie, community gatherings vs radio if coverage is poor)</li> <li>• Utilise interactive approaches such as community dialogues, storytelling/posters</li> <li>• Emphasise specific key messages during BCC activities: <ul style="list-style-type: none"> <li>– Promote timely and effective utilisation of iCCM services</li> <li>– The importance of community participation in the CHW selection process</li> <li>– The voluntary nature of the CHW role</li> <li>– The role of the community in supporting CHWs</li> <li>– Clarification on the purpose of RDTs, specifically what the blood is being tested for to avoid misconceptions</li> </ul> </li> </ul>
<b>Management and coordination</b>	<ul style="list-style-type: none"> <li>• Enhance information sharing of results and surveys between implementing partners and DHTs</li> <li>• Document roles and responsibilities ie, through Memorandums of Understanding (MoUs) to serve as a record of agreed processes</li> <li>• Improve collaboration and more frequent communication between implementing partners, the district and the different levels of the health system to enable effective implementation and address challenges</li> </ul>
<b>Integration</b>	<ul style="list-style-type: none"> <li>• Advocate for the MOH and donors to prioritise iCCM in terms of funding and logistical support</li> <li>• Facilitate visits from central MOH and donors both at start-up and during implementation to share experiences and promote the value of the programme</li> <li>• Prioritise addressing the gaps in support supervision and data management</li> <li>• Strengthen the supply chain to facilitate the timely and frequent delivery of iCCM commodities</li> <li>• More collaboration with the district during planning stage on how best to integrate iCCM activities into district level plans and budget</li> </ul>
<b>Technical and geographical scope</b>	<ul style="list-style-type: none"> <li>• Strengthen current iCCM activities before widening the scope in terms of age or coverage</li> <li>• Continue to/ prioritise hard to reach locations</li> <li>• Gather and share more evidence to inform appropriate CHW/ population ratios</li> </ul>
<b>Evaluation</b>	<ul style="list-style-type: none"> <li>• Evaluate programme impact and feedback findings to all levels of the MOH, partners and communities</li> <li>• Involve the districts closely in all monitoring and evaluation activities</li> <li>• Strengthen local capacity to undertake monitoring and evaluation activities</li> </ul>

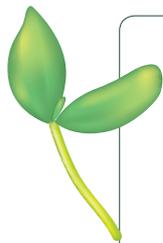
CHW – community health worker, iCCM – integrated community case management, MOH – Ministry of Health, DH(M)T – district health (management) team, HMIS – health information management system, RDT – rapid diagnostic test

emerged from this study are consistent with other iCCM programme evaluations [16–19].

## CONCLUSIONS

This qualitative study offers a valuable contribution in understanding the “hows” of implementation, and uncovers many implications for improved feasibility and

acceptability of iCCM in practice. The findings clearly demonstrate that community support to iCCM and CHWs is necessary for sustained health benefits while keeping a focus on strengthening and “enabling” the public health system. The use of participatory methodologies enabled the scope of the research enquiry to be context specific and to be inclusive of stakeholders at all levels.



**Acknowledgments:** Our deepest thanks to the members of our research teams and the lead consultants – Derrick Elemu, Warren Aryeija, Tabitha Kibuka, Martin Akena. We would also like to thank all participants of this study for sharing their valuable views and experiences.

**Ethics approval:** The study protocol and tools were approved by Makerere College of Health Sciences, School of Public Health Institutional Review Board, Republic of South Sudan MOH Ethical Review Board and ERES Converge (a private Zambian Institutional Review Board recognised by the MOH).

**Funding:** This research was supported by funding from the UK government and was conducted alongside implementation of iCCM which was supported by Canadian International Development Agency in the three countries, as well as UNICEF in Uganda and UK government in South Sudan.

**Authorship declaration:** CS, AWS, HC and JKT contributed towards the conception and design of the study. AWS, ChS, JS, DM, JM and MG were responsible for the acquisition of data. AWS and CS analysed and interpreted the data, with significant input from HC. AWS drafted the manuscript with significant input from CS and HC. All authors have given final approval of the version to be published.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). All authors declare no conflict of interest in relation to this study.

## REFERENCES

- Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG, et al. Global, regional, and national causes of child mortality in 2008: a systematic analysis. *Lancet*. 2010;375:1969-87. Medline:20466419 doi:10.1016/S0140-6736(10)60549-1
- Marsh DR, Hamer DH, Pagnoni F, Peterson S. Introduction to a special supplement: evidence for the implementation, effects and impact of the Integrated Community Case Management strategy to treat childhood infection. *Am J Trop Med Hyg*. 2012;87 Suppl:2-5. Medline:23136271 doi:10.4269/ajtmh.2012.12-0504
- Young M, Wolfheim C, Marsh DR, Hammamy D. World Health Organisation/United Nations Children's Fund Joint Statement on Integrated Community Case Management: An equity-focused strategy to improve access to essential treatment services for children. *Am J Trop Med Hyg*. 2012;87 Suppl:6-10. Medline:23136272 doi:10.4269/ajtmh.2012.12-0221
- Mukanga D, Tiono AB, Anyorigiya T, Kallander K, Konate AT, Oduro AR, et al. Integrated community case management of fever in children under five using rapid diagnostic tests and respiratory rate counting: a multi-country cluster randomized trial. *Am J Trop Med Hyg*. 2012;87 Suppl:21-9. Medline:23136274 doi:10.4269/ajtmh.2012.11-0816
- Hamer DH, Marsh DR, Peterson S, Pagnoni F. Impact of integrated community case management on health-seeking behavior in rural Zambia. *Am J Trop Med Hyg*. 2012;87 Suppl:151-3. Medline:23136291 doi:10.4269/ajtmh.2012.12-0505
- Chinbuah MA, Kager PA, Abbey M, Gyapong M, Awini E. Impact of community management of fever (using antimalarials with or without antibiotics) on childhood mortality: a cluster randomized controlled trial in Ghana. *Am J Trop Med Hyg*. 2012;87 Suppl:11-20. Medline:23136273 doi:10.4269/ajtmh.2012.12-0078
- Collins DH, Jarrah Z, Wright KD, Lee AC. The cost of integrated community health services for treating child pneumonia, diarrhoea, and malaria in three African countries: economic research using systematic sampling. *Lancet*. 2013;381 Suppl:S31. doi:10.1016/S0140-6736(13)61285-4
- Nanyonjo A, Nakirunda M, Makumbi F, Tomson G, Källander K. Community acceptability and adoption of integrated community case management in Uganda. *Am J Trop Med Hyg*. 2012;87 Suppl:97-104. Medline:23136284 doi:10.4269/ajtmh.2012.11-0763
- Källander K, Tibenderana JK, Akpogheneta OJ, Strachan DL, Hill Z, ten Asbroek AH, et al. Mobile health (mHealth) approaches and lessons for increased performance and retention of community health workers in low- and middle-income countries: a review. *J Med Internet Res*. 2013;15:e17. Medline:23353680 doi:10.2196/jmir.2130
- Strachan DL, Källander K, Ten Asbroek AH, Kirkwood B, Meek SR, Benton L, et al. Interventions to improve motivation and retention of community health workers delivering integrated community case management (iCCM): stakeholder perceptions and priorities. *Am J Trop Med Hyg*. 2012;87 Suppl:111-9. Medline:23136286 doi:10.4269/ajtmh.2012.12-0030
- Kalyango JN, Rutebemberwa E, Alfven T, Ssali S, Peterson S, Karamagi C. Performance of community health workers under integrated community case management of childhood illnesses in eastern Uganda. *Malar J*. 2012;11:282. Medline:22905758 doi:10.1186/1475-2875-11-282

- 12 Hamer DH, Marsh DR, Peterson S, Pagnoni F. Integrated Community Case Management: Next steps in addressing the implementation research agenda. *Am J Trop Med Hyg.* 2012;87 Suppl:151-3. Medline:23136291 doi:10.4269/ajtmh.2012.12-0505
- 13 Zukoski A, Luluquisen M. Participatory Evaluation: What is it? Why do it? What are the challenges? *Community Based Public Health Policy Pract.* 2002;2012:1-6. Medline:11982021
- 14 Sandelowski M. Sample size in qualitative research. *Res Nurs Health.* 1995;18:179-83. Medline:7899572 doi:10.1002/nur.4770180211
- 15 Pope C, Ziebland S, Mays N. Qualitative research in health care: analysing qualitative data. *BMJ.* 2000;320:114-6. Medline:10625273 doi:10.1136/bmj.320.7227.114
- 16 Population Services International. lessons learned from CIDA-funded community case management programs in Cameroun, DRC, Malawi and Mali, 26 July 2013. Available at: [http://www.psi.org/sites/default/files/publication\\_files/CIDA-lessons-learned.pdf](http://www.psi.org/sites/default/files/publication_files/CIDA-lessons-learned.pdf). Accessed: 20 August 2013.
- 17 USAID. Malawi community case management evaluation, May 2011. Available at: <http://www.mchip.net/sites/default/files/1.470%20Malawi%20CCM%20Evaluation%20FINAL%2009.12.11.pdf>. Accessed: 20 August 2013.
- 18 USAID. Integrated community case management of childhood illness. Documentation of Best Practices and bottlenecks to Programme Implementation in Senegal: Summary Report, January 2012. Available at: <http://www.mchip.net/sites/default/files/Senegal%20Summary%20English.pdf>. Accessed: 20 August 2013.
- 19 Concern Worldwide. Implementing community case management for malaria in Burundi: Concern Worldwide Learning Brief, 2012. Available at: [http://www.concernusa.org/media/pdf/2013/04/Burundi%20Malaria\\_learningbrief.pdf](http://www.concernusa.org/media/pdf/2013/04/Burundi%20Malaria_learningbrief.pdf). Accessed: 21 August 2013.

# Making products available among community health workers: Evidence for improving community health supply chains from Ethiopia, Malawi, and Rwanda

Yasmin Chandani<sup>1</sup>, Sarah Andersson<sup>2</sup>, Alexis Heaton<sup>2</sup>, Megan Noel<sup>2</sup>, Mildred Shieshia<sup>1</sup>, Amanda Mwiroti<sup>1</sup>, Kirstin Krudwig<sup>2</sup>, Humphreys Nsona<sup>3</sup>, Barbara Felling<sup>2</sup>

<sup>1</sup> JSI Research & Training Institute, Inc., Nairobi, Kenya

<sup>2</sup> JSI Research & Training Institute, Inc., Arlington, VA, USA

<sup>3</sup> Ministry of Health Malawi, Lilongwe, Malawi

**Background** A UNICEF review of the challenges to scaling up integrated community case management (iCCM) found that drug shortages were a common bottleneck. In many settings, little thought has gone into the design of supply chains to the community level and limited evidence exists for how to address these unique challenges. SC4CCM's purpose was to conduct intervention research to identify proven, simple, affordable solutions that address the unique supply chain challenges faced by CHWs and to demonstrate that supply chain constraints at the community level can be overcome.

**Methods** SC4CCM selected three countries to implement supply chain innovations and developed a theory of change (TOC) framework for the learning phase, which identified the main drivers of product availability and was used for baseline assessments, design, implementation and evaluation of interventions in Ethiopia, Malawi, and Rwanda. Interventions were developed in each country and tested over 12–24 months. Mixed-method follow up assessments were conducted in each country in 2012–2013. The Supply Chain for Community Case Management (SC4CCM) Project then simplified the TOC into a Community Health Supply Chain (CHSC) framework to enable cross country analysis

**Results** The findings from interventions in the three countries suggest that the greatest supply chain benefits are realized when all three CHSC framework elements (product flow, data flow, and effective people) are in place and working together. The synergistic effect of these three elements on supply chain performance was most effectively demonstrated by results from the Enhanced Management and Quality Collaborative interventions in Malawi and Rwanda, respectively, which were characterized by lower mean stockout rates and higher in stock rates on day of visit, when compared to other interventions.

**Conclusions** Many conditions are necessary to ensure continuous product availability at the community level, however a supply chain works best when three key elements (product flow, data flow, and effective people) are deliberately included as an integral part of the system design. Although these elements may be designed differently in different settings, streamlining and synchronizing them while ensuring inclusion of all components for each element improves supply chain performance and promotes product availability at the community level.

## Correspondence to:

Yasmin Chandani  
 JSI Research & Training Institute, Inc.  
 4th Floor 2nd wing  
 ABC Place, Westlands  
 P.O. Box 46566-00100  
 Nairobi  
 Kenya

A UNICEF review of the challenges to scaling up integrated community case management (iCCM) conducted in six countries found that drug shortages were one of the most frequently reported bottlenecks and were evident during the implementation and scale-up stages of iCCM [1]. Low or no product availability has even been shown to lead to delays in implementation of iCCM. One of the main conclusions of the March 2014 iCCM Evidence Review Symposium was the need to reduce stock outs in order to increase uptake of iCCM services [2].

Public health supply chains, of which the community is part, generally face chronic challenges in the areas of human resource capacity and skills, general management/management of processes, communication between levels, budget planning, physical infrastructure and capabilities and resources (including storage and distribution capacity), availability and use of data for management decisions, commitment and motivation, and accountability [3]. Each of these elements plays a role in disrupting the availability of essential medicines throughout the supply chain.

These problems are magnified at the community level, as a result of the unique challenges faced by community health workers (CHWs). CHW programs vary widely, but CHWs generally work in remote, rural locations characterized by difficult geographies. Transit to resupply points can be long and difficult and CHWs typically have limited transportation options, given the terrain; often they are forced to use non-motorized forms of transportation such as bikes, donkeys, camels, mules, boats, and even foot [4–6]. Public transport is uncommon and costly. Often, CHWs are not highly literate—which can cause challenges around recording, reporting, and submitting data—and often have no dedicated facility to work from. Medicines are often stored in drug boxes along with paperwork, and storage space is limited, potentially compromising the quality and security of product storage. CHWs in many countries are unpaid [7], increasing the need for motivation of these workers, especially with regard to supply chain (SC) tasks, which are often seen as tedious, time consuming, and burdensome. Finally, given that CHWs are at the end, or “last mile” of the supply chain, they have no platform for advocacy, so when shortages of essential medicines occur in the system, CHWs tend to miss out on supplies.

In many settings, little thought has gone into the design of supply chains to the community level—community health supply chains have not been deliberately designed to address the unique circumstances of CHWs [8]. Furthermore, limited evidence exists for how to address these unique challenges with a view to improving community health supply chain performance and product availability. The Supply Chain for Community Case Management (SC4CCM) Project’s purpose was to conduct intervention

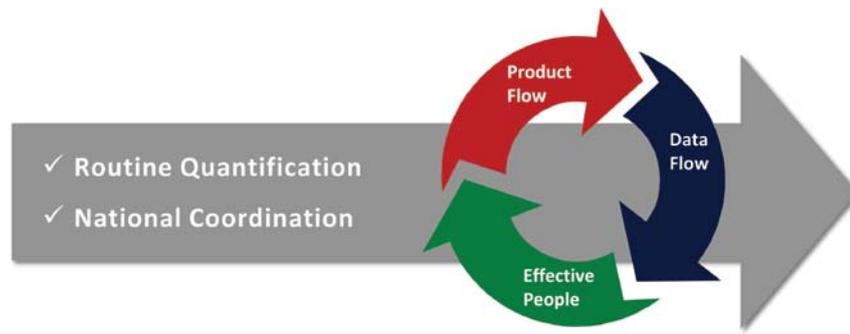
research to identify proven, simple, affordable solutions that address the unique supply chain challenges faced by CHWs and to demonstrate that supply chain constraints at the community level can be overcome. SC4CCM’s mandate was limited to strengthening the community level of the supply chain and did not include funding for commodity procurement. The project’s intent was to gather evidence on “game changing” interventions for ensuring product availability among CHWs, with the goal of helping countries achieve Millennium Development Goal (MDG) 4: Reduce Child Mortality.

This paper presents evidence from community health supply chain innovations implemented in the three project countries that confirm product flow, data flow and effective people as elements that need to be deliberately incorporated into design and which need to work together to effectively improve supply chain performance and the availability of life-saving medicines among CHWs.

### Program description and country context

SC4CCM selected three countries, using these criteria: existence of policies enabling CHWs to deliver the full package of iCCM services (including permission to treat pneumonia with antibiotics); existence of a diverse array of CHW profiles (volunteer vs paid; untrained, limited training, or extensive training); a basic minimum level of procurement for community-level products; and a country context in which JSI was familiar with the overall public health supply chain and its functionality. **Table 1** shows basic demographic and community health statistics for the selected countries.

**Theory of change framework.** SC4CCM developed a project theory of change (TOC) as a common framework for the learning phase, which identified the main drivers of product availability at the community level and the interrelationships and linkages between these drivers as well as those between the community and higher levels of the supply chain. The TOC identified five preconditions for the main outcome of interest (product availability among CHWs), and served as a framework for design, implementation and evaluation of interventions, providing core indicators for design and implementation of baseline assessment surveys conducted in 2010, in Ethiopia, Malawi, and Rwanda. Baseline findings confirmed the validity of the drivers, interrelationships, and linkages in the TOC, and allowed formulation of three country-specific TOCs [8]. Following the results of the follow up evaluation survey, SC4CCM simplified the TOC into the Community Health Supply Chain (CHSC) Framework, as presented in **Figure 1**, to categorize the necessary preconditions into the basic elements of product flow, data flow and effective people, validated as important for community supply chains. The



**Figure 1.** Community Health Supply Chain Framework (A simplified theory of change framework for strengthening the supply chain for iCCM).

**Table 1.** Selected data on population, health worker coverage, and iCCM for intervention countries

CHARACTERISTIC	MALAWI	RWANDA	ETHIOPIA
Population (thousands) (2012)*	14 573	10 537	84 838
Population, percentage rural (2010)†	80	81	83
Community and traditional health worker density (per 1000 population)*	0.732 (2008)	1.415 (2004)	0.364 (2009)
Community health policy with full iCCM package‡	2006	2008	2010 (pneumonia added)
iCCM implementation commenced§	2008	2008	2011
CHW name and profile (paid/unpaid, training duration etc)#	Health Surveillance Assistant (HSA). Paid cadre. Initial 12 weeks training in preventive health including primary health care, the EHP, community assessment and mobilization, the role of the VHC, CBHC, WASH, common diseases, patient follow up, and health education. Follow on trainings cover family planning, pre and postnatal care, immunization, nutrition, growth monitoring, iCCM, infection prevention and universal precautions.	Community Health Worker (CHW)/binomes. Volunteer cadre with performance paid based on results, and grouped in cooperatives with start up capital since 2008. 4 weeks training in primary health care services specializing in family planning and iCCM as well as providing information and education on the importance of pre and postnatal care, and other programs including CBP, CBNP, Immunization, DOT, NCDs.	Health Extension Worker (HEW). Paid cadre. 10 months training in environmental sanitation; health and nutrition education; pre and postnatal care; family planning; child health including immunization and iCCM; community mobilization.
Number of CHWs nationwide who manage iCCM products¶	3746	30 000	30 000
Number (and types) of products managed per CHW on routine basis (2010)**	Up to 19 (iCCM, FP, HIV)	~6–12 (iCCM, and/or FP)	50+ (iCCM, family planning (FP), HIV, vaccines, other essential medicines)

CBHC – community based health clinic, CBNP – community based nutrition program, CHW – community health worker, DOT – directly observed therapy for tuberculosis, EHP – essential health package, FP – family planning, HEW – health extension worker, HIV – human immunodeficiency virus, HSA – health surveillance assistant, iCCM – integrated community case management, NCDs – neglected communicable diseases, VHC – village health clinic, WASH – water sanitation and hygiene

\*Source: Republic of Rwanda National Institute of Statistics Rwanda: 2012 Population and Housing Census. Report on the Provisional Results, November 2012.

†WHO Global Health Observatory.

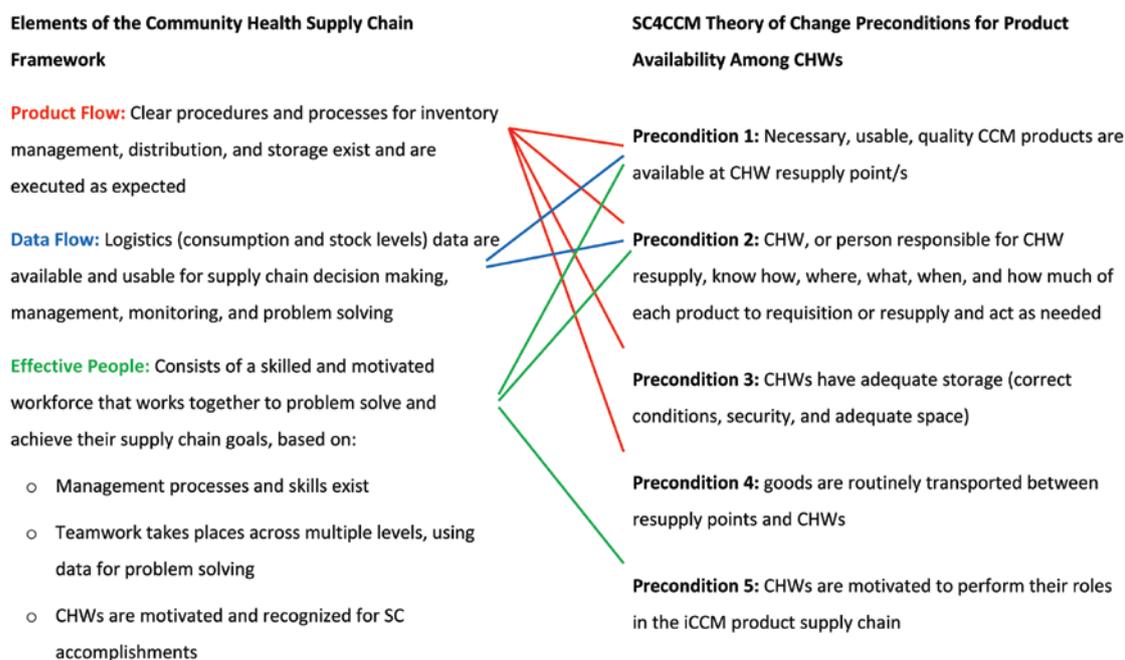
‡‘Full iCCM package’ defined as CHWs providing treatment for uncomplicated pneumonia, diarrhea, and malaria in children under five. Sources: Ethiopia National Implementation Plan for Community-based Case Management of Common Childhood Illness; IMCI Approach Policy For Accelerated Child Survival and Development in Malawi. 2006; Rwanda National Community Health Policy, 2008, respectively.

§Source: USAID Malawi Community Case Management Evaluation, May 2011, key informant interviews.

§Source: Advancing Partners in Communities Community Health Systems Catalog.

¶Source: UNICEF 2013 iCCM Survey.

\*\*Source: Advancing Partners in Communities Community Health Systems Catalog and key informant interviews.



**Figure 2.** Mapping elements of the Community Health Supply Chain Framework to SC4CCM Theory of Change Preconditions.

relationship between the TOC preconditions and the CHSC Framework is presented in **Figure 2**. The CHSC Framework enabled cross-country analysis as well as a demonstration of the interdependency of the three basic elements in enhancing supply chain effectiveness—vital information going into the scale-up phase.

*Product flow* describes how CHWs are resupplied—for example, using a demand-based system or a fixed-quantity supply—and requires clear procedures and processes for inventory management, distribution, and storage.

*Data flow* ensures that logistics (consumption and stock level) data are available and usable for supply chain decision making, management, monitoring, and problem solving. Data flow solutions incorporate mechanisms to capture logistics data at the lowest levels of the system and transmit it in a disaggregated form so that it can be useful for management and decision making. Data flow and product flow are interconnected as the correct data must be collected and visible to the right people to inform product flow.

*Effective people* refers to the workforce involved in making sure product flow and data flow happen; effective people ensure continuous use and improvement of SC skills and practices at the lower levels of the system, build district leadership and ownership for tackling community health SC problems rather than waiting for solutions from higher-level managers, and recognize CHW achievements.

Effective people encompasses:

- *Management processes and skills*, including clear standard operating procedures (SOPs), roles and responsibilities, and provision of SC training/skill and knowledge building,
- *Teamwork*, using a formal structure across multiple levels and/or tools to facilitate group problem solving toward common objectives,
- *Motivation and recognition of CHWs* for SC accomplishments. CHWs take on their responsibilities because they want to serve their community, but often they will need to be motivated to take on SC tasks.

Effective *national-level coordination* and *routine quantification* are fundamental keystones for continuous product availability by ensuring funding for and the timely procurement and distribution of medicines. Well-functioning systems include routine mechanisms for quantification, regular updates to forecasts and supply plans, and close coordination between Ministry of Health (MOH) programs, donors, quantification teams, and procurement units to ensure continuous product availability and to maximize the use of limited resources. In particular, routine quantification and coordination are necessary for ensuring continuous availability of products at the resupply points for CHWs, which in turn is a prerequisite for ensuring that CHWs have products. While we present evidence that

product flow, data flow, and effective people will help programs maximize community health supply chain *performance*, quantification and coordination ensure that there are *products available* to flow through the supply chain so that performance can be improved.

Our presentation of results in this paper will focus mainly on the evidence related to the CHSC Framework, since the project did not have a mandate to fully participate in all aspects of quantification and procurement, thus limiting our available evidence.

**Intervention design using theory of change framework and data.** The baseline surveys showed poor combined availability of products required to provide iCCM services among CHWs on the day of visit (DOV) in all countries [8]. **Table 2** shows country findings at baseline. Country-specific results from the baseline surveys were organized according to the original TOC to analyze bottlenecks in the supply chain affecting product availability at the community level. After assembling preliminary results, the project presented findings to in-country stakeholders and repre-

**Table 2.** Baseline LIAT survey results, all countries

Supply chain performance indicator	COUNTRIES		
	Malawi (No. CHW = 139)	Rwanda (No. CHW = 321)	Ethiopia (No. CHW = 240)
<b>Product availability at community level (DOV)</b>	<ul style="list-style-type: none"> <li>• 27% of CHWs had 4 key iCCM products on day of visit (cotrimoxazole, ORS, ACTs 1×6 and ACTs 2×6)</li> <li>• 35% of CHWs had 3 key iCCM products on day of visit (cotrimoxazole, ORS, and either ACTs 1×6 or ACTs 2×6)</li> </ul>	<ul style="list-style-type: none"> <li>• 49% of CHWs had 5 key iCCM products on day of visit (amoxicillin, ORS, zinc, ACTs 1×6, Primo Rouge [ACT 1×6] and Primo Jaune [ACTs 2×6])</li> </ul>	<ul style="list-style-type: none"> <li>• 24% of CHWs had 5 tracer iCCM and FP products in stock on day of visit (ORS, RUTF, COCs, DMPA, and any ACT) (Zinc and cotrimoxazole introduced after baseline)</li> </ul>
<b>Product flow</b>	<p>Demand-based resupply but using non-standardized forms and data not consistently used for resupply:</p> <ul style="list-style-type: none"> <li>• 56% of HC staff determined resupply quantities using a standard formula, though 10% used the same quantity as last month, 5% used knowledge from past experience, 5% used another method, and 23% did not know.</li> </ul> <p>Transportation is a constraint for CHWs in collecting products:</p> <ul style="list-style-type: none"> <li>• 18% of CHWs identified a transport related challenge as their number one challenge with collecting and receiving supplies. The problems included “it was too long to reach the resupply point,” “there was no transport available,” “the transport was always broken” and “difficulties carrying supplies.”</li> </ul>	<p>Unstructured approach with no defined rules or process to drive resupply:</p> <ul style="list-style-type: none"> <li>• 62% of HCs resupplied based on (non-standard) documentation; 19% of HCs used a variety of (“other”) methods; 8% of HCs provided the same as last month; 7% and 4% of HCs “didn’t know” or used a formula, respectively</li> </ul>	<p>Transitioning to a demand-based system, Integrated Pharmaceutical Logistics System (IPLS), but using fixed-quantity supply (kits):</p> <ul style="list-style-type: none"> <li>• More than 50% of CHWs reported submitting requests when stock runs low or when they stock out</li> <li>• 66% of CHWs report getting their health products from the HC, 44% report getting from the district health office</li> </ul>
<b>Data flow</b>	<p>Despite the existence for SC procedures, visibility of CHW logistics data was poor at higher levels:</p> <ul style="list-style-type: none"> <li>• 43% of CHWs reported to HCs using a standard form</li> <li>• 55% of HC staff across ten districts (n=73) reported HSA supply chain data up to district level, and 14% reported this data disaggregated from HC data</li> </ul>	<p>Misaligned reporting system, where data flow did not support decision making:</p> <ul style="list-style-type: none"> <li>• 97% of CHWs received products from HCs, but only 54% of CHWs submitted logistics data to HCs</li> </ul>	<p>Due to lack of training and kit system, CHWs were not using the manual IPLS reporting system for iCCM products:</p> <ul style="list-style-type: none"> <li>• CHWs mentioned 6–7 different reports that they submitted regularly with no single report having more than 30% of HEWs using them.</li> <li>• 14% of CHWs reported using some kind of stock keeping record</li> </ul>
<b>Effective people</b>	<p>SC procedures existed, including LMIS forms for CHWs, and CHWs were trained but challenges were identified in supervision and motivation:</p> <ul style="list-style-type: none"> <li>• 50% reported supervision on SC tasks</li> <li>• When asked about job satisfaction, about 20% of HSAs who manage products ranked a ‘2’ or ‘3’ out of ‘5’</li> </ul>	<p>No harmonized procedures for determining resupply quantities for CHWs existed:</p> <ul style="list-style-type: none"> <li>• CHW motivation to travel and collect products threatened by challenges they mentioned with remuneration (40%), transport (27%) and storage (11%)</li> </ul>	<p>Low SC knowledge and skills among CHWs and their HCs:</p> <ul style="list-style-type: none"> <li>• Only 11% of CHWs and 8% of HC staff had received SC training</li> </ul>

ACT – artemisin-based combination therapy, CHW – community health worker, COC – combined oral contraceptive, DMPA – Depo Provera, DOV – day of visit, FP – family planning, HC – health center, HSA – health surveillance assistant, IPLS – Integrated Pharmaceutical Logistics System, LMIS – logistics management information system, ORS = oral rehydration solution, RUTF – ready-to-use therapeutic food, SC – supply chain

**Table 3.** Design of country intervention packages

	DEFINITION	MALAWI		RWANDA		ETHIOPIA
<b>Intervention package</b>		Enhanced Management (EM), in 3 of 28 districts nationwide*	Efficient Product Transport (EPT), in 3 of 28 districts nationwide*	Quality Collaboratives (QCs), in 3 of 31 districts nationwide†	Incentives for Community Supply Chain Improvement (IcSCI), in 3 of 31 districts nationwide‡	Ready Lessons and Problem Solving, in 28 of ~765 woredas nationwide‡
<b>Product flow</b>	Clear procedures and processes for inventory management, distribution, and storage exist and are executed as expected	cStock: mHealth reporting and resupply system for CHWs	cStock Continuous review inventory control system / bicycle maintenance	Standard Resupply Procedures (RSP)	RSP	Ready Lessons
<b>Data flow</b>	Logistics (consumption and stock levels) data are available and usable for supply chain decision making, management, monitoring, and problem solving	cStock	cStock	RSP	RSP	Ready Lessons
<b>Effective people</b>	Consists of a skilled and motivated workforce that works together to problem solve and achieve their supply chain goals, based on: <ul style="list-style-type: none"> <li>• Management processes and skills</li> <li>• Teamwork across multiple levels, using data for problem solving</li> <li>• CHWs motivated and recognized for SC accomplishments</li> </ul>	DPATs	None	Teamwork: Quality Improvement Teams (QITs) Motivation: Allowances	Motivation: Allowances and performance-based incentive paid to CHW cooperative	Ready Lessons Problem Solving

ACT – artemisin–based combination therapy, CHW – community health worker, EM – enhanced management, DMPA – depo provera/depot medroxy-progesterone acetate, DPAT – district product availability teams, EPT – efficient product transport, FP – family planning, IcSCI – incentives for community supply chain improvement, mHealth – mobile health, ORS – oral rehydration solution, QIT – Quality Improvement Team, QC – Quality Collaboratives, RSP – standar resupply procedures, RUTF – ready-to-use therapeutic food, SC – supllly chain

\*Source: CIA World Factbook. Available at: <https://www.cia.gov/library/publications/the-world-factbook/geos/mi.html>; accessed: 10 November, 2014.

†Source: National Institute of Statistics, Rwanda; 2006. Available at: <http://www.statistics.gov.rw/geodata>. Accessed: 10 November, 2014.

‡Source: Population and Housing Census Report – Country – 2007. Central Statistical Agency, 2010–2007. Available at: [http://www.csa.gov.et/newc-saweb/images/documents/surveys/Population%20and%20Housing%20census/ETH-pop-2007/survey0/data/Doc/Reports/National\\_Statistical.pdf](http://www.csa.gov.et/newc-saweb/images/documents/surveys/Population%20and%20Housing%20census/ETH-pop-2007/survey0/data/Doc/Reports/National_Statistical.pdf). Accessed: 10 November, 2014.

sentatives of all levels of the supply chain in a series of participatory data validation workshops, which served to both validate results and obtain inputs for designing intervention packages. In all countries, data supported the possibility of testing more than one approach to improving outcomes, but also indicated that intervention packages required a two-phase approach to lay a strong foundation in supply chain knowledge, skills, and procedures before implementing “value-added” innovations. Intervention packages are shown in **Table 3**. The testing period ranged from 12 to 24 months and was characterized by regular monitoring to guide intervention support and adjust the intervention design toward achieving the respective objectives.

**1. Malawi.** At baseline, Malawi was in the process of implementing a demand-based resupply system; however, data was not visible at all levels of the system with only 55% of health center staff across ten districts reporting

CHW supply chain data up to district level, and only 14% reported this data disaggregated from health center data; therefore CHW-specific supply chain data was not available for management decision making or performance monitoring at higher levels of the system. Reporting rates were low and few data were available to district managers for identifying and resolving stock outs or other management issues. Given that 89% of the CHWs surveyed at the 2010 baseline had mobile phones, and network coverage was high, the project developed a simple SMS and web-accessible reporting and resupply system, cStock. cStock was intended to improve the resupply process by enhancing communication between CHWs and their resupply points, to facilitate visibility of real-time CHW logistics data at district and central levels, and to enable supply chain managers to respond immediately to performance or product availability issues. The design of cStock mirrors processes

for the demand-based resupply system while improving data visibility through better data flow for operations and management, and improving product flow using a streamlined resupply process. cStock was combined with two different approaches (Enhanced Management [EM] and Efficient Product Transport [EPT]), that were tested side by side in three districts each. EM addresses all three framework elements by combining cStock, which addresses product flow and data flow, with the establishment of District Product Availability Teams (DPATs), which aimed to improve the effectiveness of the people by promoting team performance practices through the use of data to inform decisions and improve supply chain performance. DPATs comprise district management, health center staff, and CHWs who have a shared vision and collective commitment to ensuring continuous availability of products through use of data for continuous improvement and recognition of good CHW performance.

The EPT intervention only aimed to address two of the three framework elements, namely product flow and data flow, and did not address the element of effective people. Transport was a big challenge identified at baseline; although the MOH provides all CHWs with bicycles, breakdowns were frequent, reducing CHWs' ability to collect supplies regularly. In addition to cStock, EPT introduced two approaches to improve product flow. First, a continuous-review inventory control system that allowed CHWs to make more frequent trips to collect smaller amounts of supplies during their scheduled visits to health facilities and reducing the need for them to make special trips for product pickup. Second, EPT trained CHWs in regular, preventive bicycle maintenance to reduce breakdowns and repairs needed to keep the bicycles functioning.

Malawi conducted an annual quantification that included the iCCM program. Quantification for iCCM is complicated, however, by the fact that all of the products used by CHWs in Malawi are also used at higher levels of the health system or by other programs, requiring the input of good quality data from all programs and levels to develop a robust iCCM program forecast and supply plan. Further, donor support to CHWs in Malawi often targeted individual districts. Thus distribution data and data on products used by level and program were not always available. These circumstances made coordination and monitoring overall stock levels, other than the community level through cStock, difficult.

**2. Rwanda.** Baseline results demonstrated that CHWs were not resupplied according to any rules. The foundational intervention, therefore, was to establish a demand-based resupply system, called Standard Resupply Procedures (RSPs) for CHWs. The processes targeted the Cell Coordinator (CC) as the primary actor to collect and aggregate data from CHWs in their cell and resupply them with prod-

ucts, to increase efficiency at the health center level. If scaled nationally, RSPs would result in monthly reports for approximately 2150 CCs rather than 30 000 individual CHW reports. The intervention required the use of three basic tools: CHW stock cards to capture consumption data and stock data, a simple tool to calculate resupply quantities ("the magic calculator"), and a resupply worksheet (RSW) that CCs use to aggregate data for all CHWs in their cell each month.

The RSPs were implemented in six test districts and ensured sufficient and appropriate data flow for operations and SOPs as part of the first step toward developing effective people. The hypothesis was that designing supply chain processes and imparting skills were necessary first steps but not sufficient alone to significantly improve product availability. Thus, once RSPs were implemented, and the foundation for product flow and data flow was established, two different strategies (Quality Collaboratives [QCs] and Incentives for Community Supply Chain Improvement [IcSCI]) were tested side by side; both aimed at making CHW, health center and district staff engaged in supply chain tasks more effective and improving product availability.

The QC approach, previously used successfully to solve bottlenecks in clinical work (9), involves establishing and training Quality Improvement Teams (QITs) at health centers to find solutions for operationalizing the new resupply procedures at the CHW level. The aim of the QCs, or networks of QITs, is to close the gap between desired and actual performance by using data to target and address problems, and then developing, testing/implementing, and spreading changes quickly across many teams and/or organizations. QITs brought CCs, health center, and district staff together as a team to look at data on SC performance collected by CCs on supervision checklists; problems were identified and prioritized; action plans were developed and progress tracked. The project worked closely with the MOH to ensure the QITs functioned as expected during the testing period.

In contrast, IcSCI aims to strengthen the commodity supply chain by adding supply chain related-indicators to Rwanda's existing community performance-based financing scheme for CHWs, which targets improvements in delivery of health services at the village level. IcSCI provides an incentive package that specifically rewards CHWs for improved performance of supply chain tasks linked to nine supply chain indicators by providing monetary incentives to CHWs through their community cooperatives based on quarterly performance scores. In essence, both QCs and IcSCI targeted all three elements of the framework, namely product flow, data flow and effective people, although QCs addressed effective people more comprehensively

than IcSCI by including a formal teamwork component, which was more informal and indirect in the incentives approach.

In Rwanda, the community health desk within the MOH plays a strong role in coordination, ensuring that quantification in collaboration with different programs (Malaria, MCH, etc) takes place annually and supply plans are monitored regularly, as well as providing funding for product procurement for iCCM and working with the national procurement unit (Medical Procurement and Production Division) to coordinate procurement of products, many of which are used exclusively at the community level.

**3. Ethiopia.** Baseline results showed that CHWs and health centers were ineffective in managing health products because they lacked SC knowledge and skills. The Federal Ministry of Health (FMOH) and donors were supplying iCCM products to CHWs using a fixed-quantity supply (FQS) method: kits. The national logistics system in Ethiopia is transitioning to a new demand-based supply chain system (the Integrated Pharmaceutical Logistics System, or IPLS); hence, SOPs existed for all levels, although they had not been fully implemented at any level of the system. The IPLS outlines how data and products should flow between the levels of the supply chain, so the project's priority was to test a way of rapidly and affordably building foundational CHW supply chain knowledge and skills around the SOPs for IPLS, as a first step toward addressing the effective people element, with the expectation that the approach could be scaled up to all 30 000 plus CHWs, who could then move away from fixed quantity supply to a demand-based system. Three different approaches were taken to implement the training using existing activities at health centers as opportunities to impart SC knowledge and skills. Two approaches used a group training method during monthly meetings at the health center, and one approach used one-on-one training or on-the-job-training (implemented by another project and called the comparison group) at the time HEWs came to collect products. In the two groups that used the group training method, one group received follow up support (intensive group) and the other received no additional support (non-intensive group). Key supply chain skills for CHWs were distilled into five one-hour "Ready Lessons" that could be administered in any order and/or repeatedly; these lessons were combined with supply chain problem solving to address bottlenecks and identify gaps in skills that needed to be addressed. While recognition/motivation is a key element of "effective people," this element was deliberately excluded from the design since "Ready Lessons" were intended to be administered during pre-existing meetings that already had HEW recognition on the agenda. Because of Ethiopia's vast geography and large numbers of CHWs, the 2010–2013 period was spent implementing and testing the foundational in-

tervention, with the "added-value" intervention planned for 2013–2015 (not included in this paper). Supply chain knowledge and skills are critical prerequisites for operationalizing IPLS; however, training is necessary but not sufficient for developing "effective people" or for significantly improving product availability. Therefore, significant improvements in product availability and other key supply chain indicators were not expected from this intervention.

Ethiopia conducted regular quantification for iCCM but faced additional challenges with coordination because of the kit system, as six months of supply for each site had to be available in fixed quantities for kitting centrally before distribution. Given the different funding and procurement cycles of the government and various donors, the required level of coordination was difficult to achieve. Additionally, as the quantities in the kits were based on initial estimates of need that were not revised in light of actual consumption patterns, CHWs ran out of some items rapidly while others lasted much longer than anticipated.

## METHODS

Using the TOC as the guiding evaluation framework, the project conducted baseline and follow up assessments in select areas of the three countries in 2010 and 2012–2013, respectively, using complementary quantitative and qualitative methods. The quantitative survey tool, called the Logistics Indicator Assessment Tool (LIAT), was adapted from tools originally developed by the USAID | DELIVER PROJECT, including questionnaires, inventory assessment forms, storage assessment forms, and key informant interview guides [9,10]. The survey was tailored to each level of the supply chain, from central medical stores down to the community level, to capture processes, behaviors, and product availability along each step in the chain, and to measure indicators of intervention implementation. Tools were field-tested and adapted for each country setting [11]. Permissions for the assessments were obtained from all relevant MOH partners and institutional review board (IRB) approval was obtained in Malawi and Rwanda, where it was required.

Survey samples were not intended to be nationally representative, but rather chosen to first diagnose major iCCM supply chain strengths and weaknesses in a cross-section of districts served by key iCCM partners, and then to follow the supply chain from the central level to the community level. Purposeful selection at the district level was done based on existence of a functioning iCCM program, geographic variation, and balance of iCCM partner support. Probability proportional to size sampling was used to randomly select health facilities and CHWs at the lower levels of the supply chain. In all countries, CHWs were the unit of analysis. **Table 4** shows the full details on survey dates,

sample sizes, and levels of the supply chain visited by country surveys.

Quantitative data for both surveys and all three countries were collected by local evaluation partners, all selected through competitive processes. Enumerators were trained to interview CHWs and other staff managing supplies of medicines, conduct product inventories, and rate storage conditions. Data collectors used Nokia e71 and e63 smartphones loaded with DataDyne's Magpi application, which allowed for streamlined data entry and immediate review of data after uploading records to a web-based system. Qualitative methods were also employed for deeper under-

standing of user experiences, but this paper focuses primarily on quantitative results.

In Malawi and Rwanda, supplemental data sources were also considered, including routine data collected through cStock and the IcSCI indicators database respectively. In Malawi, routine logistics monitoring data submitted by CHWs using cStock were utilized to study inventory trends over time between the EM and EPT groups. The web-based cStock dashboard provided reports showing monthly stock reporting rates, average time taken to restock the drugs (lead time), product availability, and stock outs for these time periods for the six intervention districts (three for the

**Table 4.** Evaluation profile: dates, sampling, and intervention grouping, by country

	MALAWI	RWANDA	ETHIOPIA						
<b>Evaluation dates:</b>									
Baseline (BL)	May – June 2010	Sept – Nov 2010	July – Sept 2010						
Follow up* (FU)	Jan – Mar 2013	Apr – May 2013	Oct – Dec 2012						
Intervention kickoff and duration of testing period	EM and EPT training (June – Dec 2011) Monitoring and Intervention support (Jan 2012 – Feb 2013)	RSPs (Aug 2011– March 2013) QCs (April 2012 – March 2013) IcSCI (April 2012 – March 2013)	Ready Lessons/Problem Solving TOTs for HCs (Oct – Dec 2011) Assumed rollout to HEWs (Jan – June 2012)						
<b>Overall LIAT sample:</b>									
Districts FU (BL)	10 (10) of 28 nationwide†	10 (10) of 31 nationwide‡	28 (26) Woredas of ~765 woredas nationwide§ 12 (9) Zones of ~85 nationwide§						
Health Centers FU (BL)	76 (77)	108 (100)	82 (74)						
CHWs FU (BL)	249 (249)	349 (321)	263 (245) Health Posts						
<b>LIAT sample size by intervention group:</b>									
	EM	EPT	Comparison	QCs	IcSCI	Comparison	Intensive	Non-intensive	Comparison OJT
District/Woreda FU (BL)	3 (3)	3 (3)	4 (4)	3 (3)	3 (3)	4 (4)	8 (8)	10 (9)	10 (9)
Health Centers FU (BL)	25 (26)	23 (25)	28 (26)	31 (30)	37 (31)	40 (39)	24 (28)	30 (20)	28 (26)
CHWs FU (BL)	81 (81)	78 (83)	90 (85)	105 (85) 70 (0) CCs	116 (102) 78 (0) CCs	128 (134)	80 HPs (69)	92 (102)	91 (74)
<b>% CHWs managing iCCM products:</b>									
BL	139 of 249 (56%) manage any health products (including iCCM, FP, HIV)			65% of 321 manage amoxicillin 250mg, ORS, zinc 20mg, Primo Rouge (ACT 1×6), Primo Jaune (ACT 2×6)			71 of 245 (29%) manage ORS, RUTF any ACT, COCs, and DMPA		
FU	100% of 249 manage cotrimoxazole 480mg, both LA (1×6 and 2×6), and ORS			94% of 349 manage amoxicillin, 150mg, ORS, zinc 10mg, Primo Rouge (ACT 1×6), Primo Jaune (ACT 2×6)			151 of 263 (58%) manage ORS, RUTF, any ACT, COCs, and DMPA		

ACT – artemisin-based combination therapy, BL– baseline, CHW – community health worker, COC – combined oral contraceptives, DMPA – depo provera/depot medroxyprogesterone acetate EM – enhanced management, EPT – efficient product transport, FP – family planning, HEW – Health Extension Worker, HC – health center, HIV – human immunodeficiency virus, iCCM – integrated community case management, IcSCI – Incentives for Community Supply Chain Improvement, LA – artemether/lumefantrine, LIAT – logistics indicator assessment tool, FU – follow up, OJT – on the job training, ORS – oral rehydration solution, QC – Quality Collaboratives, RUTF – ready-to-use therapeutic food, TOT – training of trainer

\*Follow up survey results also referred to as Follow Up survey in Tables 5, 6 and 8 and text.

†Source: CIA World Factbook (<https://www.cia.gov/library/publications/the-world-factbook/geos/mi.html>). Accessed: 10 November, 2014.

‡Source: National Institute of Statistics, Rwanda; 2006. Available: <http://www.statistics.gov.rw/geodata>. Accessed: 10 November 2014.

§Source: Population and Housing Census Report – Country – 2007. Central Statistical Agency, 2010–2007. Available at: ([http://www.csa.gov.et/newc-saweb/images/documents/surveys/Population%20and%20Housing%20census/ETH-pop-2007/survey0/data/Doc/Reports/National\\_Statistical.pdf](http://www.csa.gov.et/newc-saweb/images/documents/surveys/Population%20and%20Housing%20census/ETH-pop-2007/survey0/data/Doc/Reports/National_Statistical.pdf)). Accessed: 10 November, 2014.

EM group and three for the EPT group). In Rwanda, the project, over the intervention period maintained quarterly performance scores for the nine supply chain indicators, submitted by health centers, for the IcSCI group (three districts) in the IcSCI indicators database.

## Study Groups and DiD

After the formative assessments in each country in 2010, the project formed three groups from original baseline evaluation areas by matching geographical and demographic characteristics, and other external dimensions including iCCM partner coverage, prevalence of diarrhea, malaria, and cough, as well as baseline CHW iCCM product availability, to create comparable groups. Two of the three groups were randomly assigned a unique intervention, while the third group was assigned as the comparison group. For Malawi and Rwanda, this division of areas was designed to facilitate a difference in difference (DiD) analysis to calculate the effect of the interventions on a key supply chain indicator (CHW product availability) by comparing the average change over time in this indicator for the intervention group to the average change over time for the comparison group. **Table 4** provides further details on and division of areas into intervention and comparison groups. In Malawi and Rwanda, a DiD regression analysis was conducted using iCCM product availability as the outcome variable. Because of the extraordinary challenges related to parallel supply chains in Malawi, the DiD results were inconclusive and further analyses were conducted to determine the effect of the interventions on supply chain performance and product availability. In Rwanda, the DiD analysis attempted to control for factors that may have affected the product availability over time indicator, including formal training of CHWs on the management of medicines and health products, training of CHWs in pneumonia, malaria, or diarrhea, and CHWs reporting transport obstacles in getting to their resupply point (**Table 7**). Limitations to this model include the real possibility that outside factors, applied unequally between groups over the three year period between baseline and follow up surveys, also caused changes, reducing the ability to attribute changes to the interventions alone.

## Country analyses

For both baseline and follow up surveys, frequencies and cross-tabulations were carried out using SPSS 18 and STATA version 11. Analyses were conducted using pathways identified in each country-specific TOC [12–14]. Indicators associated with the precondition pathways were laid out to determine progress along the pathway of change, both to validate the TOC as well as identify where obstacles may have prevented achievement of outcomes.

For Malawi, cStock data were retrieved for the 18-month period from January 2012 to June 2013 and average values of key supply chain indicators were calculated. Paired Student's *t*-tests were conducted to compare the trends between the EM and EPT groups. For data from the Rwanda IcSCI indicators database, Pearson chi squared tests were run to determine whether there was a significant difference in the performance of CHWs on select indicators by district over the four quarters of the testing period.

## Cross-country analysis

Following completion of follow up surveys in all countries, the project partnered with Accenture Development Partners (ADP) to develop a practical framework to facilitate cross-country analysis and synthesis of intervention findings using a broader lens. SC4CCM and ADP refined the project and country TOCs into the CHSC framework to capture important and consistent results from each country evaluation. Results related to each intervention package were categorized by product flow, data flow, and effective people and interpreted with a view to determining the effectiveness of each package.

Effectiveness was defined as achieving the intended or desired outcome of the intervention. The ultimate goal of any supply chain is improved product availability—to ensure that the service delivery point, in this case the CHW, has usable and quality medicines available to serve clients when needed. However, product availability is influenced by numerous factors, as shown by the TOC. Although supply chain performance is a critical factor, the greatest prerequisite is having products flowing through the national supply chain; supply chain performance is irrelevant if there are no products. The expected outcome for interventions in Malawi and Rwanda consisted of improvements in community supply chain performance, which we hypothesized, would lead to improvements in product availability. Improved supply reliability, defined as reductions in stock-out rates, was used as an alternate outcome measure in Malawi due to limitations associated with attributing improvements in product availability to project efforts. Indicators for supply chain performance varied in each country, given the data available. In Ethiopia, the expected outcome was an improvement in supply chain competencies, leading to improvements in key supply chain practices.

## RESULTS

Follow up results for Malawi and Rwanda are presented first according to the CHSC Framework elements of product flow, data flow, and effective people, and then the results of intervention packages as a whole are compared to understand how the combination of the different elements

affected the supply chain performance indicators and product availability. In Ethiopia, results are presented based on the aspect of the effective people element only. Data source is the LIAT survey unless otherwise noted, but results draw from focus group discussions (FGDs), cStock dashboard reports and the IcSCI indicators database.

## Malawi

All aspects of the EM intervention were fully implemented, while only the cStock component of EPT was implemented – the continuous review inventory management system was not implemented, with users finding it burdensome, and neither was regular practice of preventive bicycle maintenance by trained CHWs. Since EPT was not designed to address the effective people element, and its product flow design was unchanged, the project used the comparison of key supply chain performance indicators between EM and EPT groups to show the added value of the effective people (DPAT) component to product and data flow (cStock) in the EM group. **Table 5** summarizes key follow up results for Malawi.

**Product Flow.** Follow up evaluation results show that inventory management was streamlined and standardized product flow in both EM and EPT groups, largely due to cStock, compared to the non-intervention (NI) group, where less consistency was shown in forms used to request and resupply. Ninety-eight percent of CHWs in the EM group and 91% in the EPT group reported using cStock for requesting health products, compared to NI, where 48% of CHWs reported using Form 1A, 34% use a request form, 9% use LMIS-01G, and 14% use another form (multiple responses allowed). Additionally, 92% of Drug Store in-Charges in the EM group and 91% in the EPT group reported using cStock to determine quantities to resupply CHWs. The NI group reported using various resupply mechanisms, with 48% of Drug Store in-Charges using Form 1A, 17% using LMIS 01G, 10% reporting that they “issue standard amount,” 10% “give as much as I have available,” and 24% reporting “other.”

**Data flow.** Results also showed improvements in the reporting and visibility of community-level stock logistics data. At baseline, the average CHW reporting rate using a standard form across the ten districts was 43%. Data visibility at higher levels also improved, with logistics data from all cStock-reporting CHWs (94% in EM and 79% in EPT) accessible at district-level through the dashboard. At baseline, while 55% of health center staff reported CHW supply chain data up to district level, only 14% reported sending disaggregated CHW logistics reports to a higher level, resulting in very limited visibility of community data for district level decision makers.

**Effective people.** Follow up findings show a high frequency of DPAT meetings in the EM group and evidence that data was used to monitor and improve supply chain performance and recognize CHW achievements. Eighty-four percent of CHW Supervisors reported that district-level DPAT meetings were held and 96% of CHW Supervisors reported conducting a DPAT meeting at the health center level. Health center staff monitored the performance of the community supply chain using cStock data, with the majority using either reports pulled from cStock (56%) or resupply worksheets (40%) where cStock transactions are recorded. FGDs highlight how DPATs meetings were used to improve key supply chain performance indicators and product availability; as one CHW explained, “*We talk about our reporting rate and how best to improve it, the products.*” Another CHW Supervisor shared that they, “*...discuss the over-stocking or under-stocking and we discuss how we can share the drugs.*”

FGDs highlighted the benefits of the DPATs in improving communication and team work, as described by one CHW, “*We also discuss and encourage teamwork among the medical assistant and us to work together, because when we send stock on hand, we depend on them to respond all the time, and that has enhanced our communication and team work.*” CHWs also described how DPATs motivated them; one CHW shared “*sometimes when we are in our meeting the medical assistant compliments one of the CHWs and when he does so, we are motivated as well to perform better so that we can be complimented.*”

**Comparing intervention packages.** Comparing the results of EM and EPT in **Table 5** for three key supply chain performance indicators (lead times, reporting rates, and completeness of reporting) demonstrates how the EM group outperformed the EPT group suggesting the difference was likely due to the DPAT – effective people component of EM. These indicators were calculated using cStock data for the period of January 2012 to June 2013 and T-tests yielded significant differences ( $P < 0.001$ ) for all three indicators.

Product availability for four tracer iCCM products on the day of visit more than doubled, increasing from 27% of all CHWs with products at baseline to 64% in EM, 59% in EPT, and 63% in NI at follow up. However, due to the presence of a number of parallel supply chains bypassing the government supply chain to deliver directly to health facilities or CHWs over the testing period, it was not possible to isolate the impact of our interventions from that of the donor-supported drug distribution for this indicator. Therefore, given that product availability data could not be used to evaluate program effectiveness, the project measured supply reliability by comparing stock out rates in cStock over the period of the intervention between EM and EPT groups. EM stock out rates were consistently lower

**Table 5.** Summary of quantitative follow up survey results, Malawi (source: LIAT survey, unless otherwise noted)

	DEFINITION	EM GROUP	EPT GROUP	NI GROUP*
<b>Primary objective</b>	CHWs have usable and quality essential medicines available when needed for appropriate treatment of pneumonia and other common diseases of childhood	64% of CHWs had all 4 products† in stock on day of visit	59% of CHWs had all 4 products† in stock on day of visit	63% of CHWs had all 4 products† in stock on day of visit
<b>Product flow</b>	Clear procedures and processes for inventory management, distribution, and storage exist and are executed as expected	98% of CHWs reported using cStock, 6% use Form 1A, and 1% use another form for ordering health products from their resupply point (multiple responses allowed)	91% of CHWs reported using cStock, 13% use Form 1A, and 5% use another form for ordering health products from their resupply point (multiple responses allowed)	48% of CHWs reported using Form 1A, 34% use an unspecified request form, and 23% use another form for ordering health products from their resupply point (multiple responses allowed)
		92% of Drug Store in-Charges reported using cStock, 12% “give as much as I have available,” 8% use Form 1A, and 4% use LMIS 01G to determine quantities to resupply CHWs (multiple responses allowed)	91% of Drug Store in-Charges reported using cStock, 17% “give as much as I have available,” 17% use Form 1A, and 9% use LMIS 01G to determine quantities to resupply CHW (multiple responses allowed)	48% of Drug Store I/Cs reported using Form 1A, 17% use LMIS 01G, 10% reported that they “issue standard amount,” 10% “give as much as I have available,” and 24% reported they use another way to determine quantities to resupply CHWs (multiple responses allowed)
		Average lead time (request to receipt) for HSAs was 12.8 days from Jan 2012–June 2013‡ (multiple responses allowed)	Average lead time (request to receipt) for HSAs was 26.4 days from Jan 2012–June 2013‡ (multiple responses allowed)	N/A
<b>Data flow</b>	Logistics (consumption and stock levels) data are available and usable for supply chain decision making, management, monitoring, and problem solving	94% of CHWs send reports to HCs monthly from Jan 2012–June 2013‡	79% of CHWs send reports to HCs monthly from Jan 2012–June 2013‡	N/A
		85% of CHWs submitted complete reports from Jan 2012–June 2013‡	65% of CHWs submitted complete reports from Jan 2012–June 2013‡	N/A
<b>Effective people</b>	Management processes and skills; Teamwork across multiple levels, using data for problem solving; CHWs are motivated and recognized for SC accomplishments	84% of CHW Supervisors reported DPAT meetings were held	N/A	N/A
		96% of CHW Supervisors reported conducting a DPAT meeting	N/A	N/A
		100% of District & CHW Supervisors reported finding product availability teams useful	N/A	N/A

CHW – community health worker, DPAT – district product availability teams, EM – enhanced management, EPT – efficient product transport, HSA – health surveillance assistant, I/C – in charge, LMIS – Logistics Management Information System, NI – non intervention, SC – supply chain

\*Comparison group data available for Primary objective and some product flow indicators only, other data points in the table relate specifically to the interventions and are not relevant in the comparison group.

†Products include cotrimoxazole 480 mg, both ACTs (1 × 6 and 2 × 6), and ORS.

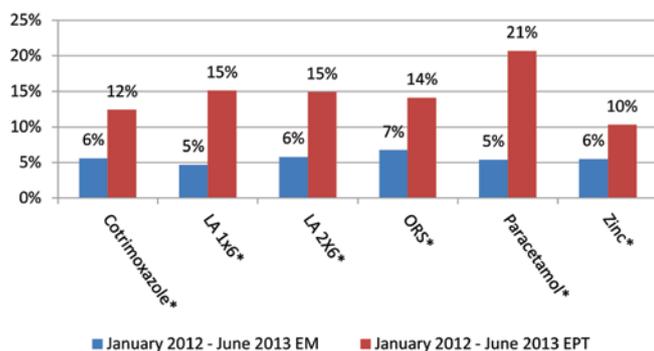
‡Source is cStock data from Jan 2012 to June 2013; this includes data from 392 HSAs in EM districts and 348 HSAs in EPT districts. Significant differences were seen for all three indicators between EM and EPT results ( $P < 0.001$ ).

(below 10%) than those for EPT for all six products over the period January 2012–June 2013. Stock out results are presented in **Figure 3** as a measure of mean percent CHW stock out rates by product. These differences were statistically significant at the  $P < 0.001$  level for all products. Results suggest higher levels of supply reliability in the EM intervention than the EPT intervention.

## Rwanda

Results show that all aspects of the RSPs, QCs, and IcSCI interventions in Rwanda were well implemented. The design and implementation of RSPs was meant to set the foundation for good product flow and data flow processes for the community level and rationalize the movement of people, data, and medicines. However, because the comparison group had no equivalent role to Cell Coordinator, it is not possible to evaluate improved product and data flow due to RSPs in the intervention groups vs the NI group. **Table 6** provides a summary of key follow up survey results for Rwanda.

**Product flow.** The RSP intervention was meant to shift responsibility for product collection away from CHWs to the CCs, while streamlining resupply by reducing inefficiencies in travel and congestion at health center pharmacies. Results presented in **Table 6** suggest improvements in product flow, with 100% of CCs in QC and 91% in IcSCI reporting that they picked up products for all CHWs in their cell after every monthly meeting and 95% of CHWs in QC and 93% in IcSCI reporting that they received products from CCs. Looking across groups at follow up, significantly more CHWs from both intervention groups (93% for QC and 93% for IcSCI) reported regularly receiving medicines and health products to treat sick children, compared with the non-intervention group (85%;  $P < 0.05$ ). Data from the IcSCI indicators database showed that the percentage of CCs who collected needed products for their cell after the HC meeting was 96% during the last quarter of the testing period.



**Figure 3.** Mean percentage stockout rate over 18 months, by product, for EM vs EPT districts, (January 2012–June 2013). Asterisk indicates  $P < 0.001$ .

Qualitative findings also supported an improvement in product flow. The RSPs bring order to the resupply process, as described by a CHW Supervisor from the IcSCI group who offered, “Before [RSPs], there was no proper procedure and CHWs could come to the pharmacy any time to request for products. It was total chaos.” Another supervisor from the QC group explained, “[Prior to RSP implementation] it was jungle law and often many CHWs went away empty-handed. The quick ones took away too many drugs, which kept expiring in the community...As a result of all this confusion, [we] were in constant conflict with pharmacy staff...now...total harmony reigns between us and the pharmacy staff. No unnecessary drugs are expiring.” Related to enabling evidence-based decision making, a supervisor from the QC group stated, “Using the *fiche de calcul* [magic calculator] helps the health centers to know exactly how much products are required. Without it everyone would be lost because the CHWs can demand anything, leading to wastage and misuse of scarce resources. It helps the CC to know who needs what and when.”

**Data flow.** Follow up results showed that RSPs led to better data capture through stock cards and data flow from the CHW to the CC to the health center pharmacy. In terms of stock card accuracy, 36% of CHWs in the QC group kept accurate stock cards for all six products, significantly better than 18% in the NI group ( $P < 0.05$ ), while 33% of CHWs in the IcSCI group followed close behind with keeping accurate stock cards. Moreover, “reporting rates” were high, with 97% of Health Center Pharmacy Managers in the QC group and 92% in the IcSCI group keeping copies of RSWs from all or some cells associated with their health center from the most recent month (prior to the survey). Cell Coordinators reported high rates of meetings (where data are captured and calculated); in both groups, 100% of CCs reported that they held meetings each month and 92% reported that all CHWs bring all of their stock cards to meetings. Only 11 of 136 (7%) CCs trained reported problems using RSWs.

**Effective people.** SC4CCM supported implementation of the QC intervention and QIT meetings took place regularly with good attendance, and use and availability of tools were high. However, this by itself does not illustrate the intervention’s effect on product availability. The most useful intermediary data bridging the gap between occurrence of meetings and improved product availability came from the FGDs. The FGD findings suggest that QCs enhanced planning and teamwork, as one Pharmacy Manager offered... “The QIT has built such a good relationship along the entire chain. For me the biggest prize has been to learn how to work on a plan and be able to achieve it every month.” FGD participants also underlined the motivating effect of the QC, one supervisor explained, “Learning sessions were very important. Each group would exhibit their achievements and

**Table 6.** Summary of quantitative follow up survey results, Rwanda (source: LIAT survey, unless otherwise noted)

	DEFINITION	QC GROUP	IcSCI GROUP	NI GROUP
<b>Primary objective*</b>	CHWs have usable and quality essential medicines available when needed for appropriate treatment of pneumonia and other common diseases of childhood	63% of CHWs had all 5 products in stock on DOV†, significantly better than comparison group ( $P < 0.001$ )	45% of CHWs had all 5 products in stock on DOV†	38% of CHWs had all 5 products in stock on DOV†
<b>Product flow*</b>	Clear procedures and processes for inventory management, distribution, and storage exist and are executed as expected	100% of CCs reported that they picked up products for all CHWs in their cell after every monthly meeting	91% of CCs reported that they picked up products for all CHWs in their cell after every monthly meeting	N/A
		93% of CHWs reported that they received products regularly	93% of CHWs reported that they received products regularly	85% of CHWs reported that they received products regularly
		95% of CHWs reported that they received products from CCs	93% of CHWs reported that they received products from CCs	26% of CHWs reported that they received products from CCs (majority receive from CHW Supervisor – 63%)
<b>Data flow*</b>	Logistics (consumption and stock levels) data are available and usable for supply chain decision making, management, monitoring, and problem solving	81% CHWs reporting on time	86% CHWs reporting on time	N/A
		97% of HCPM have copies of any resupply worksheets submitted by CCs at the last monthly meeting	92% of HCPM have copies of any resupply worksheets submitted by CCs at the last monthly meeting	N/A
			% of CCs who presented complete RSWs without any calculation errors during monthly health center meetings improved from average 77% for the three districts in the first quarter, to 98% in the final quarter (source: IcSCI indicators database)	N/A
		CCs had key QC tools completed with data collected to use for quality improvement: <ul style="list-style-type: none"> <li>• 93% CCs could show the bar graph for last month of QIT</li> <li>• 91% of CCs could show the tally sheet for last month of QIT</li> <li>• 97% of CCs who could show tally sheets and bar graphs had agreement between the two records for the last month of the intervention</li> </ul>		N/A
		83–98% of CHWs had stock cards on day of visit for amoxicillin, ORS, zinc, Primo Rouge, and RDTs, significantly better than comparison group for same products	83–95% of CHWs had stock cards on day of visit for all five iCCM products, significantly better than comparison group for same products	65–83% of CHWs with stock cards on day of visit for all five iCCM products
		36% of CHWs had accurate stock card for all 6 product	33% of CHWs had accurate stock card for all 6 products	18% of CHWs had accurate stock card for all 6 products

**Table 6.** Continued

	DEFINITION	QC GROUP	IcSCI GROUP	NI GROUP
<b>Effective people</b>	Management processes and skills exist; Teamwork takes places across multiple levels, using data for problem solving; CHWs are motivated and recognized for SC accomplishments	High levels of competency were found in completing RSWs; 80% of CCs were able to enter correct quantities required	High levels of competency were found in completing RSWs; 86% of CCs were able to enter correct quantities required	N/A
		77% of HCs could show their completed Q3 action plan	All districts showed significant improvements in 3 key SC indicators across 4 implementation quarters (source: IcSCI indicators database)	N/A

ACT – artemisin–based combination therapy, CC – Cell Coordinator, CHW – community health worker, DOV – day of visit, HCPM – Health Center Pharmacy Manager, iCCM – integrated community case management, IcSCI – Incentives for Community Supply Chain Improvement, QC – Quality Collaboratives, NI – non intervention comparison group, ORS – oral rehydration solution, Q3 – 3rd quartile, QIT – Quality Improvement Team, RDT – rapid diagnostic tests (malaria), RSW – resupply worksheet, SC – supply chain

\*Comparison group data available for Primary Objective, and for select Product Flow and Data Flow data points, other data points in the table relate specifically to the interventions and are not relevant in the comparison group.

†Products include amoxicillin, 150 mg, ORS, zinc 10 mg, Primo Rouge (ACT 1 × 6), Primo Jaune (ACT 2 × 6).

**Table 7.** Rwanda difference–in–differences (DiD) regional results: IcSCI and QC groups

Group	IcSCI*		Non–intervention		DiD†	N	QC*		Non–intervention		DiD†	N
	BL	FU	BL	FU			BL	FU	BL	FU		
<b>Percent of CHWs who manage all 5 products, in stock on DOV</b>	53	46	58	37	14	351	35	62	58	36	49‡	346

BL – base-line, CHW – community health worker, DiD – Difference in Differences, DOV – day of visit, FU – follow up, IcSCI – Incentives for Community Supply Chain Improvement, QC – Quality Collaboratives

\*Controls: CHW has formal training on how to manage medicines and health products, CHW has training in pneumonia, malaria, or diarrhea, CHW has obstacles to transport

†DiD is calculated as  $DID = (Intervention\ Follow\ up\% - Intervention\ Baseline\%) - (Comparison\ Follow\ up\% - Comparison\ Baseline\%)$ . Results displayed represent two steps in the analysis of the data: the significance, denoted by the stars, represents the results from the multivariate logistic regression on the time–group interaction variable, which is the key independent variable of a DiD regression. Since the interaction coefficient is non–intuitive, we have instead depicted the difference over time between the intervention and non–intervention groups using the predicted probabilities resulting from the regression. Essentially, this is the net percentage point change in the intervention region once the comparison group change is subtracted.

‡ $P < 0.001$ .

*challenges. This allowed us to learn from those who had faced a similar challenge in the past and how they solved it.”*

In the IcSCI group, three of nine incentives indicators showed strong evidence of significant SC improvements between Q1 and Q2, and continued high performance across the group over the remaining three quarters of the test period, as would be expected for an effective incentive scheme. Results from the IcSCI database show the proportion of CHWs with stock cards for iCCM products where *physical inventory matches stock card balance* for all on the DOV, increased from 86% in Q1 to 96% in Q4 (n ranges 3157–3201 CHWs visited in the three intervention dis-

tricts each quarter, over four quarters). We found an improvement of 7.03% between Q1 and Q2 for this indicator across the three districts,  $P < 0.001$ , 95% CI [5.5–8.57%]. The proportion of CCs who presented complete RSWs *without any calculation errors* during monthly health center meetings, in the past quarter, rose from 77% in Q1 to 98% in Q4 (n same as above). Results from the three districts show a 13.43% difference between Q1–2,  $P < 0.001$ , 95% CI [8.8–18.2%]. The proportion of CHWs who have *at least one treatment for a five–year–old child in stock*, for each iCCM product on the DOV, rose from 79% in Q1 to 92% in Q4 (n same as above). Results from the three districts

show a 14.06% difference for this indicator between Q1–2,  $P < 0.001$ , 95% CI [12.9–15.2%].

**Comparing Intervention Packages.** In comparing the results of QCs and IcSCIs, it is possible to consider the additional value of the teamwork component of the effective people element. While QCs performed slightly better than IcSCIs in key supply chain performance indicators (eg, reporting completeness, stock card accuracy, and six-month stock out rates) there were no significant differences, and both performed better than the NI group. However, there were differences in the overall impact on product availability.

The follow up survey found significantly greater availability among CHWs of all five iCCM products in stock on the DOV in the QC group (63%) compared to NI group (38%;  $P < 0.001$ ), and non-significantly greater availability in the IcSCI group (45%) compared to NI group (38%). A significant decline was detected since baseline for this measure in the NI group (from 58% to 38%;  $P < 0.01$ ).

Further analysis of in-stock data using DiD analysis showed a highly significant improvement ( $P < 0.001$ ) in the QCs group compared with the NI group for the key composite indicator of all five iCCM products in stock on DOV. The DiD detected significant improvements in availability for

**Table 8.** Summary of quantitative follow up survey results, Ethiopia

	DEFINITION	INTENSIVE GROUP (READY LESSONS, PROBLEM SOLVING, FOLLOW UP)	NON-INTENSIVE GROUP (READY LESSONS, PROBLEM SOLVING, NO FOLLOW UP)	COMPARISON (OJT) GROUP
<b>Primary objective</b>	CHWs have usable and quality essential medicines available when needed for appropriate treatment of pneumonia and other common diseases of childhood	27% of CHWs had all 5 products* in stock on day of visit	36% of CHWs had all 5 products* in stock on day of visit	36% of CHWs had all 5 products* in stock on day of visit
<b>Product flow</b>	Clear procedures and processes for inventory management, distribution, and storage exist and are executed as expected	61% of CHWs report they are supposed to receive products monthly	39% of CHWs report they are supposed to receive products monthly	23% of CHWs report they are supposed to receive products monthly
		99% of CHWs report getting their health products from the health center, 11% from district health office, 4% from NGO (multiple responses allowed)	94% of CHWs report getting their health products from the health center, 5% from district health office, 10% from NGO (multiple responses allowed)	93% of CHWs report getting their health products from the health center, 22% from district health office, 25% from NGO (multiple responses allowed)
<b>Data flow</b>	Logistics (consumption and stock levels) data are available and usable for supply chain decision making, management, monitoring, and problem solving	87% of CHWs trained know they are supposed to submit the HPMRR† every month to the higher level	59% of CHWs trained know they are supposed to submit the HPMRR† every month to the higher level	14% of CHWs trained know they are supposed to submit the HPMRR† every month to the higher level
<b>Effective people</b>	Management processes and skills exist	84% of CHWs were trained in IPLS	62% of CHWs were trained in IPLS	17% of CHWs were trained in IPLS
		65% of CHWs completed the most important data for the bin card correctly	59% of CHWs completed the most important data for the bin card correctly	62% of CHWs completed the most important data for the bin card correctly
		36% of CHWs completed the most important data for the HPMRR† correctly	29% of CHWs completed the most important data for the HPMRR† correctly	25% of CHWs completed the most important data for the HPMRR† correctly
		68% of HEWs (I and NI) report participating in a problem solving (PS) session during monthly meetings	26% of HEWs (I and NI) report participating in a problem solving (PS) session during monthly meetings	N/A‡
		85% HC staff report conducting IPLS PS sessions with HEWs	53% HC staff report conducting IPLS PS sessions with HEWs	N/A‡

ACT – artemisin-based combination therapy, CHW – community health worker, IPLS – Integrated Pharmaceutical Logistics System, HC – Health Center, HEW – health extension worker, I – intervention, N/A – not applicable, NI – non intervention, NGO – Non Governmental Organization, OJT – on the job training, ORS – oral rehydration solution, RUTF – ready-to-use therapeutic food

\*Products include cotrimoxazole 120 mg, either ACTs (1 × 6 and 2 × 6), ORS, zinc and RUTE

†HPMRR refers to the Health Post Monthly Report and Request form.

‡Problem solving was not part of the intervention package for the comparison group.

all products individually ( $P$  values range from  $<0.05$  to  $<0.01$  for ORS, zinc, and ACT  $1 \times 6$ ), with the exception of amoxicillin and ACT  $2 \times 6$ . In the IcSCI group, a significant result was detected only for one product, ACT  $1 \times 6$  ( $P < 0.05$ ), but no results for other individual products or the composite indicator.

## Ethiopia

The supply chain Ready Lessons and Problem Solving approach was *not* implemented exactly as designed; however it still proved to be a rapid, affordable and effective way to build a foundation in supply chain knowledge and skills for CHWs. As previously mentioned, the project's activities only targeted the effective people element, and only laid the foundation for two components of this element – management and teamwork. As this was primarily a training intervention, the aim was not to measure product availability but to determine whether the training led to competency, setting a foundation for improved practices supporting product flow and data flow. Therefore the follow up survey focused on whether health center staff could train CHWs opportunistically and affordably and in a way that built skills. Survey results are largely limited to coverage and competency of the CHWs six months after the Ready Lessons were introduced. However other supply chain indicators are provided in **Table 8** but the results are mixed and not always a reflection of the intervention. Further interventions are being tested to determine what is required to fully achieve all three elements and improve product availability significantly (results are expected in late 2014). **Table 8** summarizes follow up survey results for Ethiopia.

**Product flow and data flow.** Product flow and data flow indicators did improve across all groups; however, the intensive group, where the effective people component was implemented to a greater extent through follow up support, showed better results in terms of CHWs' knowledge: more CHWs knew they should receive products monthly and that they should submit a HPMRR form each month to the higher level. Data are not available on if this knowledge was translated into practice. The process of receiving products from the health center appeared more standardized across groups with more CHWs receiving products from health center (as per IPLS) however this was not necessarily due to the intervention as there was a policy change at national level directing CHWs to collect salaries and products from the nearest health center.

**Effective people.** The follow up survey results show that six months after training health center staff, the number of CHWs trained in supply chain had increased five-fold and CHW competency and knowledge had improved. In the intensive group (I), where health center staff received support from the project and higher levels to organize

trainings and conduct follow up [15], 84% of CHWs surveyed had been trained in supply chain, compared with 62% in non-intensive (NI), and 17% in the comparison group (C). All increased from the baseline (11%). CHW knowledge improved, with 87% of CHWs in the intensive group, 59% in non-intensive group, and 14% in comparison group knowing to submit reports to health centers, compared to 5% at baseline. CHW competency varied by task, being higher for a simpler task of completing a bin card correctly (65% intensive, 59% non-intensive, 62% comparison), and lower for the most complicated skill of completing the HPMRR form (36%, 29%, and 25% respectively) [16]. The latter modest performance scores were, in fact, a dramatic improvement over baseline (0%) and would likely improve further over time with practice and targeted supportive supervision. Ready Lessons had improved the skills of CHWs laying the groundwork for improving management processes.

Sixty eight percent of CHWs in the intensive group reported participating in a Problem Solving session during monthly meetings compared to 26% in the non-intensive group, the team building component of this intervention (problem solving was not part of the intervention package for the comparison group). At the health center level, 85% of HC respondents in the intensive group and 53% in non-intensive group reported conducting Problem Solving sessions with CHWs. However, despite slow rollout of the Problem Solving sessions, when CHWs were asked about their usefulness, CHWs from all regions stressed that the problem solving was very important for strengthening the IPLS at the CHW level.

**Comparing Intervention Packages.** As seen in **Table 8**, improving CHW knowledge of the reporting and resupply processes was not sufficient to have an impact on product availability at community level. The results show that in the comparison group where the least number of CHWs were trained, the product availability was higher. More CHWs in this group reported receiving products from an NGO and it is therefore likely due to the presence of kits which were being distributed ad hoc and not in response to need. When considering the other results and comparing the different approaches to making people effective we see that the intensive group which received more follow up and had a larger number of Problem Solving sessions did better for many of the indicators, suggesting that achieving the effective people element requires more than just training staff.

## DISCUSSION

The findings from all interventions in the three countries suggest that the greatest supply chain benefits are realized

when all three elements—product flow, data flow, and effective people—are in place and working together. This is most clearly demonstrated by the benefits of synergy on the supply chain as demonstrated by the EM and QC results; these interventions brought together product flow, data flow, and effective people to achieve the greatest improvements in supply chain to the community level. The Rwanda IcSCI intervention, that also brings all three elements together but does not directly address the multi-level team work component of effective people, showed less detectable improvements in SC performance and product availability compared to the QC. This suggests that the three elements work best together when all components related to each element are part of the intervention design. Results from the EPT group in Malawi where data flow and effective people were only partially addressed and Ethiopia where effective people was only partially addressed, further suggest that when only one or two elements are present, only minor or incremental benefits are observed, and effectiveness of the supply chain – as measured by improvements in supply chain performance, supply reliability or product availability – are not affected. Quantification and national product availability proved to play an important role in determining product availability at the community level – pointing to the importance of implementing community health supply chain improvements within the context of the overall supply chain.

### **Product flow, data flow and effective people: interconnected elements**

Product flow and data flow, though two distinct elements of the CHSC Framework, need to be deliberately linked, aligned and synchronized during intervention design to ensure that the right data are collected and made available to the right person (eg, the person resupplying a CHW needs access to consumption and stock on hand data to determine resupply quantities) who then uses it to make informed decisions on resupply/product flow. The inter-relationship between these two elements are further strengthened and sustained when levels of the system supplying the data see the associated benefits, such as products flowing to them based on demand. In addition, data and product flow must also align with management practices and workflows, as part of the effective people element, to realize maximum benefits in the SC, as seen in the case of Rwanda QCs and Malawi EM where streamlined data flow combined with a structured mechanism for reviewing and using data made people more effective and involved in managing product flow thus resulting in improvements in supply reliability and supply chain performance.

The “gold standard” is an EM-like solution that combines a demand-based system with a real time reporting system, such as a mHealth system, that allows inventory data to be available at all levels of the system simultaneously to enable

rapid decision making and response as well as activities such as performance monitoring, management and quantification. Although the RSPs in Rwanda included a demand-based system that resulted in effective data flow and product flow between the community level and resupply point, the manual nature of the data flow system prevented CHW logistics data from being immediately available at levels beyond the CHW resupply point to enable effective community supply chain performance monitoring and management by district and central level managers.

### **Effective people**

The effective people element of supply chain interventions – despite its potential for reinforcing product and data flow and improving community health supply chain practices – is the element most often left out, in part because of the required time investment and challenges to monitoring and measurement. Additionally, because CHWs generally are at the last mile they can be isolated from the main health system. Program design to support effective people can reduce perceptions of isolation by making supply chain performance and supply reliability a joint goal amongst facility-based staff and CHWs. However, this requires ongoing commitment at multiple levels to ensure that CHWs, at the end of the supply chain, receive routine support and feedback from managers who are close to them in the chain. The qualitative data for the EM and QC interventions best demonstrate how and why the effective people component is so important in enhancing results; DPATs and QITs strengthened linkages across multiple levels of the health system, enhanced communication and understanding of tasks, and established common goals and a collective responsibility for achieving results, while motivating CHWs who performed well.

In Malawi, the difference between the EM and EPT groups on key supply chain performance indicators such as complete reporting, reduced lead times, and stock out rates, can be attributed to the DPAT component in the EM intervention, underlining the importance of the effective people component. In Rwanda, the RSP intervention rationalized data and product flow and the QC and IcSCI groups addressed management and motivation each in slightly different ways. The IcSCI intervention included the management and motivation components of effective people which accelerated the immediate uptake and utilization of the data and product flow process (RSPs) and contributed to behavior change of CHWs towards improved performance of supply chain tasks. However the difference in findings between QC and IcSCI demonstrates the added benefit of the formalized team component in the QC group, where greater improvements in supply chain performance and product availability could suggest that this is related to the effects of multi-level teams working together to identify and solve problems related to community supply manage-

ment, rather than the single-level nature of cooperatives as teams. The significant improvements detected by the DiD for the QCs intervention also establish evidence of this as a successful method for improving iCCM product availability at the CHW level.

In Ethiopia, an important finding was that using health center staff to train CHWs in basic supply chain knowledge and skills by incorporating lessons into existing activities can significantly improve training coverage in a short period of time and is affordable since it doesn't require extra travel or allowances. However, although the Ready Lessons/Problem Solving intervention yielded a reasonable improvement in supply chain competency levels, it wasn't sufficient to affect supply chain performance or improve product availability. In Ethiopia, the intervention mainly addressed management, while structured problem solving increased contact between CHWs and HCs, but did not establish a sense of a team with common goals or involve district levels to help with more complex problems, as was seen in Malawi and Rwanda, two differences that might explain limited achievements. Essentially, the Ethiopia experience demonstrates that *within* the effective people component, all three components must work together – management, teamwork, and motivation – so that optimal results are achieved.

### Quantification and national coordination

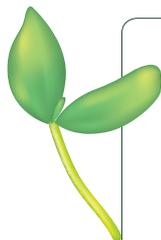
As the foundation to the product flow – data flow – effective people cycle, quantification and national coordination are important central-level activities that support community-level product availability. If community-level needs are not carefully considered and estimated in national quantifications and procurements, CHWs will likely suffer the most from shortages and expiries since they are at the end of the supply chain, regardless of how well the lower level supply chain functions. Therefore, to see optimal product availability at the community level and realize the benefits of designing and implementing interventions using the CHSC framework, sufficient quantities of products need to be available at higher levels. This requires the flow of data from the community level as well as coordination with data from higher levels where the same products are used and careful oversight of stock levels, considering total system demand for each product. Some of these challenges are overcome by using unique products as was seen in Rwanda, as it is easier to quantify for iCCM as a stand-alone program and ensure that products are not used up before they arrive at the community level.

Coordination between MOH programs, donors, and procurement units is also important for ensuring that available resources are used efficiently and that products used by multiple levels/programs are sufficient for all intended uses. The level of coordination required is often difficult

to achieve, especially in countries where procurement for community-level products spans multiple programs and donors. In Rwanda, for instance, follow up results for product availability were aided by strong coordination at the MOH level and the use of unique products at the community level which made it easier to estimate CHWs' needs and ensure that products were available at resupply points for community use. On the other hand, Malawi experienced an economic crisis and currency devaluation during the test period, which impacted the distribution and availability of supplies. Given the sudden lack of funds available for functions that typically fall under the government's purview, partners stepped in to support parallel supply chains and procure and distribute products outside the system that the interventions were meant to strengthen. Simultaneously, government budgets for procurement of essential medicines were dramatically reduced and uncertain, making central-level coordination and planning very difficult. Intervention results in Malawi made clear that the political and economic environment as well as the national product availability environment and distribution mechanisms play important roles in determining product availability at the community level – pointing to the importance of implementing community health supply chain improvements within the context of the overall supply chain, where quantification and national coordination take place regularly and effectively, and the overall supply chain is characterized by strong organization/leadership. Aligning management, motivation, and teamwork with coordination and routine quantification creates a system with improved availability of data and products when and where needed.

### CONCLUSIONS

In addition to an enabling political and economic environment, there are many factors necessary for ensuring continuous product availability at the community level. Assuming the presence of sufficient capacity and funding to procure products on a regular basis, an in-country distribution system works best when three key elements (product flow, data flow, and effective people) are included in system design. The way these are implemented may look different in each setting, as they were designed with the local context and longer term scale and sustainability in mind [17]. However in all countries the common finding was that intervention designs need to ensure that data flow and product flow processes are streamlined, aligned, and reinforced by an effective and supportive workforce that is organized into multi-level teams with common objectives and structures for supervision, that use data to improve supply chain performance and communicate regularly to promote product availability at the community level.



**Acknowledgements:** The authors greatly appreciate the leadership and support of key colleagues from the Ethiopia, Malawi and Rwanda Ministries of Health and the Pharmaceuticals Fund and Supplies Agency in Ethiopia. Special thanks go to the head of the Community Health Desk (Rwanda) who guided and led the design and implementation of interventions in Rwanda; the head of IMCI (Malawi); past and current Deputy Directors of HTSS (Malawi); and the Logistics Officers affiliated with various program (all countries) for enabling research to be conducted as part of programmatic implementation. The authors also thank colleagues from implementing partner organizations in all countries including Concern International, i+ Solutions, Save the Children, mHealth alliance/ UN Foundation, the RFHP project, the SSDI Project, UNICEF, the USAID | DELIVER Project, WHO and World Relief for their contributions throughout the pilot and scale up phases of SC4CCM interventions in all three countries. Finally, the authors would like to thank Accenture Development Partners for their input in development of the CHSC framework.

**Ethics approval:** Ethics approval was waived in Malawi after review by the National Health Sciences Research Committee and was not required in Ethiopia. Ethics approval was received from the Rwanda National Ethics Committee (RNEC) in Rwanda as per requirement.

**Funding:** This work was funded as part of SC4CCM project activities. SC4CCM is implemented by JSI Research & Training Institute with funding from The Bill & Melinda Gates Foundation

**Authorship declaration:** YC, SA, AH, MN, MS, AO, HN and BF were involved in conception, design, analysis, interpretation of data, all rounds of revision. MN, SA, AH, MS, YC assembled the data and created the figures. MN, MS conducted the statistical analysis with substantial input from SA, AH, YC and BF. YC, SA, AH, KK and BF led conceptualization of the paper, guided interpretation of the data and provided critical revisions for intellectual content. YC, SA, AH, KK and MN wrote the paper. All authors provided critical input required for the final version of the manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). The authors declare no financial relationships with any organizations that might have interest in the submitted work and no other relationships or activities that could appear to have influenced the submitted work; apart from that declared under Funding.

## REFERENCES

- 1 Oliver K, Young M, Oliphant N, Diaz T, Kim J. Review of systematic challenges to the scale-up of Integrated Community Case Management: Emerging lessons & recommendations from the Catalytic Initiative (CI/IHSS). New York, NY: United Nations Children's Fund (UNICEF); 2012. Available at: [http://www.unicef.org/infoby-country/files/Analysis\\_of\\_Systematic\\_Barriers\\_cover\\_1163.pdf](http://www.unicef.org/infoby-country/files/Analysis_of_Systematic_Barriers_cover_1163.pdf). Accessed: 21 May 2014.
- 2 Integrated Community Case Management Evidence Review Symposium. Final Report: Summary and Conclusions. Available at: <http://ccmcentral.com/wp-content/uploads/2014/07/iCCM-Symposium-Final-Report-17.07.2014.pdf>. Accessed: 21 May 2014.
- 3 Schopperle A. Analysis of challenges of medical supply chains in sub-Saharan Africa regarding inventory management and transport and distribution. London: University of Westminster Business School; 2013. Available at: <http://www.transaid.org/images/resources/Medical%20Supply%20Chain%20Challenges.Masterthesis.ASchopperle.pdf>. Accessed: 21 May 2014.
- 4 SC4CCM. Rwanda Community Health Supply Chain Baseline Assessment Report. Arlington, VA: JSI Research & Training Institute, Inc., 2011. Available at: [http://sc4ccm.jsi.com/files/2013/11/Rwanda-Baseline-Report\\_FINAL.pdf](http://sc4ccm.jsi.com/files/2013/11/Rwanda-Baseline-Report_FINAL.pdf). Accessed: 21 May 2014.
- 5 SC4CCM. Ethiopia Health Post Supply Chain Baseline Assessment Report. Arlington, VA: JSI Research & Training Institute, Inc., 2010. Available at: [http://sc4ccm.jsi.com/files/2013/08/Ethiopia-baseline-report\\_FINAL.pdf](http://sc4ccm.jsi.com/files/2013/08/Ethiopia-baseline-report_FINAL.pdf). Accessed: 21 May 2014.
- 6 SC4CCM. Malawi Community Health Supply Chain Baseline Assessment Report. Arlington, VA: JSI Research & Training Institute, Inc., 2010. Available from: [http://sc4ccm.jsi.com/files/2013/10/Malawi-Baseline-Report\\_FINAL.pdf](http://sc4ccm.jsi.com/files/2013/10/Malawi-Baseline-Report_FINAL.pdf). Accessed: 21 May 2014.
- 7 George A, Young M, Nefdt R, Basu R, Sylla M, Clarysse G, et al. Community health workers providing government community case management for child survival in Sub-Saharan Africa: Who are they and what are they expected to do? *Am J Trop Med Hyg.* 2012;87(5 Suppl):85-91. Medline:23136282 doi:10.4269/ajtmh.2012.11-0757
- 8 Chandani Y, Noel M, Pomeroy A, Andersson S, Pahl MK, Williams T. Factors affecting availability of essential medicines among community health workers in Ethiopia, Malawi, and Rwanda: Solving the last mile puzzle. *Am J Trop Med Hyg.* 2012;87(5 Suppl):120-6. Medline:23136287 doi:10.4269/ajtmh.2012.11-0781
- 9 USAID Health Care Improvement Project; The Improvement Collaborative. An approach to rapidly improve health care and scale up quality services. Bethesda, MD: University Research Co., 2008.

- 10 USAID Deliver Project Task Order 1. Logistics Indicators Assessment Tool (LIAT). Arlington, VA: USAID, 2008.
- 11 Habicht JP, Victora CG, Vaughan JP. Evaluation designs for adequacy, plausibility and probability of public health programme performance and impact. *Int J Epidemiol.* 1999;28:10-8. Medline:10195658 doi:10.1093/ije/28.1.10
- 12 SC4CCM. Malawi intervention strategy for improving the community health supply chain implementation and M&E plan. Arlington, VA: JSI Research & Training Institute, Inc., 2011. Available at: <http://sc4ccm.jsi.com/files/2012/10/Malawi-Implementation-Plan.pdf>. Accessed: 15 July 2014.
- 13 SC4CCM. Rwanda intervention strategy for improving the community health supply chain implementation and M&E plan. Arlington, VA: JSI Research & Training Institute, Inc., 2011. Available at: [http://sc4ccm.jsi.com/files/2013/05/Rwanda-Implementation-Plan-updated\\_5.8.13.pdf](http://sc4ccm.jsi.com/files/2013/05/Rwanda-Implementation-Plan-updated_5.8.13.pdf). Accessed: 15 July 2014.
- 14 SC4CCM. Ethiopia intervention strategy for improving the community health supply chain implementation and M&E plan. Arlington, VA: JSI Research & Training Institute, Inc.; 2011. Available at: <http://sc4ccm.jsi.com/files/2014/07/Ethiopia-Implementation-Plan-final.pdf>. Accessed: 22 July 2014.
- 15 SC4CCM. Ethiopia IPLS for HEWS Training Midline Evaluation Report. Arlington, VA: JSI Research & Training Institute, Inc., 2012. Available at: [http://sc4ccm.jsi.com/files/2013/09/Ethiopia-Midline-Report\\_FINAL.pdf](http://sc4ccm.jsi.com/files/2013/09/Ethiopia-Midline-Report_FINAL.pdf). Accessed: 21 May 2014.
- 16 Nigatu A, Homa G, Getachew D, Gelaw S, Andersson S, Subramanian S, et al. Can training HEWs in the integrated pharmaceutical logistics system (IPLS) be effective, affordable, and opportunistic? *Ethiop Med J.* In press.
- 17 SC4CCM. From pilot to practice: Lessons on scale, institutionalization and sustainability from the (in-progress) journey of the SC4CCM project. Arlington, VA: JSI Research & Training Institute, Inc.; 2014. Available at: <http://sc4ccm.jsi.com/files/2014/09/Pilot-to-Practice-Brief.pdf>. Accessed: 15 June 2014.



# Strengthening community health supply chain performance through an integrated approach: Using mHealth technology and multilevel teams in Malawi

Mildred Shieshia<sup>1</sup>, Megan Noel<sup>2</sup>, Sarah Andersson<sup>2</sup>, Barbara Felling<sup>2</sup>, Soumya Alva<sup>2</sup>, Smisha Agarwal<sup>3</sup>, Amnesty Lefevre<sup>4</sup>, Amos Misomali<sup>4</sup>, Boniface Chimphanga<sup>4</sup>, Humphreys Nsona<sup>5</sup>, Yasmin Chandani<sup>1</sup>

<sup>1</sup> JSI Research & Training Institute, Inc., Nairobi, Kenya

<sup>2</sup> JSI Research & Training Institute, Inc., Arlington, VA, USA

<sup>3</sup> Johns Hopkins University, Baltimore, MD, USA

<sup>4</sup> JSI Research & Training Institute, Inc., Lilongwe, Malawi

<sup>5</sup> Ministry of Health, Blantyre, Malawi

**Background** In 2010, 7.6 million children under five died globally – largely due to preventable diseases. Majority of these deaths occurred in sub-Saharan Africa. As a strategy to reduce child mortality, the Government of Malawi, in 2008, initiated integrated community case management allowing health surveillance assistants (HSAs) to treat sick children in communities. Malawi however, faces health infrastructure challenges, including weak supply chain systems leading to low product availability. A baseline assessment conducted in 2010 identified data visibility, transport and motivation of HSAs as challenges to continuous product availability. The project designed a mHealth tool as part of two interventions to address these challenges.

**Methods** A mobile health (mHealth) technology – cStock, for reporting on community stock data – was designed and implemented as an integral component of Enhanced Management (EM) and Efficient Product Transport (EPT) interventions. We developed a feasibility and acceptability framework to evaluate the effectiveness and predict the likelihood of scalability and ownership of the interventions. Mixed methods were used to conduct baseline and follow up assessments in May 2010 and February 2013, respectively. Routine monitoring data on community stock level reports, from cStock, were used to analyze supply chain performance over 18-month period in the intervention groups.

**Results** Mean stock reporting rate by HSA was 94% in EM group (n=393) and 79% in EPT group (n=253); mean reporting completeness was 85% and 65%, respectively. Lead time for HSA drug resupply over the 18-month period was, on average, 12.8 days in EM and 26.4 days in EPT, and mean stock out rate for 6 tracer products was significantly lower in EM compared to EPT group.

**Conclusions** Results demonstrate that cStock was feasible and acceptable to test users in Malawi, and that based on comparison with the EPT group, the team component of the EM group was an essential pairing with cStock to achieve the best possible supply chain performance and supply reliability. Establishing multi-level teams serves to connect HSAs with decision makers at higher levels of the health system, align objectives, clarify roles and promote trust and collaboration, thereby promoting country ownership and scalability of a cStock-like system.

## Correspondence to:

Yasmin Chandani  
 JSI Research & Training Institute, Inc,  
 1616 N Fort Myer Drive, 16th floor  
 Arlington, VA 22209, USA  
 ychandani@jsi.com

In 2010, 7.6 million children under five died globally – largely due to preventable diseases including pneumonia (14%), diarrhea (10%), and malaria (7%) [1]. Ninety–nine percent of these deaths occurred in low–resource settings and nearly half (47%) in Sub–Saharan Africa in communities where people have limited or no access to life saving interventions and medical supplies. Integrated Community Case Management (iCCM) is a strategy designed to bring care and treatment for childhood pneumonia, diarrhea, and malaria closer home by training community health workers (CHW) in the identification and treatment of common childhood illnesses [2,3]. iCCM involves training CHWs on essential health packages and ensuring that they have the medicines needed to manage and treat illnesses among children under five years of age. Continuous access to these medicines by CHWs requires a well–functioning supply chain across all levels of the health care system. However, the supply chain systems of many resource–constrained countries function poorly and face a myriad of challenges [4], including but not limited to shortage of human resources, weak inventory management, low supply chain skills among health workers, and a lack of data visibility and utilization for sound decision making.

In 2008, the Government of Malawi (GoM) initiated iCCM as a strategy to reduce child mortality. The program entailed training an existing cadre of CHWs, known as Health Surveillance Assistants (HSAs) to treat children in the community. HSAs are posted nationwide to serve communities at a ratio of 1:1000 population. By September 2011, 3296 HSAs had been trained in integrated management of childhood illness (IMCI) [5]. With the implementation of the iCCM strategy in Malawi, mortality among children under five years decreased from 225 deaths per 1000 live births in 1990 to 71 per 1000 live births in 2012 [6], and the country is considered on track to achieve Millennium Development Goal (MDG) 4, to reduce child–mortality by two–thirds, by 2015.

Despite the gains made towards MDG 4, the health care infrastructure in Malawi still faces challenges, among them weak supply chain systems. This affects continuous health product availability at the community level, consequently undermining the full effectiveness of the iCCM strategy. In order to identify the constraints associated with maintaining regular product availability, Supply Chains for Community Case Management (SC4CCM) in collaboration with the Ministry of Health (MOH), conducted a formative assessment across 10 districts in Malawi (Nkhatabay, Nkhohakota, Mulanje, Kasungu, Nsanje, Machinga, Mzimba North, Zomba, Nchitsi, and Salima) in 2010 [7]. The assessment identified poor availability and limited use of logistics data (ie, low data visibility) across all levels of the health system, low motivation among HSAs and transport

challenges such as difficult terrain and long travel time for HSAs to collect products as key barriers to continuous product availability. This assessment identified additional opportunities of using mobile phones to promote data visibility as 89% of the HSAs surveyed had mobile phones, 80% of HSAs and health facility (HF) staff had continuous network coverage at their place of work and all districts surveyed had computers and access to the Internet. The survey also found high levels (80%) of bicycle ownership among the HSAs [7].

To address the identified constraints related to data visibility, motivation and transport, SC4CCM designed and piloted cStock, a mHealth tool for community–level reporting of stock on hand data and resupply of 19 health products managed by HSAs. cStock was nested within two broader interventions, namely, Enhanced Management (EM) and Efficient Product Transport (EPT), to address challenges in motivation of HSAs and transport to the health facilities, respectively. The primary objective of this paper is to assess the feasibility, acceptability, and effectiveness of cStock as a mHealth strategy for improving data visibility and reducing stockouts of health products used at the community level. Additionally, the study will explore the added effects of the team approach deployed through EM in improving supply chain performance.

## Program description

cStock is an SMS and web–based reporting and resupply system that is used by HSAs to report stock data via SMS through their personal mobile phones. cStock calculates HSA resupply quantities and sends this information to HF staff to use to pick and pack products for HSAs and notify them about a collection time.

cStock was designed using a consultative, user–centered and iterative process. Potential users at all levels of the health system provided inputs based on their experience with the existing manual reporting and resupply system. Information on the existing flow of data across levels of the health system was combined with inputs from supply chain specialists to ensure the system was based on supply chain best practices. In designing the workflows and dashboard for cStock, an important criterion was to ensure the health care workers and managers at each level would have access to data most relevant to them, at the right time and in a format that could be easily accessed, interpreted and used for decision making. HSAs and HF staff would interact with cStock using SMS messages on their own phones, while district and central level staff would receive alert messages from cStock on their own phones. District and central level staff would use computers to access the web–based dashboard for reports. The dashboard was redesigned six months after implementation so that district and central

level users could incorporate their experience interacting with the system into the redesign and prioritize metrics and visuals most useful for their day-to-day operations.

cStock is a key component of both the EM and EPT intervention packages. The EM intervention addresses challenges related to data availability and visibility, as well as low motivation among HSAs while the EPT intervention addresses challenges of transport in addition to data visibility. The additional component of the EM intervention was District Product Availability Teams (DPATs). These are multilevel quality improvement teams that use data supplied by cStock to monitor performance of the supply chain and make informed supply chain decisions. In contrast, the additional component of the EPT intervention consisted of training all HSAs on bicycle maintenance, provision of a basic tool kit, and the use of a continuous review inventory control system.

HSAs and HF staff in six districts where the project was piloted were trained on the use of cStock for reporting and resupply and used their own phones to register with cStock. Training was conducted using a cascade approach. The project trained a group of trainers consisting of central and district level staff from pilot districts as TOTs and they in turn trained the HSAs, HF and district staff. Both intervention groups were trained over a 2-day period, with one day dedicated to training users on how to register and use cStock. HSAs in the EM group were trained to send reports to cStock using a fixed monthly reporting schedule between the last day of the month and second day of the next month, while those in the EPT group were trained to send reports to cStock at any time during the month when they planned to travel to the HF giving them the flexibility to

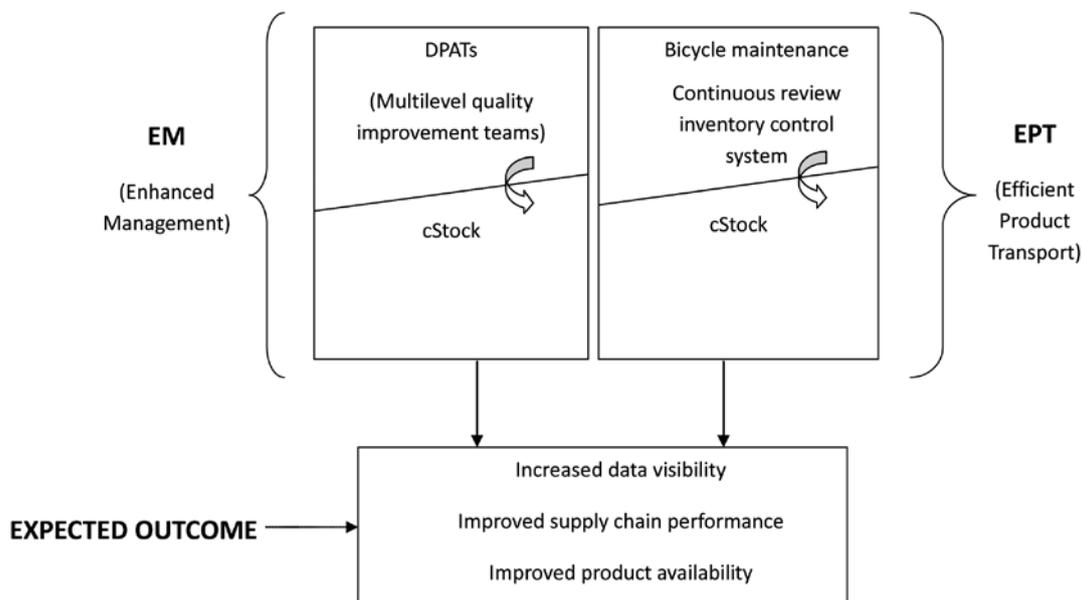
report and receive product. Once trained, HSAs were provided with job aids to carry back to their facilities and expected to start using cStock immediately. Implementation support for cStock was provided through group messages sent by the system administrator to users to correct common errors, automated messages sent directly by the system to users in response to formatting errors, and field visits made by Ministry and project staff to monitor and reinforce good practice.

In designing the interventions, the project identified feasibility and acceptability of cStock as critical components to enhancing uptake and laying the foundation for country ownership and scalability. See **Figure 1** for a visual representation of the intervention design.

## METHODS

### Study site

Malawi is a landlocked country that covers an area of 118 484 km<sup>2</sup> and shares boundaries with Zambia in the west, Mozambique in the east, south and southwest, and Tanzania in the north. The country is divided into three administrative regions, namely the northern, central and southern regions with 28 districts in total [8]. The study purposefully selected 10 out of Malawi's 28 districts for the 2010 baseline assessment, in consultation with stakeholders. Selection criteria for the districts included the existence of a functioning iCCM program, a balance of iCCM partner support, and a relatively balanced geographical coverage across the three administrative regions of the country.



**Figure 1.** Components of the two intervention groups (EM – Enhanced Management and EPT – Efficient Product Transport). DPAT – district product availability teams.

## Evaluation framework

To evaluate the effectiveness of the interventions, the project designed a feasibility and acceptability framework (Figure 2) that identifies key domain areas as important measures for predicting the likelihood of long-term effectiveness, scalability and ownership of an intervention.

In this framework a **feasible intervention** is one that seeks to address a defined problem and that provides a viable solution or platform for solving the problems within existing health system structures and staff capacities in a country. The solution should be easy to learn, quick and easy to use, with few or no difficulties experienced by the user. For this evaluation the measures of feasibility are:

- Improved reporting rates, and
- HSAs and HFs have the necessary skills and ability to use cStock.

An **acceptable intervention** is one that users perceive as valid, reliable, and beneficial; users are satisfied that the in-

tervention meets their needs by helping them adequately solve a problem or make improvements in their daily work. Acceptability is achieved when the majority of users use the intervention on a regular basis for supporting routine tasks. For this evaluation the measures of acceptability are:

- cStock has become the primary means for HSAs to order or request health products from their resupply point,
- cStock has become the primary tool for HF staff to use for resupplying HSAs, and
- Teams use data from cStock to measure, monitor, and improve supply chain performance.

An **effective intervention** is one that achieves the intended or desired outcome. In this study the desired outcomes across the two intervention groups are improvements in data visibility, responsiveness and supply reliability. For this evaluation effectiveness is measured and compared across the EM and EPT groups as:

- Improved data visibility measured as improved reporting rates and complete reporting rates,

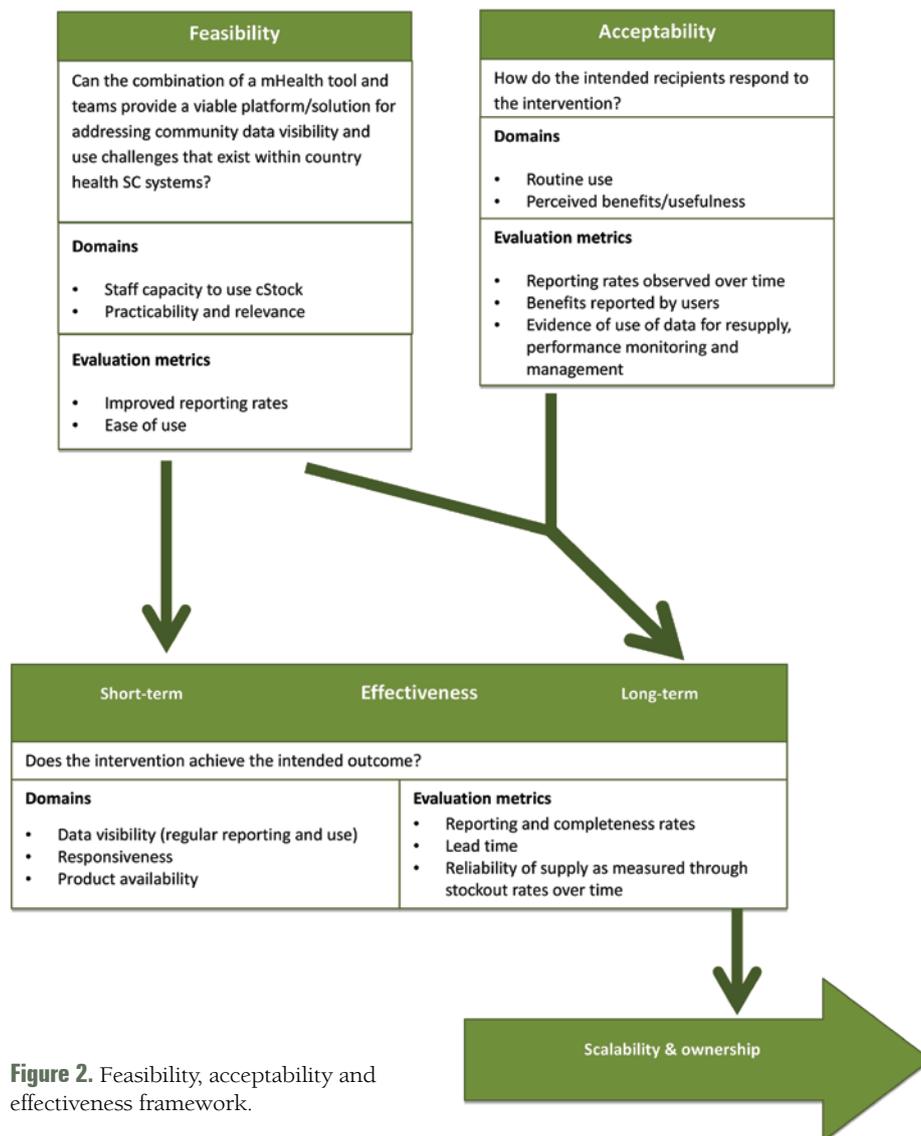


Figure 2. Feasibility, acceptability and effectiveness framework.

- Improved responsiveness measured as improved lead times, and
- Improved supply reliability measured as reductions in stock out rates.

**Assessment tools and study groups**

The project employed mixed methods to conduct baseline and follow up assessments in May 2010 and February 2013, respectively. Permissions for the assessments were obtained from the MOH. The quantitative survey tool was adapted from the Logistics Indicator Assessment Tool (LIAT) originally developed by the USAID | DELIVER PROJECT [9], including questionnaires, inventory assessment forms, and key informant interview guides. The survey was tailored to the district, HF and community level, to capture processes, behaviors, and product availability data along each step in the supply chain and to measure indicators of intervention implementation.

A local evaluation partner, the Malaria Alert Center (MAC), was selected through a competitive process to lead data collection activities. For quantitative data collection, enumerators were trained to interview HSAs and other staff managing supplies of medicines. Data collectors used Nokia e71 and e63 smart phones loaded with Data Dyne’s Magpi application, which allowed for streamlined data entry and immediate review of data after uploading records to a web-based system. Data were saved on a daily basis to external

memory cards to prevent loss. Frequencies were carried out using STATA version 11.

In addition to the cross-sectional data collection at baseline and follow up, focus group discussions (FGDs) were carried out in February 2013 (at follow up) by a team of two researchers from MAC, with HSAs and health facility staff in all six pilot districts. Two FGDs per district, with 6–10 participants each, were held with staff from several health facilities. In each district, one FGD included only HSAs (one male and one female per HF), and the other included only HF staff handling CCM products (HSA Supervisors, Drug Store In-Charge / HF In-Charge). A thematic guide was used to collect qualitative information around community supply chain data visibility and use, with particular focus on contributions made by the cStock system. For the EM group, FGDs also gathered views on the EM intervention and achievements made by the DPATs, as well as lessons learned about the intervention. The data collection team transcribed notes immediately after discussions, and qualitative results were thematically synthesized using a notes-based analysis.

Routine monitoring data on HSA drug stock level reports, submitted using cStock, were utilized to study supply chain (SC) performance trends over time between the EM and EPT groups. These data were retrieved for the 18-month period from January 2012 to June 2013. The web-based cStock dashboard provided reports showing monthly stock report-

**Table 1.** Malawi data sources

DATA SOURCE/TOOL	DESCRIPTION AND METHODS	FREQUENCY OF COLLECTION	SAMPLE SIZE
Logistics Indicators Assessment Tool (LIAT) used to measure feasibility and acceptability parameters	Quantitative data collection to determine supply chain (SC) performance at HSA and higher levels; longitudinal comparisons of key indicators using Facility-based survey, for assessment of stock levels, reports, and storage conditions	Baseline Midline	– Districts: n=6 – HFs: n=51 (BL);n=48(ML) – HSAs: n=100 (BL); n=159 (ML) *Includes EM & EPT groups
FGDs used to measure the feasibility and acceptability parameters	Qualitative data collection to learn about community and HF user perceptions of cStock and EM by conducting FGDs with HF staff and HSAs in the 3 districts using cStock and DPAT (EM group)	Midline	Six (6) FGDs total, 2 per district: one (1) with HSAs (1 male and 1 female per HF), and the other (1) with HF staff who handle CCM products (ie, HSA Supervisors, Drug Store In-Charge / HF In-Charge). Each FGD had 6–10 participants, from 3–4 HFs per district. *Includes EM group
cStock used to measure the effectiveness parameters	Routine SMS reporting system for all products managed by HSAs. Web-based dashboard reports for SC performance monitoring of trends over time providing monthly data accessible by time and/or district-based query reports from the cStock dashboard Reports include: – Reporting rates – Stock status – Lead times – Order fill rates	Jan 2012–June 2013	Registered cStock users as of June 2014: – Districts: n=27 (including 6 EM & EPT) – HFs: n=522 – HSAs: n=2707 (including n=646 from EM & EPT districts) *Includes EM & EPT groups

LIAT – logistics indicators assessment tool, SC – supply chain; HF – health facility, HSA – health surveillance assistant, SMS – short message service, FGD – focus group discussion, EM – enhanced management, EPT – efficient product transport, BL – baseline, ML – midline

ing rates, average time taken between sending an order request and receiving health products (lead time), product availability, and stock-outs for these time periods for the six intervention districts (three for EM and three for EPT). The average values of these key indicators were calculated for the 18-month period and paired Student's t-tests were conducted to compare the trends between the EM and EPT groups. **Table 1** presents an overview of the various data sources and frequency of collection.

HSAs were the primary unit of survey analysis. This paper presents two sets of samples, one from the baseline and follow up surveys, the second from backend data collected via cStock where the sample is comprised of all HSAs who ever registered on cStock at any point in the program cycle. 56 HSAs from the EM districts, and 44 HSAs from the EPT districts were sampled at baseline, 81 HSAs from EM districts and 78 HSAs from the EPT districts were sampled at follow up. The cStock sample of HSAs registered in each group as of June 2014, is  $n = 393$  HSAs in EM, and  $n = 253$  HSAs in EPT (total  $n = 646$ ).

### Sampling strategy

After the formative assessment, the project formed three groups of three, three, and four districts from the ten districts by matching geographical and demographic characteristics, and other external dimensions including iCCM partner coverage, prevalence of diarrhea, malaria, and cough, as well as baseline HSA iCCM product availability, to create comparable groups. The three groups were randomly assigned to receive the EPT intervention (three districts), the EM intervention (three districts) and no intervention (four districts). This paper presents results from the six intervention districts where the project implemented EM and EPT, and thus where cStock was tested.

As the project chose 10 districts purposefully for evaluation, a representative sample of HFs was chosen from within the 10 districts at baseline and follow up. Probability proportional to size sampling was used to randomly select health centers based on number of associated village clinics (sites where HSAs work), and approximately three HSAs who manage health products were randomly selected per health center and visited at their village clinic.

## RESULTS

Study findings on the feasibility and acceptability of cStock, as well as acceptability of EM, are presented below from the follow up LIAT survey and FGD findings (**Tables 2 and 3**).

Because outcomes related to effectiveness are determined in the model by the aspects of feasibility and acceptability, we first present the findings on feasibility and acceptability.

### Feasibility of cStock for users

The feasibility of cStock was evaluated by looking at **staff capacity to use cStock, practicability, and relevance**. Follow up findings (February 2013) demonstrated an improvement in reporting of community-level stock data using the cStock system, with 85% of HSAs in six districts sending reports to cStock. In comparison, community data was much less visible at baseline, with only 61% of HF staff across six districts ( $n = 51$ ) reporting HSA supply chain data up to district level, and only 29% of those HFs reporting this data disaggregated from HF data. **Table 2** presents a summary of feasibility findings from the follow up survey.

A majority of users at all levels of the system found the cStock technology **easy to learn**, with 80% of HSAs and 92% of HF staff in the EM group, and 71% of HSAs and 91% of HF staff in EPT group able to send and receive messages without any challenges. HSAs also noted that cStock is **easy to use**, with the majority able to "type in the SMS" without any challenges. District staff in all three EM districts and two of three in EPT districts reported feeling comfortable accessing and navigating the dashboard. Minor use challenges reported by HSAs and HF staff were mainly infrastructural in nature, related to poor network penetration and lack of charger or a place to charge phones.

FGD findings highlight the **practicability** of cStock as shown by the convenience of the system in enabling HSAs to send data on stock levels at any time, and corroborate the survey findings where majority (86%) of HSAs were able to compile and send stock data within an hour. One HSA from the EM group explains: "... [cStock] is also good because we are able to send the messages at any time even in the night and we get the response in time."

FGD findings related to the theme of **relevance to users** include HSAs description of cStock and its components as a fast system for sending messages and receiving feedback. An HSA Supervisor in the EPT group offered: "Yes, [cStock is] very useful because communication is very fast between the HSA and the In-Charge, whenever they want emergency order they receive feedback right away from the health facility."

HSAs and HF staff also perceived cStock as a linkage that facilitates communication between levels from the villages to the HSAs, HSAs to the HF. One HSA Supervisor in the EPT group offered, "... [cStock] is a linkage between the HSAs and the supervisors, even the In-Charge because when the products are ready we just send the message to let them know that the drugs are ready. While before it was hard to reach every HSA." Users also noted that the cStock system helps users remember to take necessary actions, for example one HSA in the EPT group stated, "cStock is good because it reminds you what to do, like if you have one day left to send the report it always reminds you that you have one day left."

**Table 2.** Feasibility of cStock – LIAT Findings (Midline only)\*

DOMAIN	EM, No. (%)	EPT, No. (%)
<b>Staff capacity to use cStock</b>		
District staff comfort level navigating cStock dashboard:		
– Very comfortable	3 (67)	3 (33)
– Comfortable	3 (33)	3 (33)
– Somewhat comfortable	3 (0)	3 (33)
District staff receive SMS alerts on low stocks from cStock	3 (100)	3 (100)
HSA supervisor reports they are able to send order–ready message and receive cStock messages for HSAs	25 (96)	23 (87)
<b>Practicability</b>		
HSAs are able to prepare and send report to cStock within an hour	81 (86)	77 (91)
<b>Challenges associated with use</b>		
HSAs reporting challenges transmitting the cStock reports by SMS†	81 (20)	77 (29)
Drug Store In–Charge encountered challenges using cStock‡	24 (33)	22 (23)
HSA Supervisor encountered challenges using cStock§	25 (8)	23 (9)

LIAT – logistics indicators assessment tool, HSA – health surveillance assistant, SMS – short message service, EM – enhanced management, EPT – efficient product transport

\*Results presented after 18 months of follow-up.

†HSA challenges include network not always available (n = 16), getting error messages (n = 8), repeated nags (n = 2), no place to recharge (n = 1).

‡Drug Store In–Charge challenges include insufficient or no training (n = 5), quantities do not make sense (n = 2), phone issues (n = 2), HSAs not sending reports through cStock/abnormal SOH provided by some HSAs (n = 2), ready message not received (n = 1), network (n = 1), understock (n = 1).

§HSA Supervisor challenges included quantities do not make sense (n = 2), getting error messages (n = 1), no place to charge battery (n = 1).

## Acceptability of cStock

The acceptability of cStock was evaluated by looking at its level of **routine use**, **its effect on users' daily work**, and **perceived benefits** identified by the user. Data for the six intervention districts, analyzed over 18 months from Jan 2102 – June 2013, showed a steady increase (79% to 99% in EM and 71% to 90% in EPT) in routine use of cStock to report on stock levels averaging at 94% for EM, 79% for EPT. Follow up findings also showed that a large majority (97% in EM and 91% in EPT) of HSAs reported that cStock had become their primary means for ordering or requesting health products from their resupply point. Additionally, 92% of health facility Drug Store In–Charges in EM and 91% in EPT reported using cStock to determine the quantities to resupply to HSAs. **Table 3** presents a summary of acceptability findings from the follow up survey.

In addition to routine orders, HSAs also reported using cStock as the primary means for submitting emergency orders. While at baseline, 52% of HSAs across six districts (n = 98) reported travelling to the HFs to submit emergency orders, this percentage dropped to 28% in EM and 21% in EPT at follow up, with the majority (94% in EM, 88% in EPT) of HSAs now using cStock to send emergency orders. All HSAs (100% in EM, 99% in EPT) also reported using cStock routinely to send receipt messages upon collecting their products. Most (96% in EM and 87% in EPT) of the HF staff interviewed reported always using cStock to inform HSAs of orders ready for collection; 44% of HF staff in EM and 30% in EPT used it for follow-up on non- and incomplete reporting, both critical SC performance indicators, particularly for the DPATs.

FGD findings show that cStock contributed to improved accountability for managing products, as HSAs, HFs, and district staff were all responsible for and played roles in reporting and communicating stock-related issues. One positive result of this is reduced product wastage; an HSA Supervisor from the EM group explained “*There is more transparency now as drugs are not given on a friendly basis, when you find products are ready, we count with the specific HSA for accountability...*”

According to FGD participants, cStock is an important source of feedback and information. HSAs perceive monthly cStock reminders about reporting as useful, and HF staff noted that cStock alerts are beneficial in notifying them of late reporting from HSAs. An HSA in the EPT group shared “*I feel very happy whenever I am sending SMS to cStock because I receive feedback right away and because of this I am motivated.*” An HSA Supervisor from EPT adds, “*Yes, it's very useful because communication is very fast between the HSA and the In–Charge, whenever they want emergency order they receive feedback right away from the health facility.*” cStock provides useful information for monitoring SC performance. HF staff reported that cStock enables supervisors to monitor HSA performance and supervisors' own performance through self-assessment. In the EM group, a HSA Supervisor offered “*...we look at their reporting rate, the time they sent their report, the completeness of the report and supervisor notes that, on cStock helps us to monitor performance as the information is easily available.*”

FGD participants felt that cStock increases the overall efficiency of the community supply chain system. HSAs reported that cStock has resulted in a marked reduction in the significant effort, time, and/or money they had previ-

**Table 3.** Acceptability of cStock and EM—LIAT Findings (Midline only)\*

DOMAIN	EM, No. (%)	EPT, No. (%)
<b>Routine use</b>		
<b>cStock:</b>		
HSAs reported using cStock to place emergency orders.	81 (94)	78 (88)
HSAs reported using cStock to send receipts after collecting products.	81 (100)	77 (99)
District staff reported monitoring stock levels and contacting HF when low stock.	3 (33)	3 (0)
District staff use cStock to target HFs for supervision	2 (67)	3 (0)
<b>DPAT:</b>		
HF staff reported monitoring the performance of their DPAT using EM	56% consult cStock; 40% consult Resupply Work sheet (25); 4% do not use anything	NA
<b>Perceived benefits</b>		
<b>cStock:</b>		
HSAs use cStock as the primary means for ordering health products from their resupply point.	81 (97)	78 (91)
HF Drug Stores use cStock to determine quantities to resupply HSAs	25 (92)	23 (91)
<b>DPAT:</b>		
HSAs who attended DPAT meetings reported that a variety of SC topics were covered, including:		
– Reporting, including timeliness and completeness	58 (79)	NA
– Stock management, including expiries and product availability	58 (53)	NA
– Performance improvement	58 (33)	NA
– Performance and recognition plans	58 (13)	NA
HSAs reporting that their DPAT has performance targets to help improve the way they manage products	81 (85)	NA

LIAT – logistics indicators assessment tool, SC – supply chain; HF – health facility, HSA – health surveillance assistant, EM – enhanced management, EPT – efficient product transport, DPAT – district product availability team, NA – not applicable

\*Results presented after 18 months of follow-up.

ously spent in collecting products from the HF. One HSA in the EM group shared, “*as my friends have said, transport costs have been reduced significantly and that is good for us.*” HF staff reported being able to manage inflow of HSAs to the HF to collect products by picking and packing in advance as well as sending notifications to HSAs that their order is ready thus serving them better. cStock also increases staff ability to monitor and communicate information on product usage. HSAs reported that cStock allows tracking product distribution and use, both at the HSA Supervisor level and higher. An HSA from the EPT group added, “*... there is transparency on cStock that your boss is able to know if the products are distributed.*”

### Acceptability of EM (added effect of DPAT)

Acceptability of the DPAT component of the EM intervention was evaluated by looking at how districts, HF staff and HSAs used information supplied by cStock for routine monitoring and managing of community SC performance, improving on their DPAT targets and rewarding well performing HSAs. All district staff in EM districts reported visiting the dashboard at least once a week to obtain data from cStock for planning, coordination, and supervision. District staff also printed cStock reports for use by HF staff to monitor HF and HSA performance. HF staff reported using cStock information obtained either through the resupply worksheets or cStock reports to discuss reporting (79%) and stock management (53%) during DPAT meetings. Seventy-eight percent of the HSAs said their supervisors re-

ferred to the performance targets such as reporting during the DPAT meetings and 80% knew they would receive rewards if they performed well in stock management using cStock. **Table 3** presents summary of acceptability findings for DPATs from the follow up survey.

One aspect that made EM acceptable to users was the DPAT role in monitoring SC performance. HSAs reported that DPAT meetings were useful for discussing SC issues, such as HSA performance, reporting rates, and performance targets. One example from an HSA in the EM group is “*sometimes it happens that you receive less products when you see more cases, we discuss how best to cater for these cases.*” HSA Supervisors reported discussing similar topics, such as HSA performance, supply management, stock outs, reporting rates, and recognition of good performance among HSAs. And HSAs described being motivated by the performance monitoring, positive feedback, and performance targets used as part of the DPAT design. Another HSA in the EM group stated, “*for us we share ideas during the meeting, as a single person you cannot build a house, we are motivated.*” HF staff also cited DPAT meetings as useful in providing a forum for reviewing SC issues and performance.

HSAs and HF staff said that EM helped link people and activities across the supply chain, aligning the flow of information and clarity of processes. Challenges to DPATs included HSA attendance, HSA hunger when no food or refreshments were offered, lack of follow up on issues discussed at meetings, lack of needed materials, and poor coordination/communication by HF In-Charge.

In terms of comparison with the EPT group, performance on most acceptability indicators in **Table 3** was slightly higher in the EM group. For example, district staff in the EM group used cStock more than their EPT counterparts, with 2 of 3 (67%) EM district staff using cStock to target health facilities for supervision compared to 0 of 3 in EPT.

### Effectiveness: supply chain performance of EM vs EPT groups

Findings on effectiveness are presented as a comparison of supply chain performance between the EM and EPT groups according to these four indicators: reporting, complete reporting, lead time, and stock out rates over time, using data from cStock dashboard reports.

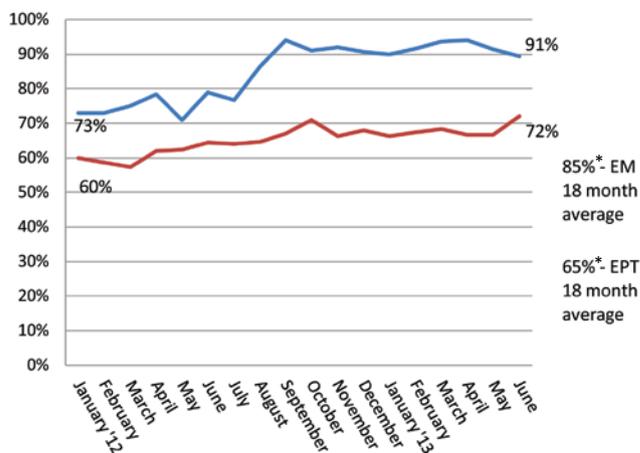
#### Reporting rates

Analysis of cStock results for January 2012 – June 2013 showed higher mean reporting rates in EM (94%) compared to the EPT (79%) group. There was a slow increase in time for both groups, and greater variation seen within the EPT group than EM. This study found that the EM group had significantly higher reporting rates ( $94.0 \pm 10.7\%$ ) compared to the EPT group ( $79.1 \pm 11.0\%$ ),  $t_{(106)} = 6.9766$ ,  $P < 0.001$  (**Figure 3**).

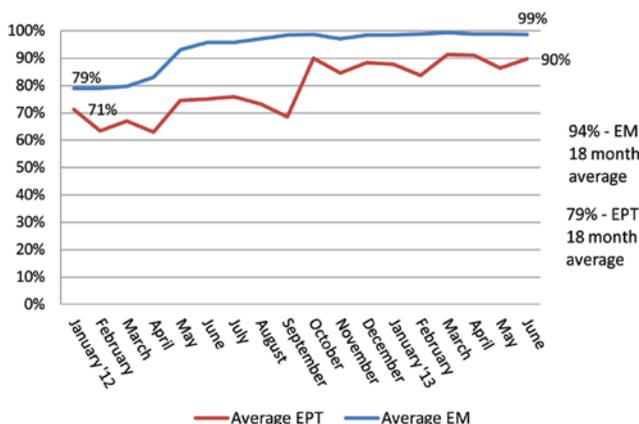
#### Complete reporting

Completeness in reporting measures the extent to which HSAs send in stock on hand messages to cStock for all the products they manage. Mean completeness rates were found to be higher among EM (85%) than EPT districts (65%). **Figure 4** shows the trends in complete reporting between the two groups over 18 months. This study found statistically significantly higher completeness rates ( $85.0 \pm 9.7\%$ ) in the EM group compared to the EPT group ( $65.2 \pm 11.1\%$ ),  $t_{(106)} = 9.8953$ ,  $P < 0.001$ .

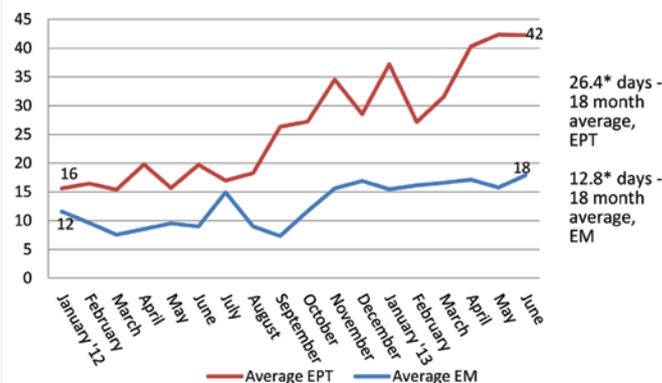
**Lead times.** On average, lead times, a measure of responsiveness in the supply chain, were significantly ( $P < 0.05$ ) lower/better in EM compared to EPT districts with HFs in the EM group taking on average 12.8 days to fulfill an HSA order compared to 26 days in the EPT group. The difference in the two groups was small (four percentage points) in Jan 2012, increasing (to 24 percentage points) in June 2013. This study found statistically significantly lower lead times ( $12.8 \pm 6.2$ ) in the EM group compared to the EPT group ( $26.4 \pm 11.3$ ),  $t_{(106)} = -7.75$ ,  $P < 0.001$  (**Figure 5**).



**Figure 4.** Mean reporting completeness by HSAs (health surveillance assistants), on all commodities, in EM (Enhanced Management, n=393) and EPT (Efficient Product Transport, n=253) districts, January 2012 – June 2013. Asterisk – findings from a two sample t-test with equal variances suggest that the differences in means between the EM and EPT districts are statistically significant ( $P < 0.001$ ).



**Figure 3.** Mean reporting rates to cStock by HSAs, on all commodities in EM (Enhanced Management, n=393) and EPT (Efficient Product Transport, n=253) districts, January 2012 – June 2013.



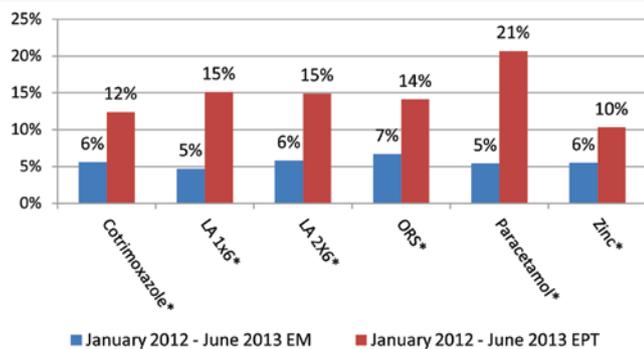
**Figure 5.** Lead time for HSA (health surveillance assistant) drug resupply calculated by cStock, in number of days, in EM (Enhanced Management, n=393) and EPT (Efficient Product Transport, n=253) districts, January 2012 – June 2013. Asterisk – findings from a two sample t-test with equal variances suggest that the differences in means between the EM and EPT districts are statistically significant ( $P < 0.001$ ).

## Supply reliability

Supply reliability can be defined as consistent availability of health products required in the community to treat sick children [10]. Reliability results are presented here as a measure of mean percent HSA stock out rates by product. cStock data analyzed for six iCCM products over an 18-month period ranged between 5–7% stocked out for all products in the EM group and between 10–21% in the EPT group. These differences were statistically significant at the  $P < 0.001$  level for all products. The difference in stockout rates was largest in the case of Paracetamol with mean stockout rates of 5% in the EM group districts and 21% in the EPT group districts (Figure 6).

## DISCUSSION

Our results in both study groups demonstrate that cStock was considered feasible and acceptable to users at all levels in Malawi, and that based on comparison with the EPT group, the DPAT component of the EM group is an essential pairing with cStock to achieve the best possible SC performance and supply reliability among HSAs. Findings on the feasibility of cStock demonstrate that over 70% of community and facility based providers in both study arms were able to send and receive messages without any challenges. Among the few providers experiencing difficulty, challenges were noted as poor network penetration, particularly in mountainous districts, and limitations in the availability of phone chargers. At district level, dashboards used to synthesize data were similarly reported to be easy to use and accessible. The feasibility results also point to the importance of design considerations in development of a mHealth system. cStock was designed as a simple and user friendly system that aligned with the country's existing health information reporting systems and staff capacity to perform SC tasks which facilitated adoption and continued uptake by the users.



**Figure 6.** Mean percentage stockout rate over 18 months, by product, for EM (Enhanced Management) vs EPT (Efficient Product Transport) districts, (January 12–June 13). Asterisk –  $P < 0.001$ .

The acceptability of cStock—measured through routine use and perceived benefits – increased over time, and over an 18-month period the mean use rates for reporting stock levels were 94% among EM districts and 79% in EPT. cStock acceptability levels were high in both groups, as the system was found to be beneficial in supporting essential SC tasks such as resupplying HSAs. This made the work of HF staff less burdensome and more efficient as it helped prevent unnecessary distribution of drugs through automated calculation of resupply quantities and improved accountability and transparency in stock management. Usage rate among HSAs, also an indication of feasibility and acceptability of the system, were high from inception (compared to BL data from paper reports) and sustained as shown by the data extracted from cStock over 18 months. The study also found that following training, HSAs readily adopted and routinely used cStock as an alternative method for ordering products on their own volition without institutional strength ordering them to do so. This rapid uptake of cStock occurred even with the existence of a government-approved paper system that served the same function and can be attributed to the immediate perceived benefits that included a communication and feedback loop related to product requests. The high cStock reporting rates sustained over time despite the presence of an alternative mechanism for sending reports are a further indication of user preference and acceptability of the system. Additionally, empirical evidence from the cStock dashboard shows that HSAs continued using cStock after the pilot at nearly the same or similar usage rates at the follow up assessment.

The difference noted in reporting rates across the two study groups demonstrates the added benefit of DPATs – teams created in EM districts to enhance data utilization and reward HSAs for good performance of SC tasks. While feasibility and acceptability were equally high in both groups, the enhanced effectiveness shown by improvements in timely reporting, and reductions in lead time and stock outs in the EM group can be also be attributed to the DPAT component, which laid emphasis on the use of data for decision making to drive continuous improvements and recognize good performance. DPATs facilitated much of the continued use of data by HF staff in EM districts for monitoring and management, and had a clear and strong association with improvements in all measures of effectiveness— complete reporting rates were on average 20% higher in the EM group, lead times/responsiveness to orders were half as long and mean stock out rates half as high in EM compared to EPT districts. Compared to the paper based reporting system assessed at baseline, where districts only had access to HSA logistics data from 29% of HFs, now they are able to have timely access to data from over 80% of HSAs. Equally important, due to the design and acceptability of DPATs, HF and district managers use cS-

tock data for resupply, for monitoring priority indicators such as reporting rates, and for management decision making to improve outcomes such as supply reliability. These findings show that not only is a feasible, acceptable system like cStock for supplying data beneficial, the higher performance on SC indicators in the EM group clearly points to the added value of DPATs, which, when integrated within existing health organizational systems and structures, can provide a mechanism for making data more meaningful and useful.

### Generalizability of findings

Although there is a growing evidence base for implementation of mHealth systems to solve public health problems, only a limited number of solutions aim to improve supply chain effectiveness [11]. To the best of our knowledge, our study is the first to address feasibility, acceptability and effectiveness of a mHealth solution that targets CHWs at the last mile of supply chains. Our findings on the use of mHealth to improve data visibility and use are consistent with the studies conducted by SMS for Life in Kenya and Tanzania and an SMS-based malaria reporting system supported by Rapid SMS tested in Uganda at peripheral health facilities (one step above the last mile), that demonstrated that mobile technology can improve reporting rates and lead to a reduction in stock outs if managers respond to the timely data [12–14].

The importance of exploring ways to promote routine system use and enhance acceptability is demonstrated by the SMS for Life study in Kenya and Tanzania, where financial incentives were provided for reporting stock information, resulting in higher reporting rates than in the Uganda study, where incentives were not used. The Uganda study however recognizes that better impact related to stock management was likely if district teams were fully engaged, emphasizing the importance of such reporting systems being nested within organization support structures. Similarly in Malawi, the implementation of cStock was integrated with additional components in the two intervention groups designed to enhance the overall performance of the supply chain; the findings from the EM group suggest that the team approach had an additive and significant effect in further improving SC performance for reporting rates, reporting completeness, lead times (responsiveness of the supply chain) and stock out rates (supply reliability). This finding is in agreement with the broader discussion by experts in the field of mHealth who have suggested that integration of mobile-based tools with existing health management

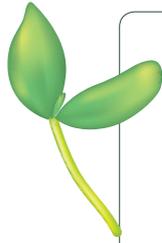
systems and structures will be critical to national level adoption and scaling up of such programs [15]. We believe this is one of the first papers that has tested the hypothesis that while a viable mobile-based tool like cStock is important, the integration of information flow systems with management structures such as DPAT is critical to the tools' adoption and ability to achieve scale and long term effectiveness.

### Limitations

One of the greatest challenges in implementation and evaluation of cStock was related to the complex supply chain and product management environment in Malawi. Due to the economic crisis in the country iCCM implementing partners were provided funding by their donors to supplement the national supply of iCCM medicines and distribute products directly to HSAs. These parallel donor-funded distribution systems bypassed the government-funded public supply chain and therefore masked true product availability throughout the supply chain. Thus attribution of improvements in product availability as a result of the EM and EPT interventions was not possible to determine and supply reliability was used as an indicator instead. Additionally, the scope of this research was limited to analysis of effectiveness of cStock and DPATs (EM) in terms of supply chain outcomes, and did not delve into the additional cost and cost saving related to either component of this integrated approach.

### CONCLUSIONS

Our findings suggest that cStock is a feasible, acceptable and effective tool for improving community health supply chain management. The integration with DPATs to promote the timely and appropriate use of system generated data to strengthen community health supply chain outcomes should be considered as a context-specific adaption for countries interested in adopting cStock. We hypothesize that establishing multilevel teams serves to connect HSAs with decision makers at higher levels of the health system, align objectives, clarify roles in the supply chain and promote trust and collaboration, thereby laying the foundation for country ownership and scalability of a cStock-like system. Continued research around the factors contributing to scalability and sustainability, as well as cost-effectiveness of such interventions, will be critical to strengthen the evidence base in this area.



**Acknowledgements:** The authors greatly appreciate the leadership and support of key colleagues from the Malawi Ministry of Health, especially the head of IMCI and past and current Deputy Directors of HTSS and the Logistics Officers affiliated with each program for enabling research to be conducted as part of programmatic implementation. The authors also thank colleagues at WHO and Save the Children for their contributions throughout the pilot and scale up phases of SC4CCM interventions in Malawi.

**Ethics approval:** Ethics approval was waived after review by Malawi's National Health Sciences Research Committee.

**Funding:** This work was funded as part of SC4CCM project activities. SC4CCM is implemented by JSI Research & Training Institute with funding from The Bill & Melinda Gates Foundation.

**Authorship declaration:** MS, MN, SA1, BF, AM, BC, HN and YC were involved in conception, design, analysis, interpretation of data, all rounds of revision. MS and MN assembled the data and created the figures. SA2 conducted the statistical analysis with substantial input from MS, MN and YC. SA3 and AL led conceptualization of the paper, guided interpretation of the data and provided critical revisions for intellectual content. MS, MN, SA1 and YC wrote the paper. All authors provided critical input required for the final version of the manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). The authors declare no financial relationships with any organizations that might have interest in the submitted work and no other relationships or activities that could appear to have influenced the submitted work; apart from that declared under Funding declaration.

## REFERENCES

- 1 Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet*. 2012;379:2151-61. Medline:22579125 doi:10.1016/S0140-6736(12)60560-1
- 2 WHO/UNICEF Joint Statement: Integrated Community Case Management. New York, NY: UNICEF; 2012. Available from: <http://pubmedcentralcanada.ca/pmc/articles/PMC3748523/pdf/tropmed-87-6.pdf>. Accessed: 16 April 2014.
- 3 MCHIP. CCM Central. Available from: <http://cmcentral.com/>. Accessed: 12 June 2014.
- 4 Schopperle A. Analysis of challenges of medical supply chains in sub-Saharan Africa regarding inventory management and transport and distribution. London: University of Westminster Business School; 2013. Available from: <http://www.transaid.org/images/resources/Medical%20Supply%20Chain%20Challenges.Masterthesis.AS-choepperle.pdf>. Accessed: 12 June 2014.
- 5 Nsona H, Mtimuni A, Daelmans B, Callaghan-Koru JA, Gilroy K, Mgalula L, et al. Scaling up integrated community case management of childhood illness: update from Malawi. *Am J Trop Med Hyg*. 2012;87:54-60. Medline:23136278 doi:10.4269/ajtmh.2012.11-0759
- 6 UNICEF Malawi statistics. Available from: [http://www.unicef.org/infobycountry/malawi\\_statistics.html](http://www.unicef.org/infobycountry/malawi_statistics.html). Accessed: 12 June 2014.
- 7 SC4CCM. Malawi Community Health Supply Chain Baseline Assessment Report. Arlington, VA: JSI Research & Training Institute, Inc., 2010. Available from: <http://sc4ccm.jsi.com/files/2013/10/Malawi-Baseline-Report-FINAL.pdf>. Accessed: 21 May 2014.
- 8 Government of Malawi, Ministry of Health. Malawi Health Sector Strategic Plan 2011-16. Bhatyre, Malawi: Ministry of Health, 2012.
- 9 USAID Deliver Project Task Order 1. Logistics Indicators Assessment Tool (LIAT). Arlington, VA: USAID; 2008.
- 10 Priedeman Skiles M, Cunningham M, Inglis A, Wilkes B, Hatch B, Bock A, et al. The effect of access on demand and use of injectable contraceptives in Malawi. Manuscript submitted for publication, 2014.
- 11 Mechael PN. The case for mHealth in developing countries. *Innov Technol Gov Glob*. 2009;4:103-18. doi:10.1162/itgg.2009.4.1.103
- 12 Barrington J, Wereko-Brobby O, Ward P, Mwafongo W, Kungulwe S. SMS for Life: a pilot project to improve anti-malarial drug supply management in rural Tanzania using standard technology. *Malar J*. 2010;9:298. Medline:20979633 doi:10.1186/1475-2875-9-298
- 13 Githinji S, Kigen S, Memusi D, Nyandigisi A, Mbithi AM, Wamari A, et al. Reducing Stock-Outs of Life Saving Malaria Commodities Using Mobile Phone Text-Messaging: SMS for Life Study in Kenya. *PLoS ONE*. 2013;8:e54066. Medline:23349786 doi:10.1371/journal.pone.0054066
- 14 Kigen S, Nyandigisi A, Mbithi A, Wamari A, Githinji S, Zurovac D, et al. SMS for Life. Kenya Pilot Project Report. Nairobi: Division of Malaria Control, Ministry of Public Health and Sanitation, 2012.
- 15 Mehl G, Labrique A. Prioritizing integrated mHealth strategies for universal health coverage. *Science*. 2014;345:1284-7. Medline:25214614 doi:10.1126/science.1258926

# The costs of integrated community case management (iCCM) programs: A multi-country analysis

David Collins, Zina Jarrah, Colin Gilmartin, Uzaib Saya

Management Sciences for Health, Medford, MA, USA

**Background** Integrated community case management (iCCM) can be an effective strategy for expanding the provision of diarrhea, pneumonia, and malaria services to children under 5 years old but there are concerns in some countries about the corresponding cost and impact. This paper presents and compares findings from a multi-country analysis of iCCM program costs.

**Methods** Data on coverage, utilization, and costs were collected as part of two sets of studies conducted between 2011 and 2013 for iCCM programs in seven sub-Saharan African countries: Cameroon, the Democratic Republic of the Congo, Malawi, Senegal, Sierra Leone, South Sudan and Zambia. The data were used to compare some elements of program performance as well as costs per capita and costs per service (which are key indicators of resource allocation and efficiency).

**Results** Among the seven countries, iCCM utilization ranged from a total of 0.26 to 3.05 contacts per capita (children 2–59 months) per year for the diseases treated, representing a range of 2.7% to 36.7% of the expected numbers of cases. The total recurrent cost per treatment ranged from US\$ 2.44 to US\$ 13.71 for diarrhea; from US\$ 2.17 to US\$ 17.54 for malaria (excluding rapid diagnostic testing); and from US\$ 1.70 to US\$ 12.94 for pneumonia. In some of the country programs, the utilization of iCCM services was quite low and this, together with significant fixed costs, particularly for management and supervision, resulted in services being quite costly. Given the differences across the countries and programs, however, these results should be treated as indicative and not definitive.

**Conclusion** A comprehensive understanding of iCCM program costs and results can help countries obtain resources and use them efficiently. To be cost-effective and affordable, iCCM programs must be well-utilized while program management and supervision should be organized to minimize costs and ensure quality of care. iCCM programs will not always be low-cost, however, particularly in small, remote villages where supervision and supply challenges are greater. Further research is needed to determine the cost-effectiveness of iCCM programs and corresponding patient and service delivery costs.

## Correspondence to:

David H. Collins  
Management Sciences for Health  
200 Rivers Edge Drive  
Medford, MA 02155, USA  
dcollins@msh.org

Due to limited access to effective treatment, diarrhea, malaria and pneumonia remain the leading causes of child mortality in sub-Saharan Africa and result in nearly 41% of global deaths in children under five years old [1]. To improve access to treatment of these illnesses, several developing countries have adopted integrated community case management (iCCM) – the delivery of timely interventions at the community level by community health workers (CHWs). This is seen as a key strategy in meeting Millennium Development Goal 4 on reducing child mortality by 2015.

To be effective, iCCM services must be available from a single provider (“one-stop shopping”) within 24 hours of the onset of symptoms. For example, if a child has a fever, the parent should be able to see a CHW in his or her community within 24 hours and the CHW should be able to provide diagnosis and treatment if the case is simple and refer the case if it is not. The integration of these services is important – there is growing evidence that this increases the utilization of malaria and pneumonia treatment [2–4] compared with separate community-based interventions, and also delivers more timely and appropriate treatment for fever, including malaria. Easy access is also crucial and the availability of iCCM services is especially important in hard-to-reach areas where people live far from health facilities.

Despite the reported success of iCCM in several low- and middle-income countries, it has yet to be implemented as a national strategy in some other countries. This is partly due to concerns about the costs and financing of iCCM programs and the justification of the extra investment in terms of the related health outcomes. A comprehensive understanding of the costs and results will help countries who are considering implementing or expanding iCCM programs to advocate for funding and to plan and budget appropriately. It will also allow for costs to be better monitored and controlled, thus contributing to the efficient use of scarce resources.

This paper describes and compares the results of iCCM cost analyses conducted under two separate sets of studies in seven sub-Saharan African countries.

## METHODS

The cost analyses were conducted between 2011 and 2013. The first two studies were conducted of national programs in Malawi and Senegal in 2011 and 2012 as part of the testing of an iCCM costing and financing tool under the United States Agency for International Development (USAID) Translating Research into Action Project, and these countries were selected because they have mature iCCM programs and sufficient data. A third study conducted in

Rwanda was excluded because data were not comparable. The second set of five studies was conducted of sub-national programs in Cameroon, Democratic Republic of Congo (DRC), Sierra Leone, South Sudan, and Zambia in 2013 with funding from the Bill and Melinda Gates Foundation (BMGF). These five countries were selected by BMGF to estimate the costs of five iCCM projects funded by another international donor. The areas where these five studies were conducted were, reportedly, based on need and feasibility, and all included areas with hard-to-reach populations.

Data were obtained from records and through interviews with the CHWs who provided iCCM services, their supervisors, and program managers. A standard questionnaire was used for the interviews. The samples of districts, health centers, and communities were selected purposefully in terms of access and availability of health facility staff and CHWs. Time limitations and access constraints, such as poor road conditions, meant that some samples may not have included health facilities and CHWs from very remote areas. The samples were relatively small but were sufficient to validate service delivery protocols and to collect data on the work and supervision of the CHWs. An average of 12 health centers were visited in each country, and interviews were conducted with an average of three CHWs per health center, totaling approximately 36 CHWs in each country.

The costs were analyzed using the USAID iCCM Costing and Financing Tool (the tool is available at [www.msh.org/iccm](http://www.msh.org/iccm) and is described in detail in the individual country studies). At the service delivery level, this is a bottom-up, activity-based costing tool, in which standard costs are used to estimate total direct costs per service. Indirect costs, such as supervision and training, are then allocated based on CHW time estimates using a top-down methodology. The resulting figures are a mixture of standard and actual costs, obtained from accounting and budget records and through interviews, in what is sometimes known as an “ingredients” approach [5]. The costs shown were generally total costs incurred by both governments and NGOs and financed from government and donor sources.

The data collection and initial analysis took an average of three weeks in-country involving a small team of experienced data collectors and one experienced health economist. The final analysis, report-writing and validation for each study took an additional two weeks.

## Country studies

All seven iCCM programs varied in terms of study period, population density and coverage, incidence rates, hard-to-reach populations, the nature of the implementing organization (government or NGO), supervision, supply chain, CHW remuneration, user fees, and other aspects. These



many differences limit the usefulness of direct comparisons of the findings, but add richness to the analysis. More information on the country studies can be found in the individual country reports [6–13] – brief descriptions are below:

**Malawi's** national iCCM activities began in 10 districts in 2008 and, with support from donors, were scaled-up throughout the country by 2010. CHWs were remunerated by the government and were expected to spend two days per week on iCCM activities at village clinics and to participate in active case finding through household visits. iCCM services comprised the treatment of malaria, diarrhea, pneumonia, and red eye as well as the identification and referral of anemia and malnutrition. The costing study was based on a sample of iCCM services in the 2328 hard-to-reach communities covered by iCCM.

**Senegal's** iCCM program started in 2003. Services were provided through USAID's Community Health Program which covered the whole country in collaboration with the Ministry of Public Health (MoPH). Services were provided at health huts in the communities and were meant to cover rural, remote areas that did not have health posts (the lowest level of facility). The iCCM service package included rapid diagnostic tests (RDTs) and malaria treatment, and diarrhea and pneumonia treatment. User fees were charged and patients were supposed to purchase the medicines; the prices included a mark-up of 5% to 25%. The funds were intended to be used to replenish stocks and to cover other costs.

In **Cameroon**, a local NGO, in collaboration with the MoPH, began implementing an iCCM project in 2009 in two remote districts – Nguemendouka and Doumé. Through this project, volunteer CHWs provided free treatment to children between the ages of 2 to 59 months for cases of malaria and diarrhea. Treatment for pneumonia was added in Nguemendouka District in 2013.

In the **Democratic Republic of the Congo (DRC)**, implementation of a national iCCM program began in 2005 under the leadership of the MoPH. In 2010, iCCM services were expanded to include family planning services, and the

MoPH mandated that malaria treatment be integrated at community sites, along with pneumonia and diarrhea treatment services. The focus of the costing study was the iCCM component of a project in 9 of the 16 health zones of the Sud-Ubangi District in Equateur Province. The project started in 2010 and was implemented by a local NGO in coordination with the MoPH.

In **Sierra Leone**, an international NGO led an iCCM project which began in Kono district in May 2006. Unpaid Community Health Volunteers provided free treatment to children ages 2 to 59 months for malaria, diarrhea, and pneumonia. Starting in September 2013, the plan was to expand the role of the CHW to include the delivery of community-based maternal and newborn health care interventions.

In **South Sudan**, an international NGO began implementation of an iCCM program in 2009 in hard-to-reach areas in five states and ten counties. These include Kapoeta North County which was selected for the costing study. Unpaid Community-Based Distributors provided free treatment to children ages 2 to 59 months for cases of malaria, diarrhea, and pneumonia.

In **Zambia**, volunteer CHWs began conducting iCCM activities in four districts of Luapula Province in late 2010, then scaled up to all seven districts in 2012, serving a population of 741 373 in remote communities. The iCCM package included RDTs and treatment of pneumonia, diarrhea and malaria, and was implemented in areas where access to health facilities and services was limited. The program had a demand generation element, including having CHWs conduct behavior change communication activities. The project was managed by an international NGO working closely with the Ministry of Health (MoH) as part of a national iCCM program being implemented by the MoH across the country, although this project may not have been completely representative of the overall MoH program.

A summary of key elements of the iCCM programs studied are shown in **Table 1**.

**Table 1.** Geographical and population coverage of iCCM programs covered by the costing studies

	NATIONAL PROGRAMS		SUB-NATIONAL PROGRAMS				
	Malawi	Senegal	Cameroon	DRC	Sierra Leone	South Sudan	Zambia
Year when iCCM implementation started	2008	2003	2009	2010	2006	2009	2010
Year of utilization and cost data	2010	2011	2012	2012	2012	2012	2011
Number of districts (or equivalent) covered	28	65	2	9	14	10	4
Number of health centers supervising iCCM	400	1061	20	126	68	48	77
Total number of communities covered by iCCM	10 451	1620	213	396	900	313	684
Number of hard-to-reach communities covered by iCCM	2328	1620	213	396	900	313	684
Number of CHWs providing iCCM	2328	3240	419	805	840	891	720
iCCM catchment population 2–59 months	615 149	239 860	25 114	138 100	31 584	160 004	78 797
Average number of children 2–59 months per CHW	454	74	60	171	38	180	109

iCCM – integrated community case management, CHW – community health worker, DRC – Democratic Republic of the Congo

## RESULTS

### Coverage and utilization

The package of iCCM services varied across the programs, with only six of the seven covering the three illnesses in an integrated way (Table 2). In Cameroon pneumonia treatment was not part of the package at the time of the study. In some cases, more services were included; for example, treatment of red eye and anemia in Malawi. Malaria treatment was provided symptomatically for fever in Malawi, Cameroon, DRC, Sierra Leone and South Sudan, whereas RDTs were used to detect malaria in Senegal and Zambia. Based on estimates of incidence, the expected number of total annual episodes of illness per child (2–59 months) in the programs where the three main diseases were covered ranged from 5.3 in Malawi to 9.6 in Senegal (where fever was included in the number of episodes, we excluded the numbers of malaria episodes to avoid double-counting). The catchment areas comprised hard-to-reach communities, and it was assumed that there was no access to health facilities or other qualified service providers and all cases should, therefore, have been seen by CHWs. This may have resulted in an overestimate in terms of expected numbers of diarrhea cases to be treated by CHWs, since home treatment using oral rehydration therapy has been taught and promoted in some communities for many years.

The average total numbers of services provided per child per year ranged from 0.26 in Senegal to 3.05 in Sierra Leone and as percentages of the expected numbers of cases in the hard-to-reach areas ranged from 2.7% to 36.7% (also in Senegal and Sierra Leone). These comparisons should be treated as indicative, as estimating the catchment populations in the hard-to-reach areas was difficult. A major difference was the

treatment of malaria (diagnosed or presumptive) which accounted for higher numbers of treatments in Zambia, Sierra Leone and, to some degree, in the DRC. Numbers of referrals were only available in DRC, South Sudan and Zambia and amounted to 0.11, 0.01, and 0.38 per child per year, respectively. In South Sudan and Zambia these figures translate to about 1% and 14% of total cases, respectively. A rule of thumb used by some providers is that around 10% of cases need to be referred – a referral rate that is too low may indicate that the provider is treating too many severe cases, whereas one that is too high may indicate a lack of medicines or supplies or a lack of confidence.

### Non-recurrent costs

The costs of starting an iCCM program can include the development of plans, policies, guidelines and training materials – most of which are generally financed by the national government and/or partners. For this study, we only took into account the training and equipping of CHWs (and in some cases, of their supervisors). All costs for these activities were included irrespective of who incurred or funded them. If the training included more health topics than iCCM, we only included the proportion related to iCCM. The start-up costs for training and equipment were mostly in the range from US\$ 202 to US\$ 352 per CHW, with Malawi and Zambia being outliers at US\$ 1058 and US\$ 897, respectively (these costs are in 2012 US\$, representing the cost of training and equipment if it were provided in 2012). In Malawi, costs were higher because they included a portion of general CHW training and an incentive payment. In Zambia costs were higher because they included training-of-trainers and supervisors, the training was longer than in the other countries, and per diem rates were high relative to those in other countries.

**Table 2.** Number of cases per capita (children aged 2–59 months) in the study year\*

	NATIONAL PROGRAMS		SUB-NATIONAL PROGRAMS				
	Malawi (2010)	Senegal (2011)	Cameroon (2012)	DRC (2012)	Sierra Leone (2012)	South Sudan (2012)	Zambia (2011)
Fever treated presumptively as malaria	0.52	0	0.40	0.90	1.59	0.41	0
Fever tested for malaria with RDT	0	0.10	0	0	0	0	1.62
Confirmed malaria cases treated	0	0.03	0	0	0	0	1.30
Pneumonia cases treated	0.33	0.10	0	0.53	0.55	0.29	0.40
Diarrhea cases treated	0.12	0.06	0.24	0.45	0.91	0.24	0.20
Other cases treated	0.04	0	0	0.14	0	0	0
Referrals made	NA	NA	NA	0.11	NA	0.01	0.38
Total services utilized per child (fever/malaria, pneumonia, diarrhea only)	0.97	0.26	0.64	1.88	3.05	0.94	2.22
Total expected cases per child based on estimated incidence (fever/ malaria, pneumonia, diarrhea)†	5.3	9.6	6.1	8.9	8.3	6.5	6.7
Total cases treated as % of total expected cases	18.3%	2.7%	10.5%	21.1%	36.7%	14.5%	33.1%

DRC – Democratic Republic of the Congo, RDT – rapid diagnostic test, NA – not available

\*We did not include the treatment of non-malaria fever as a separate service, although in some cases fever-reduction medication such as paracetamol is provided and there is, therefore, a cost.

†Sub-Saharan Africa incidence rates were used for all three services in Malawi [14–16] and for malaria and pneumonia in Rwanda [14,15].

The reported annual CHW attrition rates varied significantly across the study sites, ranging from 2% in Malawi (where they are remunerated) to an estimated 10% in South Sudan (the DRC figure of 40% was an unofficial estimate and may not be reliable). The costs of training and equipping replacement CHWs can be significant, as shown above, with most costs in the range of US\$ 202 to US\$ 352 per provider.

While it is possible to amortize non-recurrent costs over the expected period of use and include them with recurrent costs, this was not done here as it would have been difficult to estimate certain aspects, such as the length of the use of equipment or how long a CHW will work after the initial training.

### Recurrent costs

A comparison of recurrent costs can provide meaningful perspectives on the resourcing, equity, and efficiency of service provision and support, and can provide input into cost-effectiveness analyses, involving comparisons of costs per output or outcome. Recurrent costs are those repeated on an ongoing basis and, in this study, include medicines and supplies, management, supervision, and refresher training. These costs are expressed in two ways: per capita and per service. The costs of the training and equipping of replacement CHWs were not included in recurrent costs in these studies although it would be reasonable to do so.

Per capita recurrent costs are calculated here by dividing the total recurrent cost by the number of children in the

catchment population. With the exception of the costs of medicines and supplies (which represent estimates of the quantities consumed), these figures represent the iCCM resources made available to the catchment populations. Per service recurrent costs, on the other hand, are calculated by dividing the total recurrent cost by the number of services provided. These figures represent the iCCM resources that should have been used in providing a single service. The ratio between per-capita and per-service costs is the same as the rate at which services are used per capita.

Medicines and supplies are variable costs which change based on the numbers of services provided. Provider remuneration, management, supervision, refresher trainings and other similar costs are generally fixed and do not vary with the number of services provided. It is important to note that the average total costs of medicines and supplies vary with the mix of services provided as well as with the unit costs of the various medicines. So if a greater proportion of services with higher-cost medicines is used, the average costs across all services will be higher.

The average total recurrent costs per capita (children aged 2–59 months) were much lower for the two national programs (Malawi and Senegal), which were US\$ 2.16 and US\$ 2.07, respectively, than for the four sub-national programs with the complete iCCM package (DRC, Sierra Leone, South Sudan and Zambia), which ranged from US\$ 5.50 to US\$ 10.20 (Table 3). This is largely due to economies of scale in the national programs where the fixed

**Table 3.** Recurrent costs by category (in US\$)\*

	NATIONAL PROGRAMS		SUB-NATIONAL PROGRAMS				
	Malawi (2010)	Senegal (2011)	Cameroon (2012)	DRC (2012)	Sierra Leone (2012)	South Sudan (2012)	Zambia (2011)
<b>Cost per capita (2–59 months)</b>							
Medicines and supplies	0.54	0.14	0.29	0.74	1.54	0.53	2.54
CHW remuneration	1.41	0	0	0	0	0	0
Management and supervision	0.07	1.62	8.40	4.39	8.65	6.90	6.90
Meetings	0.15	0.22	0.84	0.38	0	0.46	0.16
Refresher Training	0	0.09	0.75	0	0	0.68	0
<b>Total</b>	<b>2.16</b>	<b>2.07</b>	<b>10.26</b>	<b>5.50</b>	<b>10.20</b>	<b>8.58</b>	<b>9.60</b>
<b>Average cost per service</b>							
Medicines and supplies	0.53	0.47	0.46	0.34	0.50	0.56	0.65
CHW remuneration	1.40	0	0	0	0	0	0
Management and supervision	0.07	5.39	13.15	2.02	2.79	7.23	1.78
Meetings	0.15	0.74	1.32	0.17	0	0.48	0.04
Refresher Training	0	0.29	1.18	0	0	0.72	0
<b>Total</b>	<b>2.15</b>	<b>6.89</b>	<b>16.11</b>	<b>2.53</b>	<b>3.29</b>	<b>8.99</b>	<b>2.47</b>
<b>Cost breakdown %</b>							
Medicines and supplies	25%	7%	3%	13%	15%	6%	26%
CHW remuneration	65%	0%	0%	0%	0%	0%	0%
Management and supervision	3%	79%	82%	80%	85%	81%	72%
Meetings	7%	11%	8%	7%	0%	5%	2%
Refresher training	0%	4%	7%	0%	0%	8%	0%
	100%	100%	100%	100%	100%	100%	100%

DRC – Democratic Republic of the Congo, CHW – community health worker

\*Addition errors in summary numbers are due to rounding.

costs, especially of management and supervision, are spread across much higher catchment populations. As noted previously, however, caution should be used in comparing costs across the countries since there were many contextual differences.

The average total recurrent cost per service ranged from US\$ 2.15 in Malawi to US\$ 8.99 in South Sudan. Cameroon was an outlier at US\$ 16.11 due to the high level of management and supervision costs combined with low utilization rates, taking into account that pneumonia treatment was not part of the iCCM package at the time of the study. There was no major difference between the national and sub-national costs per service. In general, lower costs per service were related to higher utilization levels combined with lower management and supervision costs. Differences in case mix did not seem to be major factors since the unit cost per disease followed a similar pattern.

The average cost per service for medicines and supplies ranged from US\$ 0.34 in the DRC to US\$ 0.65 in Zambia. Costs were higher in Zambia because RDTs were included. The mix of services and purchasing prices of medicines were different in each country so these figures are not directly comparable.

The iCCM portion of the salary payments to the CHWs in Malawi was significant at US\$ 1.40 on average per service. We did not collect information on the user fees charged by the CHWs in Senegal, which is also a form of remuneration. CHWs were not formally remunerated in any of the 5 sub-national projects.

Management and supervision costs ranged from 72% to 85% of total recurrent costs among the sub-national programs compared with 3% for the national program in Malawi. The Malawi figure was proportionally lower because 65% of the total cost went on CHW remuneration. The Senegal figure of 79% was much higher than that of the Malawi programs because it was managed through a donor-funded project. A key factor in the high cost of supervision in South Sudan was that the implementing NGO had to supervise the CHWs and that was done from central levels as it could not be done from the health facilities. It is

important to note that the variations in the way these management and supervision costs were captured, calculated, and reported mean that these comparisons across the programs are indicative and not definitive.

The costs of CHW meetings ranged from US\$ 0.15 per capita in Malawi to US\$ 0.84 in Cameroon (no separate cost was recorded for Sierra Leone). These costs depended mainly on the frequency of meetings, per diem rates, and amounts reimbursed to CHWs for transport. Refresher training was sometimes provided as part of the routine supervision system or through meetings – in others it was provided as a separate dedicated training activity. In the programs where it was a separate activity, the average cost per capita ranged from US\$ 0.09 to US\$ 0.75.

Recurrent costs can be more meaningfully compared by type of service (eg, malaria) since the average total costs across all services are affected significantly by variations in service mix. Diarrhea treatment was the only service provided in all the studies and the recurrent cost ranged from US\$ 2.44 per service in Malawi to US\$ 7.80 in South Sudan (Table 4). Pneumonia diagnosis and treatment costs ranged from US\$ 1.70 in Malawi to US\$ 12.94 in South Sudan. And the cost of presumptive malaria treatment ranged from US\$ 2.17 in the DRC to US\$ 7.10 in South Sudan. Cameroon was an outlier in these measurements because of the high support costs and low utilization level described earlier. It is important to note that the costs of treating presumptive malaria in some countries cannot be compared with the costs of testing and treating malaria in others because of the contextual differences among the countries.

The cost per type of iCCM service depends on two important factors – the CHW's time and the cost of medicines and supplies. The time that CHWs spend on providing each type of service was used to allocate their remuneration (if they were paid) and the indirect costs (eg, supervision) across the service types. The estimates of time used in the studies were obtained through CHW interviews and ranged widely, for example, from 26 minutes to 91 minutes for pneumonia diagnosis and treatment in Malawi and Si-

**Table 4.** Total average recurrent cost for each type of service (in US\$)

Recurrent cost per service	NATIONAL PROGRAMS		SUB-NATIONAL PROGRAMS				
	Malawi (2010)	Senegal (2011)	Cameroon (2012)	DRC (2012)	Sierra Leone (2012)	South Sudan (2012)	Zambia (2011)
Fever treated presumptively as malaria	2.38		17.54	2.17	3.27	7.10	
RDT testing for malaria		6.89					3.69
Malaria treatment		3.47					3.90
Pneumonia diagnosis and treatment	1.70	8.75		3.55	3.45	12.94	3.56
Diarrhea diagnosis and treatment	2.44	5.89	13.71	2.70	3.22	7.80	3.60
Referrals				1.10	1.08	3.87	1.50

DRC – Democratic Republic of the Congo, RDT – rapid diagnostic test

erra Leone, respectively. Such figures should be treated with caution as in some cases the CHWs had difficulty in understanding the concept of estimating the times spent in diagnosing and treating patients. They can also be affected by the way the time is estimated, for example, if a CHW includes the time taken to travel to the house of the patient. It is important to note that some CHWs reported making follow-up visits to patient's homes and this was not generally taken into account.

The reported unit cost per episode for tests and medicines also varied across the study sites, for example ranging from US\$ 0.04 to US\$ 0.56 for pneumonia treatment in Senegal and Zambia, respectively (Table 5). These unit costs are affected by different treatment regimens and different procurement prices as well as the split in treatment doses among age groups. For example, the average cost per episode for medicines and tests for pneumonia was much lower in Senegal, Malawi and DRC, where Cotrimoxazole was used, compared to Zambia, where Amoxicillin was used.

## Efficiency

An important ratio for measuring the efficiency of iCCM is the average number of services provided per CHW. This is influenced primarily by the availability of the CHW and the demand for services. In terms of availability, most providers are volunteers and have to also perform income-

generating activities (eg, farming or animal husbandry) and many also provide other voluntary health services. Factors influencing the demand for services include the size of the catchment population, the incidence of the illnesses, the distance a person's home to the place where the CHW is based, perceptions of quality of care, and the availability of medicines.

The average catchment population of children (aged 2–59 months) per CHW differed considerably, with CHWs in Sierra Leone covering an average of 38 children and CHWs in Malawi covering an average of 454 children (Table 6). The hours per week that each CHW reported being available for iCCM services also varied – ranging from 4 in Sierra Leone to 49 in the DRC. We recognize that this is very difficult to estimate in most cases, as CHWs do not wait at home for patients. Even though these figures may be somewhat unreliable, they indicate possible differences that are significant, with an average CHW reportedly being available for 48 hours per week for 109 children in Zambia and 16 hours per week for 454 children in Malawi.

The average number of cases seen by a CHW ranged from 0.5 per week in Senegal to 8.2 per week in Zambia. In two of the seven countries less than 1 case was seen per week, on average, which raises concerns about the ability of providers to maintain their skill and highlights the importance of hands-on supervision and refresher trainings. For CHWs to maintain their skills, they should probably see at

**Table 5.** Average cost of tests and medicines per episode (in US\$)

	NATIONAL PROGRAMS		SUB-NATIONAL PROGRAMS				
	Malawi (2010)	Senegal (2011)	Cameroon (2012)	DRC (2012)	Sierra Leone (2012)	South Sudan (2012)	Zambia (2011)
Fever tested for malaria with RDT (RDT and paracetamol)		1.09					0.65
Malaria	0.76	0.56	0.38	0.47	0.62	0.77	0.85
Pneumonia	0.08	0.04	N.A.	0.10	0.18	0.27	0.56
Diarrhea (ORS and zinc)	0.82	0.09	0.59	0.58	0.51	0.56	0.77

DRC – Democratic Republic of the Congo, RDT – rapid diagnostic test, ORS – oral rehydration solution

**Table 6.** Community health worker (CHW) coverage and efficiency

	NATIONAL PROGRAMS		SUB-NATIONAL PROGRAMS				
	Malawi	Senegal	Cameroon	DRC	Sierra Leone	South Sudan	Zambia
Average number of children 2–59 month per CHW	454	74	60	171	38	180	109
Available CHW hours per week for iCCM	16	11	19	49	4	10	48
Average Number of iCCM Cases seen per CHW (year)	267	22	38	371	117	171	427
Average Number of iCCM Cases seen per CHW (week)	5.0	0.5	0.7	7.1	2.3	3.3	8.2
% of available iCCM time used	15%	2%	12%	10%	74%	85%	11%
Estimated CHW attrition rate	2%	5%	7%	40%	6%	10%	5%
Length of initial CHW training (days)	NA	NA	5	5	6	7	7
CHW remuneration	Yes	Yes	No	No	No	No	No
User fees charged for iCCM services	No	Yes	No	No	No	No	No

DRC – Democratic Republic of the Congo, iCCM – integrated community case management, NA – not available

least 10 cases per month in total, including 1 or 2 pneumonia cases, and they should have good supportive supervision where skills can be regularly assessed [17].

The estimated time spent providing iCCM services ranged from 2% to 85% of the total time they said they were available for iCCM services. In some cases, this probably reflects a high degree of over-estimation of available time reported by CHWs. Reported levels of attrition ranged from 2% to 10% (the rate of 40% reported in the DRC may not be reliable), as shown in the same table, and the higher rates are a concern since experienced, skilled providers may be lost and the cost of training and equipping replacements can be high.

The CHWs were remunerated in the two national programs but not in the five sub-national programs and it is notable that the attrition levels were lower in the national programs. There does not, however, seem to be a relationship between CHW remuneration and the numbers of iCCM cases seen, and a deeper analysis would be needed to explore this due to the contextual factors.

User fees were charged to patients in one of the national programs (Senegal) and the average numbers of iCCM cases seen were low. Again, a deeper analysis would be needed to try to determine if there was a relationship between user fees and utilization levels.

### Additional studies

Other studies have been conducted which add value to the discussion of CHW costs. In particular, an overview of community health workers by Perry et al [18] which examined different CHW models and accompanying models of effectiveness in achieving improved health for communities. Additional insights into the challenges of scaling up iCCM have been provided by Oliver et al [19]. And a study by Seidenberg et al looks at the impact of iCCM on health-seeking behavior in Zambia, in which one of the findings was that iCCM can reduce workload at primary health centers [20]. Further information is expected when the South-African Medical Research Council publishes the results of a UNICEF-funded study of iCCM program costs in 6 African countries.

Studies have also examined how patient costs, such as transport and user fees, can restrict or delay access to health services and can negatively impact on a poor family's financial situation, as well as indicating how iCCM can alleviate this economic burden by bringing services closer to the family. A study in Uganda showed, for example, that community treatment of malaria and pneumonia resulted in significant cost-saving for rural, poor communities, who would otherwise lose productive time travelling to health facilities [21]. And a study in Pakistan showed that com-

munity based management of severe pneumonia can reduce both provider and patient costs while also improving case seeking and treatment compliance [22].

## DISCUSSION

To have maximum impact on child health and mortality, iCCM services should be available within 24 hours of the onset of illness and from a single provider ("one-stop shopping"). This is especially important if there are co-morbidities. If the case is complex or severe, the CHW should be able to refer the case to the nearest health facility and help arrange transport, if necessary.

It is clear that effective iCCM can reduce morbidity and save lives but for the services to be widely accepted and implemented by governments, they must also be affordable and cost-effective. Based on this analysis, there are two main factors that affect this: utilization of services, and management and supervision costs.

The analysis shows that low utilization of iCCM services contributes significantly to high unit costs per service, as fixed supervision and management costs have to be absorbed by fewer cases. The results indicate that iCCM services may have been under-utilized in several of the programs, with less than 20% of the expected number of episodes of illness seen by CHWs and, in some cases, CHWs seeing less than one case per week. Low utilization can also be an issue in terms of quality of care because a provider should see sufficient cases per month to build and retain the necessary experience and skills.

Utilization depends partly on the number and types of service included in the iCCM package. In Cameroon, for example, where pneumonia was not treated as part of iCCM in the year of the study, overall utilization was low and this contributed to a higher average unit cost per service. On the other hand, including other services, such treatment of red eye in Malawi, increased utilization and contributed to the lower average unit cost per service. The degree to which other services can or should be added is, however, an important topic that is beyond the scope of this paper.

Utilization is affected by several other factors such as the size of the catchment population, incidence of illness, CHW access and availability, perceptions of medicine supply and quality of care and perhaps, in some cases, user fees as well. In some of the programs, utilization was low because the catchment populations were small, for example in Sierra Leone where each CHW only covered an average of 38 children. Also, incidence rates were lower in some program areas, such as in Malawi, with 5.3 expected episodes per child per year, compared with 9.6 in Senegal.

The availability of the CHWs does not appear to have been a reason for low utilization, since less than 20% of the reported available time was used for iCCM in 6 of the 7 programs. However, it appears likely that medicine stock-outs have been a factor since this was reported as a problem in several of the studies. The studies did not seek to determine if user fees had an impact on utilization in Senegal, which was the only program that had them, and the results did not indicate any obvious relationship.

The lack of maturity of programs was a possible factor in the low utilization levels seen in three of the sub-national programs that had been running for three years or less. At the 2014 iCCM Symposium in Accra, Ghana, it was noted that it can take at least 3 years before an iCCM program reaches maturity in terms of utilization of services and it may take at least 12 months of implementation at scale (with greater than 80% of CHWs trained) to have higher utilization [3]. Building confidence in the availability and quality of iCCM services can take time, but it seems that active promotion and behavior change activities, including the close involvement of community leaders, can increase demand faster, as has reportedly been the case in the Zambia program, which achieved quite high utilization in less than three years.

As noted above the other key factor in terms of iCCM program costs is management and supervision. In the five sub-national programs, this was over 70% of the total recurrent costs and even though it was much lower in the Malawi national program it was 79% in Senegal, where the national program was run by an international organization. It is understandable that the costs of setting up and running pilot projects can be relatively high and even more so if they are run by local or international organizations. These costs should become much lower in relative terms if the programs are scaled-up and taken over by the government. Nevertheless all programs should aim to minimize these costs while maintaining good support for the CHWs so that the availability and quality of iCCM is optimal. Costs can be minimized, for example, by integrating supervision (eg, covering all community health services, not just iCCM), by combining supervision with outreach visits where additional curative services are provided by the supervisor during the visit, and by using local peer supervisors to supplement professional supervisors.

Another key program cost relates to replacing CHWs who stop working. The cost of training and equipping new CHWs can be significant and is often not budgeted. Moreover, the loss of experienced, knowledgeable CHWs can affect the performance of the program. Attrition rates were 5% or more in all of the programs where CHWs were not remunerated, compared with 2% in Malawi where they were remunerated.

In terms of the impact of remunerating CHWs, there was not enough information to assess whether the additional costs were outweighed by increased utilization and reduced attrition, but that is a possibility that is worth exploring in other studies.

The additional costs of iCCM may be offset to some degree by savings elsewhere in the health system. As mentioned previously, there is some evidence that iCCM can reduce workload at primary health centers, and cost savings should also be achieved by treating cases before they become severe. In addition, there is evidence that iCCM results in savings to families with sick children. Unfortunately, it was not possible to investigate these possibilities in the costing studies.

Finally, it is important to note that iCCM programs were sometimes established as a transition strategy to save lives because primary care facility services were weak. Where this is the case, it should be accepted that iCCM services will be costly and may be unsustainable until primary health facilities are fully functional, taking into account that they need to provide the supervision and support (eg, supplies of medicines) and serve as reliable referral units for severe cases. In small, hard-to-reach communities, however, iCCM will probably be the most cost-effective way to provide services in the long term, even if they are costly.

## Limitations

There were a number of limitations to the studies that could have affected the results and which necessitate the need for caution in interpreting and comparing them. The most significant overall limitation is that the studies were carried out at different time periods in seven very different countries which were selected purposively for reasons other than cross-country comparisons. Other limitations include the following. Some of the sub-national programs only started in 2010, and the use of data from 2011 and 2012 to measure costs and efficiency may be premature as it can sometimes take 3 years before programs reach maturity in terms of utilization of services. The samples of facilities and communities were relatively small and were limited in terms of remote communities. Recurrent costs may be underestimated because of lack of complete information on services provided, such as follow-up visits, numbers of referrals, and treatment of fever which is not diagnosed as malaria or pneumonia. Costs do not include the removal of bottlenecks and other health system strengthening activities or economic costs, such as the value of a voluntary CHW's time, family out-of-pocket costs or income losses due to treatment seeking. Finally, the measurement of costs and efficiency depend significantly on CHWs' estimates of time available and time needed for services, and some inaccuracy in these estimates is likely.

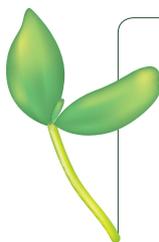
## Recommendations

While there are a growing number of studies on iCCM costs, additional analyses are needed to assess the cost–effectiveness of iCCM. Such analyses are important in making a stronger case that iCCM is a worthwhile investment, while simultaneously helping to determine the most affordable ways to provide quality services. There is a need to look at the role of iCCM within the primary health care system, not as an alternative to facility–based or other community services, but as an effective way of providing treatment for key childhood illnesses in hard–to–reach communities. It is important to take into account patient financial and economic costs as well as service provision costs, and to include factors such as timeliness, quality and appropriateness of treatment. There is also a need to look at the costs of removing bottlenecks, including the costs of improving medicine supply and demand generation, as well as the impact of CHW remuneration and the impact of charging patients for services. Supervision and management can be costly element of iCCM, and the cost–effectiveness of strategies to minimize these costs should be explored. Analysis of financing and financial sustainability is also needed, including the use of medicine sales to patients as a way of financing supplies. Finally, system improvements are generally needed to ensure the availability of routine iCCM and CHW service data, which is necessary for in–depth analysis and performance monitoring.

## CONCLUSIONS

The results of this analysis show that in order to be cost–effective and affordable, iCCM programs must be well–utilized and management and supervision must be organized in a way that minimizes cost while ensuring quality of care. This requires the removal of bottlenecks, such as medicine stock–outs, and of any barriers to access. It also requires activities that encourage the utilization of iCCM services such as the promotion of those services and the involvement of community leaders. To minimize the costs of iCCM management and supervision it is important they are an integral part of the routine systems under which, for example, a supervision visit to a community covers multiple health services, not just iCCM.

In some cases, however, it must be accepted that iCCM will not be low–cost even if the CHWs are volunteers. For example, a sub–national iCCM program that is established by an NGO to save lives because facility–based services are weak is likely to be relatively costly until the health system is strengthened. And in the case of small, remote villages, while iCCM is likely to be the most cost–effective way to provide services, it may never be low–cost because of the supervision and supply challenges.



**Acknowledgments:** We would like to thank the managers and staff of the iCCM programs in the countries for their support in providing the information needed for the studies and for their dedication to the health of the communities where they were working.

**Funding:** The original studies on which this paper is based were conducted with funding from the USAID TRAction Project and from the Bill and Melinda Gates Foundation. The preparation of this manuscript was supported through the USAID TRAction Project.

**Ethics approval:** Ethical clearance was obtained where needed for the studies on which this research is based.

**Authorship declaration:** DC wrote the manuscript; ZJ, CG and US critically reviewed the manuscript for intellectual content. ZJ led the individual country studies, conducted the analysis and led the writing of those studies. All authors read and approved the final manuscript. DC is the guarantor of the paper.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). The authors declare no support from any organization for the submitted work; no financial relationships with other organizations that might have an interest in the submitted work in the previous 3 years, and no other relationships or activities that could appear to have influenced the submitted work.

- 1 Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG, et al. Global, regional, and national causes of child mortality in 2008: a systematic analysis. *Lancet*. 2010;375:1969-87. Medline:20466419 doi:10.1016/S0140-6736(10)60549-1
- 2 Yeboah-Antwi K, Pilingana P, Macleod W, Semrau K, Siazeele K, Kalesha P, et al. Community case management of fever due to malaria and pneumonia in children under five in Zambia: a cluster randomized controlled trial. *PLoS Med*. 2010;7:e1000340. Medline:20877714 doi:10.1371/journal.pmed.1000340
- 3 iCCM Evidence Review. Synthesis of recent studies and evaluations of integrated community case management in sub-Saharan Africa. *Integrated Community Case Management: Evidence Review Symposium*; 2014 Mar 3-5; Accra, Ghana.
- 4 Rasanathan K, Oliphant N, Diaz T. Summary of integrated community case management evidence review symposium. *Integrated Community Case Management: Evidence Review Symposium*; 2014 Mar 3-5; Accra, Ghana. Available at: <http://ccmcentral.com/wp-content/uploads/2014/07/iCCM-Symposium-Final-Report-17.07.2014.pdf>. Accessed: 1 August 2014.
- 5 Levin HM. Cost-effectiveness analysis. In: Carnoy M, editor. *International Encyclopedia of Economics of Education*, 2nd ed. Oxford: Pergamon; 1995. p. 381-6.
- 6 Jarrah Z, Lee AC, Wright K, Schulkers K, Collins D. Costing of integrated community case management in Malawi. *Management Sciences for Health*, 2013. Available at: <http://www.msh.org/resources/costing-of-integrated-community-case-management-in-malawi>. Accessed: 1 June 2014.
- 7 Jarrah Z, Mugeni C, Lee AC, Wright K, Schulkers K, Collins D. Costing of integrated community case management in Rwanda. *Management Sciences for Health*, 2014. Available at: [http://tractionproject.org/sites/default/files/MSH\\_Costing\\_of\\_Integrated\\_Community\\_Case\\_Management\\_Analysis\\_Report\\_Rwanda.pdf](http://tractionproject.org/sites/default/files/MSH_Costing_of_Integrated_Community_Case_Management_Analysis_Report_Rwanda.pdf). Accessed: 1 June 2014.
- 8 Jarrah Z, Lee AC, Dilley K, Suraratdecha C, Collins D. Costing of integrated community case management: Senegal. *Management Sciences for Health*, 2013. Available at: [http://www.msh.org/sites/msh.org/files/msh\\_costing\\_of\\_integrated\\_community\\_case\\_management\\_analysis\\_report\\_sene.pdf](http://www.msh.org/sites/msh.org/files/msh_costing_of_integrated_community_case_management_analysis_report_sene.pdf). Accessed: 1 June 2014.
- 9 Jarrah Z, Gilmartin C, Collins D. The cost of integrated community case management in Nguemendouka and Doumé districts, Cameroon. Medford, MA: Management Sciences for Health; 2014.
- 10 Jarrah Z, Klein M, Collins D. The cost of integrated community case management in Sud-Ubangi District, Democratic Republic of the Congo. Medford, MA: Management Sciences for Health; 2014.
- 11 Jarrah Z, Lieber R, Gilmartin C, Collins D. The cost of integrated community case management in Kono District, Sierra Leone. Medford, MA: Management Sciences for Health; 2014.
- 12 Jarrah Z, Patel S, Gilmartin C, Collins D. The cost of integrated community case management in Kapoeta North County, South Sudan. Medford, MA: Management Sciences for Health; 2014.
- 13 Jarrah Z, Corazzini L, Schulkers K, Collins D. The cost of integrated community case management in Luapula Province, Zambia. Medford, MA: Management Sciences for Health; 2014.
- 14 Korenromp E, Roca-Feltre A, Carneiro I. Malaria incidence estimates at country level for the year 2004. Geneva: World Health Organization, Roll Back Malaria; 2005. Available at: [http://www.rollbackmalaria.org/docs/incidence\\_estimations2.pdf](http://www.rollbackmalaria.org/docs/incidence_estimations2.pdf). Accessed: 31 July 2014.
- 15 Rudan I, Boschi-Pinto C, Biloglav Z, Mulholland K, Campbell H. Epidemiology and etiology of childhood pneumonia. *Bull World Health Organ*. 2008;86:408-416. Medline:18545744 doi:10.2471/BLT.07.048769
- 16 Hamer D, Simon J, Thea D, Keusch G. Childhood diarrhea in sub-Saharan Africa: Child health research project special report, 1998. Available at: <http://www.harpmnet.org/doc/spec2.pdf>. Accessed: 31 July 2014.
- 17 Young Mark (Senior Health Specialist at UNICEF). E-mail message to: David Collins (Management Sciences for Health, Medford, MA, USA). 2014 Apr 17.
- 18 Perry HB, Zulliger R, Rogers M. Community health workers in low-, middle-, and high-income countries: an overview of their history, recent evolution, and current effectiveness. *Annu Rev Public Health*. 2014;35:399-421. Medline:24387091 doi:10.1146/annurev-publhealth-032013-182354
- 19 Oliver K, Young M, Oliphant N, Diaz T, Kim J. Review of systematic challenges to the scale-up of integrated community case management: emerging lessons & recommendations from the catalytic initiative (CI/HSS). UNICEF Maternal, Newborn and Child Health Working Paper. 2012 April. Available at: [http://www.unicef.org/infobycountry/files/Analysis\\_of\\_Systematic\\_Barriers\\_cover\\_1163.pdf](http://www.unicef.org/infobycountry/files/Analysis_of_Systematic_Barriers_cover_1163.pdf). Accessed: 31 July 2014.
- 20 Seidenberg PD, Hamer DH, Iyer H, Pilingana P, Siazeele K, Hamainza B, et al. Impact of integrated community case management on health-seeking behavior in rural Zambia. *Am J Trop Med Hyg*. 2012;87:105-10. Medline:23136285 doi:10.4269/ajtmh.2012.11-0799
- 21 Matovu F, Nanyiti A, Rutebemberwa E. Household health care-seeking costs: experiences from a randomized, controlled trial of community-based malaria and pneumonia treatment among under-fives in eastern Uganda. *Malar J*. 2014;13:222. Medline:24902959 doi:10.1186/1475-2875-13-222
- 22 Bari A, Sadruddin S, Khan A, Khan L, Khan A, Lehri IA, et al. Community case management of severe pneumonia with oral amoxicillin in children aged 2-59 months in Haripur district, Pakistan: a cluster randomized trial. *Lancet*. 2011;378:1796-803. Medline:22078721 doi:10.1016/S0140-6736(11)61140-9

# Multi-country analysis of routine data from integrated community case management (iCCM) programs in sub-Saharan Africa

Nicholas P. Oliphant<sup>1</sup>, Maria Muñiz<sup>1</sup>, Tanya Guenther<sup>2</sup>, Theresa Diaz<sup>1</sup>, Yolanda Barberá Láinez<sup>3</sup>, Helen Counihan<sup>4</sup>, Abigail Pratt<sup>5</sup>

<sup>1</sup> UNICEF, Programme Division, Health, New York, USA

<sup>2</sup> Save the Children, Washington, DC, USA

<sup>3</sup> International Rescue Committee, New York, USA

<sup>4</sup> Malaria Consortium, London, UK

<sup>5</sup> Population Services International, Nairobi, Kenya

**Aim** To identify better performing iCCM programs in sub-Saharan Africa (SSA) and identify factors associated with better performance using routine data.

**Methods** We examined 15 evaluations or studies of integrated community case management (iCCM) programs in SSA conducted between 2008 and 2013 and with information about the program; routine data on treatments, supervision, and stockouts; and, where available, data from community health worker (CHW) surveys on supervision and stockouts. Analyses included descriptive statistics, Fisher's exact test for differences in median treatment rates, the Kruskal-Wallis test for differences in the distribution of treatment rates, and Spearman's correlation by program factors.

**Results** The median percent of annual expected cases treated was 27% (1–74%) for total iCCM, 37% (1–80%) for malaria, 155% (7–552%) for pneumonia, and 27% (1–74%) for diarrhoea. Seven programs had above median total iCCM treatments rates. Four programs had above median treatment rates, above median treatments per active CHW per month, and above median percent of expected cases treated. Larger populations under-five targeted were negatively associated with treatment rates for fever, malaria, diarrhea, and total iCCM. The ratio of CHWs per population was positively associated with diarrhoea treatment rates. Use of rapid diagnostic tests (RDTs) was negatively associated with treatment rates for pneumonia. Treatment rates and percent of annual expected cases treated were equivalent between programs with volunteer CHWs and programs with salaried CHWs.

**Conclusions** There is large variation in iCCM program performance in SSA. Four programs appear to be higher performing in terms of treatment rates, treatments per CHW per month, and percent of expected cases treated. Treatment rates for diarrhoea are lower than expected across most programmes. CHWs in many programmes are overtreating pneumonia. Programs targeting larger populations under-five tend to have lower treatment rates. The reasons for lower pneumonia treatment rates where CHWs use RDTs need to be explored. Programs with volunteer CHWs and those with salaried CHWs can achieve similar treatment rates and percent of annual expected cases treated but to do so volunteer programs must manage more CHWs per population and salaried CHWs must provide more treatments per CHW per month.

## Correspondence to:

Nicholas P. Oliphant  
 Health Specialist  
 Program Division, Health Section  
 UNICEF  
 3 UN Plaza  
 New York, NY 10017, USA  
 noliphant@unicef.org



In 2010 the main causes of child mortality globally included pneumonia (18%), diarrhoea (15%), and malaria (8%), and in Africa their share was 17%, 15% and 12%, respectively [1]. In conjunction with broader efforts to address these causes of child mortality, integrated community case management (iCCM) evolved as a strategy to train, supply, and supervise community health workers (CHWs) to diagnose and treat diarrhoea, malaria, and pneumonia in communities where access to health services is poor [2]. Several studies indicate that CHWs—when appropriately trained, supplied, and supported—can effectively diagnose and treat children with uncomplicated, non-severe diarrhoea, malaria, and pneumonia [3-12]. Increasingly low and middle-income countries, including those in sub-Saharan Africa (SSA), have adopted iCCM as a component of their health strategies [13,14].

Data on iCCM program performance from routine sources—that is data collected on an ongoing basis by CHWs—provide a wealth of information but have not been fully exploited. There are few examples of analyses of routine iCCM data in the published literature [15-17]. Laínez and others reported that iCCM programs in six countries of SSA contributed to increasing the number of children treated for diarrhoea, fever, and pneumonia, but that diarrhoea treatment rates were lower than expected [15]. In Sierra Leone, they reported a strong negative correlation between treatment rates (treatments per child per year or tx/c/y) and the size of the under-five population served by CHWs and that monthly supervision of CHWs reduced the pneumonia treatment rate; the latter suggesting improved targeting of antibiotics [15]. Nsona and others reported the average monthly number of treatments per 1000 children under-five in the 28 districts of Malawi to be 20.7 for malaria (0.2 tx/c/y), 12.9 for pneumonia (0.1 tx/c/y), and 4.6 for diarrhoea (0.0 tx/c/y), and ascribed the relative predominance of malaria treatments to the national policy of presumptive treatment of fever as malaria [16]. These studies demonstrate that routine iCCM data can provide information to improve iCCM programs early—on without having to wait for full evaluations. We build on these efforts to use routine iCCM data by broadening the geographic scope of analysis to include more programs/countries, conducting comparative analysis of iCCM treatment rates, percent of annual expected cases treated, and treatments per active CHW per month across programs/countries, and broadening the analysis of program factors associated with these parameters.

We used routine iCCM data from 2012 to answer the following questions:

- 1) Have certain iCCM programs in SSA performed better than others in terms of treatment rates, treatments per CHW per month, and the percent of annual expected cases treated?
- 2) What program factors are associated with treatment rates?
- 3) What program factors are associated with treatments per active CHW per month?

## METHODS

### Data sources

Twenty-three program evaluations and implementation research studies from thirteen countries in sub-Saharan Africa conducted between 2008 and 2013 were identified through a call to researchers and implementing partners [18]. The following predetermined inclusion criteria were used for our analysis: the program 1) included integrated treatment of diarrhoea, malaria, pneumonia by CHWs; 2) followed protocols for iCCM recommended by WHO/UNICEF (eg, the program did not use dual treatment for fever with antimalarials and antibiotics); 3) had at least 12 months of implementation at scale (ie, there were at least 12 months from the date at which at least 80% of deployed CHWs were trained in iCCM until the last month of routine data on treatments); and 4) had routine data available on the number of iCCM treatments provided by CHWs disaggregated by illness for 2012. Eight studies did not meet one or more of these inclusion criteria, leaving fifteen studies from ten countries for our analysis.

We obtained the following parameters from principle investigators in a standardized Microsoft Excel (2013) spreadsheet: program description, target population, routine data on treatments and stockouts of commodities based on monthly or quarterly paper-based reporting from CHWs, and routine data on supervision coverage from supervisor's monthly or quarterly reports. Where available, additional data was provided on stockouts and/or supervision coverage from CHW surveys.

### Dependent variables

Dependent variables for our analysis included annualized treatment rates (treatments per child per year or tx/c/y) by illness, the number of treatments per active CHW per month (tx/CHW/m) by illness, and the percent of annual expected cases treated by illness in 2012 (Table 1). For the latter, the denominator was based on the reported population targeted by the program and regional estimates of incidence for SSA. It is recognized that in some programs not all communities would have been exposed (ie, have a CHW trained on iCCM). The percent of annual expected cases treated reflects the share of all expected cases in the entire area treated by CHWs and not only the cases from communities with CHWs trained in iCCM (ie, those with local exposure to CHWs). Similarly, household surveys typical-

**Table 1.** Dependent variable definitions\*

INDICATOR	NUMERATOR	DENOMINATOR
Treatment rate (by illness)	Number of treatments (by illness) provided by CHWs in the study area over the last 12 consecutive months of the study	Number of children under five years of age in the study area
Treatments per active CHW per month	Number of treatments provided by CHWs in the last 12 consecutive months of the study/12	Number of active CHWs (the number of CHWs deployed and trained in iCCM in the study area minus attrition) during the same period
Percent of annual expected cases treated (by illness)	Number of treatments (by illness)	Annual expected number of cases (by illness) × 100

CHW – community health worker, iCCM – integrated community case management

\*Annual treatment rates were adjusted by adding the product of multiplying the number of treatments by then inverse of the CHW reporting rate. For programs where CHWs do not use rapid diagnostic test (RTD), annual malaria treatment rates were adjusted downward by multiplying the number of treatments (fevers) by the RTDs positivity rate from the 2013 World Malaria Report. The adjustments above were also used for calculating the 'Average monthly treatments per CHW' and 'Percent of annual expected cases treated by CHWs'. The denominator for the 'Percent of annual expected cases treated by CHWs' is derived by multiplying the estimated average annual regional incidence by the estimated population of children under five years of age in the study area.

ly sample across entire districts or regions (not only communities served by CHWs). In the absence of national or sub-national level estimates of incidence we used regional estimates for SSA: 0.27 for pneumonia and 3.30 for diarrhoea from Fischer Walker and others [19]; and 1.68 for malaria in average transmission areas of central Africa from Roca-Feltrer and others [20]. National level estimates of pneumonia incidence were not available for all countries in our study so we defaulted to regional level estimates for all countries [21].

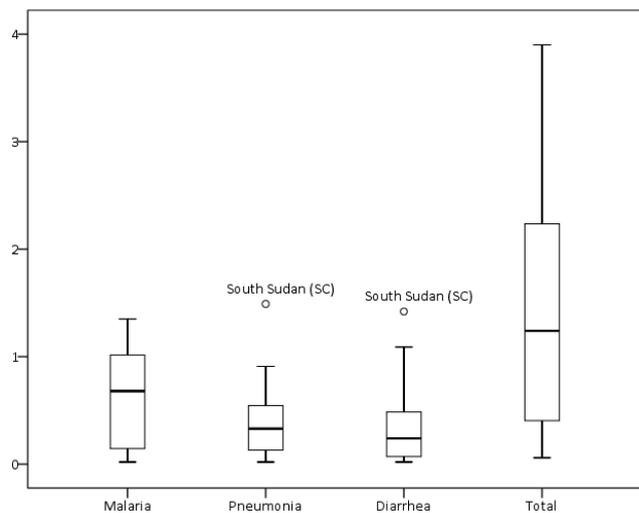
We adjusted the numerators (number of treatments provided by CHWs) for the three dependent variables to account for CHW reporting rates, number of months of treatment data available, and for malaria only, RDT positivity rates. To adjust for under-reporting, the number of reported treatments was adjusted upward by multiplying the number of reported treatments by the inverse of the reported CHW reporting rate. For seven of the fifteen studies, CHW reporting rates were not available so the median value (90%) from studies with available data was used.

Routine data on the number of treatments provided by CHWs were not available for the twelve months of 2012 in two of the fifteen studies despite implementing iCCM at scale during that period. Routine data were available for six months for South Sudan (SC) and seven months for Sierra Leone (UNICEF). In these cases we pro-rated the data to twelve consecutive months in 2012 based on the per month average of the available data.

For the seven programs where RDTs were not used, reported fever treatment rates were converted to malaria treatment rates for comparison purposes by adjusting the former downward using the RDT positivity rate reported for the country in the 2013 World Malaria Report [22].

## Independent variables

Other data on program factors thought to be associated with iCCM program performance (see Figure 1 in ref. [18]) was collected from principle investigators in the Microsoft Excel spreadsheet for the programs as of 2012, including: whether CHWs charged fees for iCCM drugs or consultation; whether RDTs were used by CHWs; whether CHWs were selected by the community in which they worked; whether CHWs were paid a salary; whether implementation of the iCCM program was supported by NGOs; whether CHWs worked from a static health post (designated structure other than their home); ratio of active CHWs per 1000 children under five years of age; number of months of implementation at scale (the point in time at which at least 80% of CHWs in the field/deployed have been trained on iCCM); frequency of supervision of CHWs (as stated in



**Figure 1.** Distribution of treatment rates (treatment per child per year) by illness. SC – Save the Children.

policy, guidance or plans); ratio of active CHW per supervisor; percent of CHWs with no stockouts of iCCM commodities in a defined period (data was from routine sources and where available from CHW surveys; available data were for either of two periods: 1) no stockout greater than 7 days in the last 3 months or 2) no stockout of any duration in the last month; we used whichever was available; no program had both); percent of CHWs that received supervision in a defined period; population under five years of age in the program area; and the population (and percentage of) under five years of age targeted by the iCCM program in the program area.

## Analysis

We used IBM SPSS Statistics for Windows, Version 22.0 (IBM, Armonk, NY, USA) in all analyses. We calculated descriptive statistics (mean, median, range, minimum, maximum, and interquartile range) for dependent and independent variables. We tested the normality of the distribution of dependent variables using the Shapiro–Wilk test. We excluded missing values pair-wise.

To answer the question ‘Have certain iCCM programs in SSA performed better than others in terms of treatment rates, treatments per CHW per month, and the percent of annual expected cases treated?’ we calculated treatment rates, treatments per CHW per month, and the percent of annual expected cases treated by illness and study area.

To answer the question ‘What program and contextual factors are associated with treatment rates?’ we used box plots, non-parametric tests, and Spearman’s correlation to determine whether there were significant associations between independent variables and dependent variables. Non-parametric tests were used because the dependent variables were not normally distributed. We used the Kruskal-Wallis H test to determine whether there were statistically significant ( $P < 0.05$ ) differences in the distribution of treatment rates by dichotomous independent variables. We used Fisher’s exact test, which is robust to small sample sizes and unbalanced data [23], to determine whether there were statistically significant ( $P < 0.05$ ) differences in median treatment rates by dichotomous independent variables. We used Spearman’s rank-order correlation to test for associations between treatment rates and independent variables to complement Fisher’s exact test. We excluded outliers (values below the bottom 2% or above the upper 98% of the distribution) for the Kruskal-Wallis and Fisher’s exact tests, but we did not exclude outliers for Spearman’s correlation since it is relatively robust to outliers [24].

To answer the question ‘What program and contextual factors are associated with treatments per CHW per month?’ we undertook the same analysis described above, using

treatments per active CHW per month as the dependent variable instead of treatment rates.

## RESULTS

Thirteen (87%) programs reported CHWs were selected by the community. Twelve (80%) programs reported NGOs supported the program. Six (40%) programs reported CHWs were salaried and six (40%) programs reported CHWs work at a designated post/structure in the community (the same programs that reported CHWs were salaried). Two (13%) programs reported CHWs charge fees. The mean percentage for not having stockouts was 77% (median 84%, range 34–100%) for ACTs, 78% (median 84%, range 30–100%) for antibiotics, and 81% (median 88%, range 25–100%) for ORS. Supervision coverage was 71% (median 75%, range 25–100%). There was large variation in the size of the targeted population under-five (mean 1 165 190; median 357 773; range 69 165–10.2 million), percent of the population under-five targeted (mean 76%; median 100%; range 27–100%), ratio of children under-five per active CHW (mean 328; median 94; range 35–2007), and ratio of active CHWs per 1000 children under-five (mean 10; median 11; range 1–29). There was no significant difference in the mean or median size of the targeted population under-five between programs with volunteer CHWs and salaried CHWs. However programs with volunteer CHWs had significantly higher ratios of active CHWs per 1000 children under-five compared to programs with salaried CHWs ( $P < 0.001$  for mean and  $P = 0.007$  for median). The data on salary, ratio of active CHW per 1000 under-fives, and designated post/structure indicate two predominant program typologies: 1) programs ( $n = 9$ ) with volunteer CHWs that do not work from designated posts/structures in the community and have a larger number of CHWs per population under-five, and 2) programs ( $n = 6$ ) with salaried CHWs that work at designated posts/structures in the community and have a smaller number of CHWs per population under-five (Online Supplementary Document, Tables s1–7).

## Treatment rates

The mean treatment rate was 0.6 (median 0.7, range 0.0–1.4) for malaria, 0.4 (median 0.3, range 0.0–1.5) for pneumonia, 0.4 (median 0.2, range 0.0–1.4) for diarrhoea, and 1.4 (median 1.2, range 0.1–3.9) for total iCCM (Online Supplementary Document, Table s8). Treatment rates for each illness were not normally distributed and showed high levels of variability and positive skew with outliers at the higher end of the range (Figure 1). Excluding outliers, we found variability less pronounced but not unimportant as per the IQRs (Online Supplementary Document, Table s8).

**Treatment rates varied by program area.** For example treatment rates for malaria ranged from 0.1 in Ethiopia (UNICEF) to 1.4 in Mozambique (Save the Children). However there were seven program areas (Malawi – Save the Children, Mozambique – Save the Children, Sierra Leone – International Rescue Committee, Sierra Leone – UNICEF, South Sudan – International Rescue Committee, South Sudan – Save the Children, and Uganda Central – UNICEF) that had above median total iCCM treatment rates, indicating consistency in terms of higher performing program areas and lower performing program areas (Online Supplementary Document, Table 9).

The reported treatment mix (the share of each illness out of the total iCCM treatment rate) did not reflect the expected treatment mix from estimated regional incidence [19,20]. The share of the total iCCM treatment rate was larger than expected for pneumonia at 30% vs 5% expected and for malaria at 43% vs 32% expected, while diarrhoea treatments represented a smaller than expected share of the treatment mix at 27% vs 63% expected.

**Treatment per active CHW per month**

The mean number of treatments per active CHW per month, or workload, was 10 (median 5, range 0–40) for malaria, 7 (median 3, range 0–26) for pneumonia, and 5 (median 2, range 0–16) for diarrhoea. The mean number of total iCCM treatments per active CHW per month was 22 (median 11, range 1–72). Treatments per active CHW per month were not normally distributed and showed high levels of variability and positive skew (Figure 2; Online Supplementary Document, Table s10).

Total iCCM treatments per active CHW per month varied by study area, ranging from 1 in Rwanda (IRC) and Ghana

(UNICEF) to 72 in Niger (UNICEF) (Online Supplementary Document, Table s11). There was no significant association between program areas with above median treatments per active CHW per month and program areas with above median treatments rates.

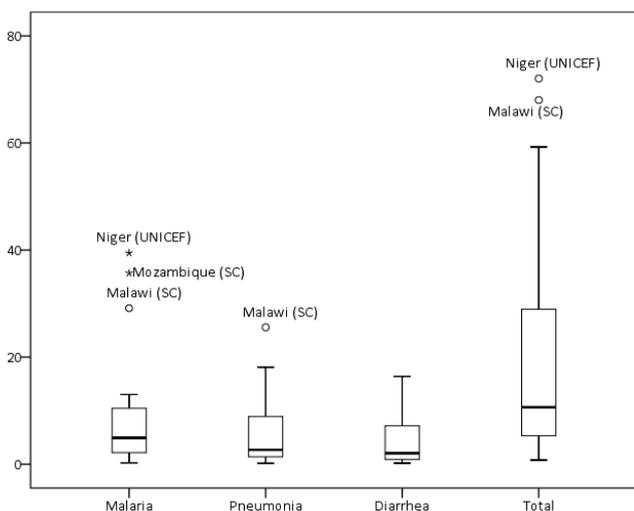
**Percent of annual expected cases treated**

The mean percent of expected annual cases treated was 37% (median 41%, range 1–80%) for malaria, 155% (median 122%, range 7–552%) for pneumonia, and 27% (median 14%, range 1–74%) for diarrhoea. The mean percent of annual expected cases treated for total iCCM was 27% (median 24%, range 1–74%) (Online Supplementary Document, Table s12). The percent of annual expected cases treated was not normally distributed for malaria or pneumonia and showed high levels of variability and positive skew (Figure 3; Online Supplementary Document, Table s12).

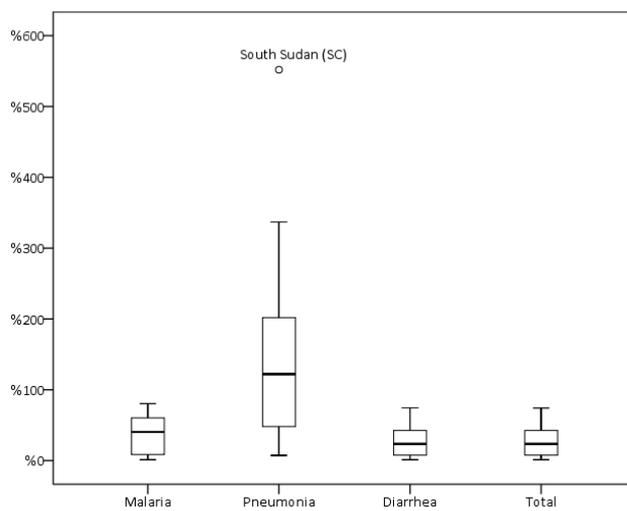
The mean percent of expected annual cases treated for total iCCM varied by study area, ranging from 1% in Ethiopia (UNICEF) to 74% in South Sudan (Save the Children). Variation was greatest for pneumonia which ranged from 1% in Ethiopia (UNICEF) to 552% in South Sudan (Save the Children) (Online Supplementary Document, Table s13).

**Program and contextual factors associated with treatment rates**

Programs with larger targeted populations under-five had significantly less variation in treatment rates and lower median treatment rates for fever ( $P=0.041$ ), malaria ( $P=0.048$ ), and diarrhea ( $P=0.041$ ), and spearman’s correlation indicated significant negative associations for fever, malaria, diarrhea, and total iCCM. We found a similar pattern for pneumonia but the difference in medians was not statistically



**Figure 2.** Distribution of treatments per active community health worker (CHW) per month by illness. SC – Save the Children, UNICEF – United Nation Children’s Fund.



**Figure 3.** Distribution of the percent of expected cases treated by illness. SC – Save the Children.

significant. Programs that reported CHWs use RDTs had similar median treatment rates for pneumonia but significantly less variation ( $P=0.042$ ) compared to programs that reported CHWs do not use RDTs, and Spearman's correlation indicated a significant negative association ( $P=0.037$ ). We found a similar but insignificant pattern between RDTs and fever treatment rates (Table 2). Spearman's correlation indicated a significant positive association between the continuous variable for the ratio of active CHWs per 1000 under-fives and the treatment rate for diarrhoea (Online Supplementary Document, Table s14).

We found no significant differences in median treatment rates and the following factors: NGOs supported implementation, CHWs worked at a fixed post, CHWs were salaried, CHWs were selected by the community, above median ratio of active CHW per 1000 under-fives, supervision was meant to be monthly by plan or policy, above median ratio of active CHWs per supervisor; above median supervision coverage, above median percent of CHWs with no stockout of antibiotics, above median percent of CHWs with no stockouts of ACTs, above median percent of CHWs with no stockouts of ORS, above median percent of the population under-five targeted, active case finding, or fees. Spearman's correlation corroborated the results from Fisher's exact tests (Online Supplementary Document, Table s13). We found no difference ( $P=0.552$ ) in median treatment rates between program typology 1 (volunteer CHWs that do not work from a designated post/structure and

serve larger populations under-five) and program typology 2 (salaried CHWs that work from a designated post/structure and serve smaller populations under-five).

### Program and contextual factors associated with treatments per active CHW per month

We found significantly higher median treatments per active CHW per month for programs with salaried CHWs ( $P=0.041$ ) and for programs with CHWs that work at a designated post/structure ( $P=0.041$ ), and found perfect collinearity between programs with these two characteristics. Similarly we found significantly higher treatments per active CHW per month among program typology 2 compared to program typology 1. No significant differences in medians were found between total iCCM treatments per active CHW per month and the following factors: NGOs supported implementation, supervision was meant to be monthly by plan or policy, above median ratio of active CHWs per supervisor, above median supervision coverage, above median no stockouts of ACTs, above median no stockouts of antibiotics, above median no stockouts of ORS, or active case finding. Spearman's correlation corroborated all results from Fisher's exact test, except for the following instances. Spearman's correlation indicated significant negative associations between treatments per active CHW per month for all illnesses and fees for iCCM, between treatments per active CHW per month for all illnesses and the percent of the under-five population targeted,

**Table 2.** Tests for differences in the distribution and median of treatment rates and tests of association by independent variables\*

FACTOR	FEVER	MALARIA	PNEUMONIA	DIARRHEA	TOTAL
<b>Above median population U5 targeted:</b>					
No (No.)	1.76 (8)	1.03 (4)	0.41 (8)	0.49 (8)	2.24 (8)
Yes (No.)	0.33 (7)	0.10 (6)	0.28 (7)	0.12 (7)	0.56 (7)
Median test	0.041†	0.048†	0.315	0.041†	0.132
Distribution test	0.041†	0.019†	0.105	0.028†	0.041†
Association test	0.031†	0.014†	0.106	0.021†	0.011†
<b>Above median ratio of active CHWs per 1000 U5s:</b>					
No (No.)	0.98 (8)	0.64 (8)	0.34 (8)	0.20 (8)	1.05 (8)
Yes (No.)	1.72 (7)	0.83 (7)	0.31 (6)	0.46 (7)	1.81 (7)
Median test	0.619	0.619	1.000	0.619	0.619
Distribution test	0.728	0.908	0.948	0.298	0.562
Association test	0.742	0.913	0.700	0.315‡	0.582
<b>RDTs:</b>					
No (No.)	1.92 (7)	NA	0.64 (7)	0.24 (7)	2.03 (7)
Yes (No.)	0.98 (8)	NA	0.23 (8)	0.19 (8)	1.05 (8)
Median test	0.619	NA	0.132	1.000	0.619
Distribution test	0.165	NA	0.042†	0.298	0.224
Association test	0.173	NA	0.037†	0.315	0.237

U5 – children under five, CHW – community health worker, RDT – rapid diagnostic test, NA – not applicable

\*Where the sum of “Yes” and “No” does not equal 15, outliers have been removed from the analysis. Fisher's exact test was used to test difference in median. Kruskal-Wallis test was used to test difference in distributions. Spearman's  $\rho$  was used to test for associations.

†Significant ( $P<0.05$ ).

‡Association with continuous variable for the ration of active CHWs per 1000 U5 was marginally insignificant ( $P=0.060$ ).

and between pneumonia treatments per active CHW per month and whether CHWs were selected by the community (Online Supplementary Document, Table s15).

## DISCUSSION

Our analysis indicated large variation in performance of iCCM programs. We identified higher performing programs, lower performing programs, and factors associated with performance using routine data. Our results for treatment rates were consistent with others studies [15,17] and for treatments per active CHW per month [16,25,26]. In half of the fifteen studies CHWs treated 24% or fewer of the total annual expected cases, and in four programs CHWs treated 5% or less of total annual expected cases. This is cause for concern but an opportunity to learn.

Programs with above median treatment rates and above median percent of annual expected cases treated were consistent across illnesses. We found no association between program areas with above median total iCCM treatment rate and program areas with above median number of treatments per active CHW per month, and we found differences in the factors associated with each. We found four program areas (Malawi – Save the Children, Mozambique – Save the Children, South Sudan – Save the Children, and Uganda Central – UNICEF) that had above median treatment rates, above median treatments per active CHW per month, and above median percent of expected cases treated.

Our results indicate that diarrhoea treatment rates and the percent of annual expected cases treated for diarrhoea are lower than expected. Similar results were reported by Láinez and others [15] and by Mugani and others [17]. Láinez and others contend that where CCM for diarrhoea was added to CCM for malaria (eg, Rwanda) a focus on malaria may persist and overshadow diarrhoea, resulting in lower treatment rates [15]. Only 20% of CHWs treating diarrhoea reported stockouts of ORS across the program areas, and while the stockout data do not reflect trends or the dynamics of stockouts one has to question whether demand-side factors were addressed. The literature suggests that managers must address a number of demand-side factors including caregiver's perceptions of diarrhoea, their perceptions of the effectiveness of ORS, and preferences for traditional remedies [27-32].

Our results indicate CHWs in most programs areas are overtreating pneumonia, and in several program areas they are doing so by large orders of magnitude. Similar results were reported by Mugani and others [17]. The appropriateness of the regional estimates of pneumonia incidence may be questioned, however the magnitude of the difference between our pneumonia treatment rates and what would be expected suggests overtreatment is the more like-

ly explanation. In addition our results for fever/malaria and diarrhoea seem plausible, lending further support to this conclusion. A recent review of pneumonia treatment by CHWs in SSA concluded that CHWs may be overtreating [33] however overtreatment has also been reported at facility level [34,35]. We found a significant negative association between the use of RDTs and pneumonia treatment rates and less variation among programs using RDTs. The mechanisms driving this association were not clear. We did not capture data on whether CHWs used respiratory rate timers (RRTs). It is possible that where CHWs used RDTs they may have also used RRTs, and that use of RRTs may have improved targeting of antibiotic treatment.

We found significant negative associations between size of the targeted population under-five and treatment rates, but more variation in treatment rates among program areas targeting smaller under-five populations. Higher treatment rates among programs targeting smaller under-five populations (eg, a district or portion thereof) may be due to the ability to concentrate resources. It is unclear why there was greater variation in treatment rates for programs targeting smaller under-five populations.

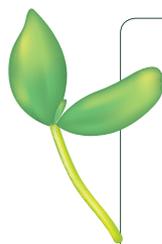
We found a significant positive association between the ratio of active CHWs per 1000 children under-five and the diarrhoea treatment rate; however the association was driven entirely by four program areas in two countries (Sierra Leone – International Rescue Committee, Sierra Leone – UNICEF, South Sudan – International Rescue Committee, and South Sudan – Save the Children). Láinez and others found a similar association with the total iCCM treatment rate in Sierra Leone [15]. It is not clear why this association might be present in these outlier programs for diarrhoea but not for malaria or pneumonia.

We found that factors associated with treatments per active CHW per month differed from factors associated with treatment rates. Unlike for treatment rates, we found a significant positive association between whether CHWs were salaried and the number of total iCCM treatments per active CHW per month. In programs with salaried CHWs, CHWs worked from designated posts/structures in the community, and the programs tended to have below median ratios of CHWs per 1000 children under-five targeted. This indicated two interesting program typologies: programs with fewer CHWs per population under-five who work from designated posts/structures in the community and are salaried, and programs with more CHWs per population under-five who do not work from designated posts/structures and are volunteers. The data indicate these two types of programs achieved equivalent treatment rates, but to do so programs with salaried CHWs treated more cases per active CHW and programs with volunteers managed more CHWs per population under-five.

There are several limitations to our study. Selection bias is a possibility since we only drew from studies we were made aware of through the call to researchers and implementing partners and may have missed other programs with data that could have contributed to this analysis. However we included data from several larger iCCM programs which may make our results reasonably representative. The small number of study areas and the point-in-time nature of this data may have decreased our ability to detect robust associations between our dependent variables and independent variables. While Fisher's exact test is robust to small sample sizes and unbalanced data, a larger sample size may have revealed greater variation and may have allowed for a wider range of robust analytical methods including multivariate analysis. We were also limited by data collected by the study teams and there are factors of interest for which we did not have data (eg, information on demand generating activities, data on referral of severe cases, aggregate data on caregiver's knowledge and socioeconomic status). The bivariate associations between performance and program/contextual factors do not control for confounding factors, nor do they consider interactive effects (ie, effect modifiers). The static view provided by our analysis may conceal dynamic relationships (eg, for stockouts). Given the above, our results on the associations between performance and program/contextual factors should be interpreted with caution. Our analysis is based on routine data reported to us by principle investigators of each study and we were unable to assess the quality of the reported data. Principle investigators reported the targeted population under-five, thus our analysis is based on the reported targeted population under-five rather than the actual age groups targeted by CHWs (eg, 2–59 months). However this should not af-

fect the comparisons across countries or the analysis of associations since the percentage of younger groups such as 0–2 months not targeted by CHWs should be similar across countries. CHW reporting rates were not available for seven of fifteen studies and had to be imputed. In two of the fifteen studies, routine data on treatments provided by CHWs were not available for each of the last twelve consecutive months of the study and values had to be imputed. In seven of fifteen studies that reported CHWs do not use RDTs we used national RDT positivity rates in the absence of local data representative of study areas to adjust fever treatments downward to be comparable with reported malaria treatments from studies that reported CHWs use RDTs. Our analysis used regional estimates of incidence in the absence of national estimates for each illness and all countries. Although we expanded the geographic scope of previous analysis using routine data and revealed variation in iCCM treatment rates and percent of annual expected cases treated across program areas, our analysis may mask inequities within program areas. Additionally, our analysis did not consider quality and timeliness of treatment—key factors if iCCM is to have an impact on child health.

Despite these limitations our analysis has provided new insights about iCCM programs in SSA, demonstrating the value of leveraging routine data. More research is needed to understand the drivers of variation in treatment rates and the percent of annual expected cases treated but our analysis points to promising leads. The underlying mechanisms driving lower diarrhoea treatment rates urgently need to be identified and addressed, and that CHWs in many program areas are over-treating pneumonia is also of concern and needs to be addressed.



**Acknowledgements:** We thank the members of the iCCM Symposium Impact Outcome Evaluation Thematic Group, including Agbessi Amouzou, UNICEF, New York, USA; Franco Pagnoni – World Health Organization, Geneva, Switzerland, Saul Morris – Children's Investment Fund, London, UK; Zinia Jarah – Management Sciences for Health, Boston, USA for their feedback on preliminary analysis. We also thank the members of the 2014 iCCM Symposium Thematic Groups for their encouragement. Most importantly we thank the staff of the Ministry of Health and partners in each country who implement iCCM and collected the data which formed the basis of this analysis.

**Funding:** This analysis was supported by the Department of Foreign Affairs Trade and Development Canada.

**Authorship declaration:** NPO, MM, TG, and TD conceptualized the analysis. TG and NPO collected the data from principal investigators. NPO conducted the analysis and wrote the manuscript. NPO, MM, TG, TD, YBL, HC, AP reviewed the manuscript and contributed to revision.

**Competing interest:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). They report no competing interests.

- 1 Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al; Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet*. 2012;379:2151-61. Medline:22579125 doi:10.1016/S0140-6736(12)60560-1
- 2 World Health Organization/United Nations Children's Fund. Joint Statement: Integrated Community Case Management. An equity-focused strategy to improve access to essential treatment services for children. Geneva: WHO/UNICEF, 2012.
- 3 Sazawal S, Black RE. Meta-analysis of intervention trials on case-management of pneumonia in community settings. *Lancet*. 1992;340:528-33. Medline:1354286 doi:10.1016/0140-6736(92)91720-5
- 4 Winch PJ, Gilroy KE, Wolfheim C, Starbuck ES, Young MW, Walker LD, et al. Intervention models for the management of children with signs of pneumonia or malaria by community health workers. *Health Policy Plan*. 2005;20:199-212. Medline:15965032 doi:10.1093/heapol/czi027
- 5 Sazawal S, Black RE; Pneumonia Case Management Trials Group. Effect of pneumonia case management on mortality in neonates, infants, and pre-school children: a meta-analysis of community-based trials. *Lancet Infect Dis*. 2003;3:547-56. Medline:12954560 doi:10.1016/S1473-3099(03)00737-0
- 6 George A, Young M, Nefdt R, Basu R, Sylla M, Bannicq MY, et al. Community case management of diarrhoea, malaria and pneumonia: Tracking science to policy and practice in sub-Saharan Africa. New York: UNICEF, 2012.
- 7 Harvey SA, Jennings L, Chinyama M, Masaninga F, Mulholland K, Bell DR. Improving community health worker use of malaria diagnostic tests in Zambia: package instructions, job-aid, and job-aid-plus-training. *Malar J*. 2008;7:160. Medline:18718028 doi:10.1186/1475-2875-7-160
- 8 Yeboah-Antwi K, Pilingana P, Macleod WB, Semrau K, Siazele K, Kalesha P, et al. Community case management of fever due to malaria and pneumonia in children under five in Zambia: A cluster randomized controlled trial. *PLoS Med*. 2010;7:e1000340. Medline:20877714 doi:10.1371/journal.pmed.1000340
- 9 Chanda P, Hamainza B, Moonga HB, Chalwe V, Pagnoni F. Community case management of malaria using ACT and RDT in two districts in Zambia: achieving high adherence to test results using community health workers. *Malar J*. 2011;10:158. Medline:21651827 doi:10.1186/1475-2875-10-158
- 10 Mubi M, Janson A, Warsame M, Mirtensson A, Källander K, Petzold MG, et al. Malaria Mubi M1, Janson A, Warsame M, Mirtensson A, Källander K, Petzold MG, in Tanzania. *PLoS ONE*. 2011;6:e19753. Medline:21750697 doi:10.1371/journal.pone.0019753
- 11 Mukanga D, Tiono AB, Anyorigiya T, Källander K, Konaté AT, Oduro AR, et al. Integrated community case management of fever in children under five using rapid diagnostic tests and respiratory rate counting: a multi-country cluster randomized trial. *Am J Trop Med Hyg*. 2012;87(5 Suppl):21-9. Medline:23136274 doi:10.4269/ajtmh.2012.11-0816
- 12 Hamer DH, Brooks ET, Semrau K, Pilingana P, MacLeod WB, Siazele K, et al. Quality and safety of integrated community case management of malaria using rapid diagnostic tests and pneumonia by community health workers. *Pathog Glob Health*. 2012;106:32-9. Medline:22595272 doi:10.1179/1364859411Y.0000000042
- 13 George A, Menotti EP, Rivera D, Montes I, Reyes CM, Marsh DR. Community case management of childhood illness in Nicaragua: transforming health systems in underserved rural areas. *J Health Care Poor Underserved*. 2009;20(4 Suppl):99-115. Medline:20168036 doi:10.1353/hpu.0.0205
- 14 Bennett S, George A, Rodriguez D, Shearer J, Diallo B, Konate M, et al. Policy challenges facing integrated community case management in Sub-Saharan Africa. *Trop Med Int Health*. 2014;19:872-82. Medline:24750516 doi:10.1111/tmi.12319
- 15 Lainez YB, Wittcoff A, Mohamud AI, Amendola P, Perry HB, D'Harcourt E. Insights from community case management data in six sub-Saharan African countries. *Am J Trop Med Hyg*. 2012;87(5 Suppl):144-50. Medline:23136290 doi:10.4269/ajtmh.2012.12-0106
- 16 Nsona H, Mtimuni A, Daelmans B, Callaghan-Koru JA, Gilroy K, Mgalula L, et al. Scaling Nsona H1, Mtimuni A, Daelmans B, Callaghan-Koru JA, Gilroy K, Mgalula L Malawi. *Am J Trop Med Hyg*. 2012;87(5 Suppl):54-60. Medline:23136278 doi:10.4269/ajtmh.2012.11-0759
- 17 Mugeni C, Levine A, Munyaneza RM, Mulindahabi E, Cockrell HC, Glabis-Bloom J, et al. Nationwide implementation of integrated community case management of childhood illness in Rwanda. *Glob Health Sci Pract*. 2014;2:328-41. Medline:25276592 doi:10.9745/GHSP-D-14-00080
- 18 Diaz T, Guenther T, Oliphant N, Muñiz M; iCCM Symposium impact outcome thematic group. A proposed model to conduct process and outcome evaluations and implementation research of child health programs in Africa using integrated community case management as an example. *J Glob Health*. 2014;4:020409. doi:10.7189/jogh.04.020409
- 19 Walker CL, Rudan I, Liu L, Nair H, Theodoratou E, Bhutta ZA, et al. Global burden to childhood pneumonia and diarrhoea. *Lancet*. 2013;381:1405-16. Medline:23582727 doi:10.1016/S0140-6736(13)60222-6
- 20 Roca-Feltrer A, Carneiro I, Armstrong Schellenberg JR. Estimates of the burden of malaria morbidity in Africa in children under the age of 5 years. *Trop Med Int Health*. 2008;13:771-83. Medline:18363586 doi:10.1111/j.1365-3156.2008.02076.x
- 21 Rudan I, O'Brien KL, Nair H, Liu L, Theodoratou E, Qazi S, et al; Child Health Epidemiology Reference Group (CHERG). Epidemiology and etiology of childhood pneumonia in 2010: estimates of incidence, severe morbid-

- ity, underlying risk factors and causative pathogens for 192 countries. *J Glob Health*. 2013;3:010401. Medline:23826505
- 22 World Health Organization. *The World Malaria Report*. Geneva: WHO, 2013.
  - 23 Mehta CR, Patel NR. *IBM SPSS Exact Tests*. Armonk, NY: IBM, 2011.
  - 24 Abdullah MB. On a robust correlation coefficient. *S J Royal Stat Soc, Series D, The Statistician*. 1990;39:455-60.
  - 25 Gilroy KE, Callaghan-Koru JA, Cardemil CV, Nsona H, Amouzou A, Mtimuni A, et al; CCM-Malawi Quality of Care Working Group. Quality of sick child care delivered by Health Surveillance Assistants in Malawi. *Health Policy Plan*. 2013;28:573-85. Medline:23065598 doi:10.1093/heapol/czs095
  - 26 Miller NP, Amouzou A, Tafesse M, Hazel E, Legesse H, Degefe T, et al. Integrated community case management of childhood illness in Ethiopia: Implementation strength and quality of care. *Am J Trop Med Hyg*. 2014;91:424-34. Medline:24799369 doi:10.4269/ajtmh.13-0751
  - 27 Wilson SE, Ouédraogo CT, Prince L, Ouédraogo A, Hess SY, Rouamba N, et al. Caregiver recognition of childhood diarrhea, care seeking behaviors and home treatment practices in Burkina Faso: a cross-sectional survey. *PLoS ONE*. 2012;7:e33273. Medline:22428006 doi:10.1371/journal.pone.0033273
  - 28 Wilson SE, Morris SS, Gilbert SS, Mosites E, Hackleman R, Weum KL, et al. Scaling up access to oral rehydration solution for diarrhea: Learning from historical experience in low- and high-performing countries. *J Glob Health*. 2013;3:010404. Medline:23826508 doi:10.7189/jogh.03.010404
  - 29 Colvin CJ, Smith HJ, Swartz A, Ahs JW, de Heer J, Opiyo N, et al. Understanding careseeking for child illness in sub-Saharan Africa: a systematic review and conceptual framework based on qualitative research of household recognition and response to child diarrhea, pneumonia, and malaria. *Soc Sci Med*. 2013;86:66-78. Medline:23608095 doi:10.1016/j.socscimed.2013.02.031
  - 30 Zwisler G, Simpson E, Moodley M. Treatment of diarrhea in young children: results from surveys on the perception and use of oral rehydration solutions, antibiotics, and other therapies in India and Kenya. *J Glob Health*. 2013;3:010403. Medline:23826507 doi:10.7189/jogh.03.010403
  - 31 Scott K, McMahan S, Yumkella F, Diaz T, George A. Navigating multiple options and social relationships in plural health systems: a qualitative study exploring healthcare seeking for sick children in Sierra Leone. *Health Policy Plan*. 2014;29:292-301. Medline:23535712 doi:10.1093/heapol/czt016
  - 32 Bedford KJ, Sharkey AB. Local barriers and solutions to improve care-seeking for diarrhoea and malaria in Kenya, Nigeria and Niger: A qualitative study. *PLoS ONE*. 2014;9:e100038. Medline:24971642 doi:10.1371/journal.pone.0100038
  - 33 Druetz T, Siekmans K, Goossens S, Ridde V, Haddad S. The community case management of pneumonia in Africa: a review of the evidence. *Health Policy Plan*. 2013. Epub ahead of print. Medline:24371218 doi:10.1093/heapol/czt104
  - 34 Armstrong Schellenberg J, Bryce J, de Savigny D, Lambrechts T, Mbuya C, Mgalula L, et al; Tanzania IMCI Multi-Country Evaluation Health Facility Survey Study Group. The effect of integrated management of childhood illness on observed quality of care of under-fives in rural Tanzania. *Health Policy Plan*. 2004;19:1-10. Medline:14679280 doi:10.1093/heapol/czh001
  - 35 Osterholt DM, Onikpo F, Lama M, Deming MS, Rowe AK. Improving pneumonia case-management in Benin: a randomized trial of a multi-faceted intervention to support health worker adherence to Integrated Management of Childhood Illness guidelines. *Hum Resour Health*. 2009;7:77. Medline:19712484 doi:10.1186/1478-4491-7-77
  - 36 Countdown to 2015. *Maternal, Newborn and Child Survival*. Available at: [www.countdown2015mnch.org](http://www.countdown2015mnch.org). Accessed: 31 August 2014.

# A proposed model to conduct process and outcome evaluations and implementation research of child health programs in Africa using integrated community case management as an example

Theresa Diaz<sup>1</sup>, Tanya Guenther<sup>2</sup>,  
Nicholas P Oliphant<sup>1</sup>, Maria Muñoz<sup>1</sup>  
and the iCCM Symposium impact  
outcome evaluation thematic  
group\*

<sup>1</sup> UNICEF, Programme Division, Health, New  
York, NY, USA

<sup>2</sup> Save the Children, Washington DC, USA

\* Contributors from the iCCM Symposium  
impact outcome evaluation thematic group  
are listed at the end of the article

**Aim** To use a newly devised set of criteria to review the study design and scope of collection of process, outcomes and contextual data for evaluations and implementation research of integrated community case management (iCCM) in Sub-Saharan African.

**Methods** We examined 24 program evaluations and implementation research studies of iCCM in sub-Saharan Africa conducted in the last 5 years (2008–2013), assessed the design used and categorized them according to whether or not they collected sufficient information to conduct process and outcome evaluations.

**Results** Five of the 24 studies used a stepped wedge design and two were randomized control trials. The remaining 17 were quasi-experimental of which 10 had comparison areas; however, not all comparison areas had a pre and post household survey. With regard to process data, 22 of the studies collected sufficient information to report on implementation strength, and all, except one, could report on program implementation. The most common missing data elements were health facility treatments, service costs, and qualitative data to assess demand. For the measurement of program outcomes, 7 of the 24 studies had a year or less of implementation at scale before the endline survey, 6 of the household surveys did not collect point of service, 10 did not collect timeliness (care seeking within 24 hours of symptoms) and 12 did not have socioeconomic (SES) information. Among the 16 studies with comparison areas, only 5 randomly selected comparison areas, while 10 had appropriate comparison areas.

**Conclusions** Several evaluations were done too soon after implementation, lacked information on health facility treatments, costs, demand, timeliness or SES and/or did not have a counterfactual. We propose several study designs and minimal data elements to be collected to provide sufficient information to assess whether iCCM increased timely coverage of treatment for the neediest children in a cost-efficient manner.

## Correspondence to:

Theresa Diaz, MD MPH  
Senior Health Advisor  
Program Division, Health Section  
UNICEF  
3 UN Plaza  
NY, NY 10017, USA  
tdiaz@unicef.org

Evaluation and implementation research of the delivery of maternal, newborn and child health interventions that focus on impact, specifically those assessing changes in morbidity or mortality, have been deemed critical to determine the effectiveness of programs being implemented [1]. However, unlike an efficacy trial, in reality evaluators and researchers cannot control programs implemented by governments, international or bilateral agencies, and private voluntary organizations, nor can they control contextual factors that affect the program [2,3]. In sub-Saharan African countries and many other developing countries, multiple organizations support different programs and may work in different areas of the same country, implement their programs differently and may implement in areas that were designated to be the control arm of an evaluation without the evaluator being aware. In addition, achieving full implementation at scale can take much longer than anticipated and other contextual factors not under the control of the evaluator, such as national stock out of medications, can negatively impact the programs. Without documenting these factors and other details of implementation, the impact studies are limited in their ability to explain why programs do or do not produce expected impact.

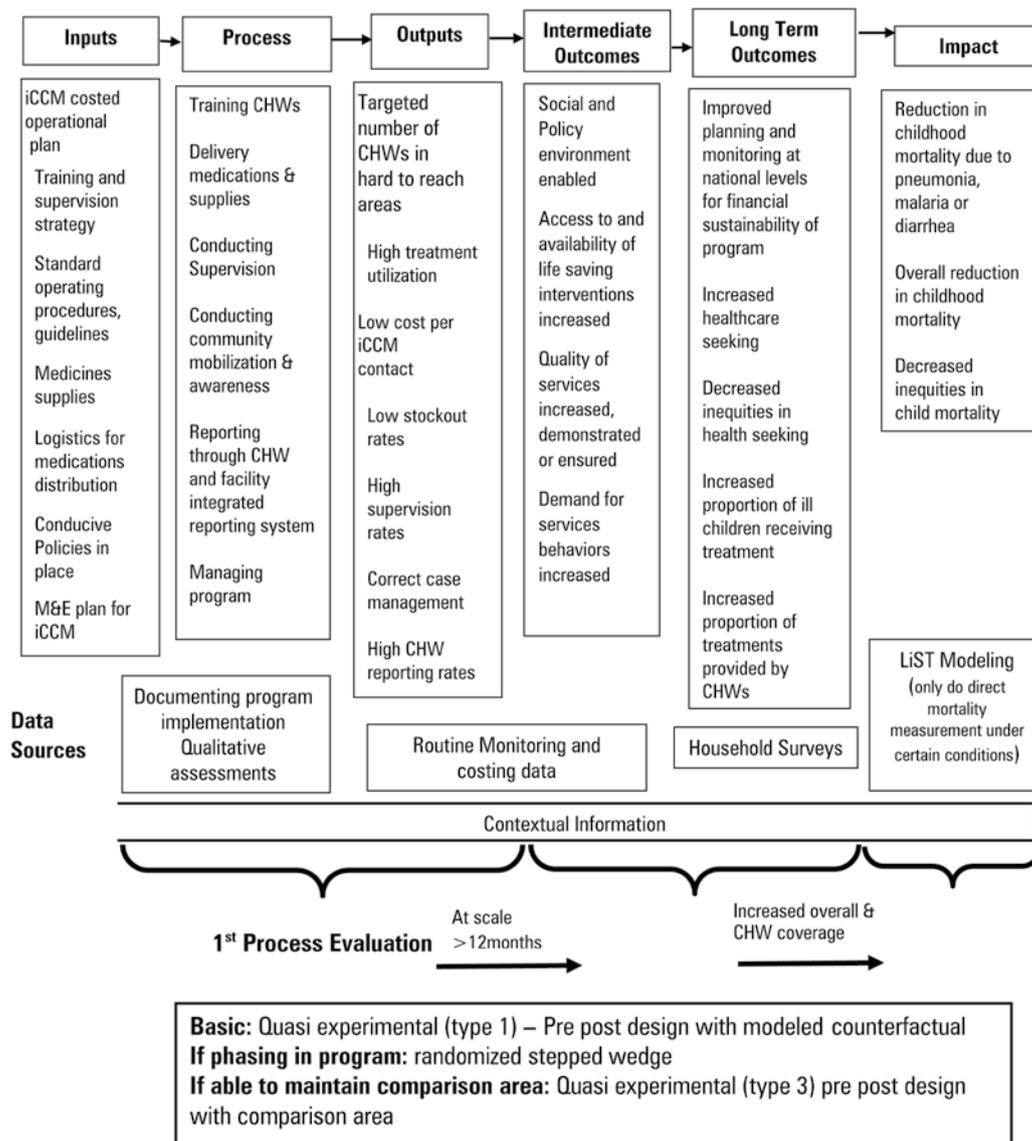
Therefore measuring impact should not be the only focus of evaluations or implementation research of maternal, newborn or child health programs that are delivering proven interventions, but rather it should be supplemented with measures of process and outcomes coupled with contextual information to better understand if and how (or if not and why not) programs are providing the interventions to those in need. Process evaluations measure the internal dynamics of implementing organizations, their policy instruments, their service delivery mechanisms, and their management practices [4]. Specifically, they determine what is done by the program, and for whom these services are provided [5]. Outcome evaluations measure the likely or achieved short- and medium-term effects of an intervention's outputs [4] such as behavior change (eg, what proportion of those who might need the service(s) sought care) and coverage (eg, what proportion of those who might need the service received them). Contextual factors can include factors that may impact implementation such as the functioning of the overall health system or factors that may affect the impact of the intervention such as the socioeconomic factors and status or underlying health status of the population [3].

The problem with evaluations that focus on impact, without examining process, outcomes and context can be highlighted with one particular child health program, integrated community case management (iCCM). Around 2008–9, funding levels to support iCCM expansion in sub-Saharan Africa increased substantially. However, a recent review of

published evaluations in Africa concluded there is no evidence of mortality impact of community-based pneumonia treatment [6]. This conclusion does not make sense given that earlier impact evaluations of iCCM, mostly in Asia, have shown that using community health workers (CHWs) to deliver treatments can reduce pneumonia specific and overall mortality in children and the fact that that provision of antibiotics for pneumonia is effective at reducing mortality in children [7–9]. In actuality, many of the reviewed studies in sub-Saharan Africa focused on specific aspects of the program, and not the entire process and outcome. Most of the included studies concentrated on measuring CHWs adherence to established guidelines [10]. Complete evaluations that included process, outcomes and context were missing.

Several researchers have proposed evaluation methods that may be able to take into account process, outcome and context. Realist evaluations, which is a form of theory driven evaluation that is context-specific, represent one example [11]. In this type of evaluation, interventions work (or not) because people make particular decisions in response to what is provided by the intervention (or not) in a particular context. Their response to the resources, or opportunities provided by the intervention is what causes the outcomes. Measuring contextual factors matters because these factors influence their response; measuring process is important to understand how and why decisions were made. Another more recent suggestion for evaluations of large-scale programs and initiatives in middle- and low-income countries is a national platform approach [12]. This evaluation approach uses a geographic unit (usually district) as the unit of analysis. Relevant information from existing databases would be integrated in a continuous manner into one data repository. New information about program implementation by different agencies (government, bilaterals, multilaterals, non-governmental organizations [NGOs]) would also be included in the database. It would also include contextual information. Although the focus would be on using existing data, additional data on program management and data quality may need to be collected and added. Comparisons of different geographic units could be done either based on a score or dose-response analyses of program implementation strength and coverage. For both these types of evaluations, additional data to assess process, outcome and contextual factors need to be collected.

With the increase in funding for iCCM there has been a great demand from donors for evaluations and implementation research largely focused on measuring the impact, specifically mortality, of these programs. Despite the pressure to focus on mortality impact many evaluators and implementers recognized the importance of documenting and measuring implementation, and therefore examined pro-



**Figure 1.** Evaluation framework for integrated community case management program. iCCM – Integrated Community Case Management, CHWs – Community Health Workers, M&E – Monitoring and Evaluation, LiST – Lives Saved Tool.

cess, outcomes and context, but used different methods and data elements. Our objective was to develop and apply a newly devised set of criteria to review the study design and scope of collection of process, outcomes and contextual data for evaluations and implementation research of iCCM) in Sub-Saharan African and to propose an evaluation study design(s) based on gaps identified. We examined 24 evaluations and/or implementation research studies of iCCM that were completed in the last 5 years (2008–2013).

## METHODS

### Identification of evaluations

We searched for completed evaluations or implementation research studies of iCCM with endpoints that included out-

comes and/or impact measures, conducted between 2008 and 2013. For purposes of this assessment implementation research was defined as studies that went beyond measuring outcomes or impact and also examined what was happening with implementation within existing health systems to determine what worked or did not work and why. The CHWs must have treated at least 2 of the three conditions (malaria, pneumonia and diarrhea) and the evaluation must have included a measure of coverage or mortality. We contacted the key international NGOs supporting iCCM implementation, universities known to be involved in evaluating iCCM, UNICEF, and WHO to create a list of all the iCCM evaluations undertaken in Africa conducted in the last 5 years (2008–2013). We identified 23 evaluations that met these criteria. We then did a PubMed search for articles from 2008 to 2013 using key words “community case man-

**Table 1.** Study descriptions (see Online Supplementary Document)

COUNTRY (STUDY ORGANIZATION)	DESIGN
1. <b>Burkina Faso</b> (Special Programme for Research and Training in Tropical Diseases, WHO, Groupe de Recherche Action en Santé)	Cluster-randomized stepped wedge (three arms).
2. <b>Cameroon</b> (Population Services International)	Quasi-experimental pre-test/post-test
3. <b>Ethiopia Oromia</b> (John Hopkins University)	Cluster-randomized step-wedge with stratification by zone
4. <b>Ghana</b> (Special Programme for Research and Training in Tropical Diseases, WHO, School of Public Health, University of Ghana)	Cluster-randomized stepped wedge
5. <b>Ghana</b> (South Africa Medical Research Council) on behalf of UNICEF)	Pre-test/post-test no comparison area
6. <b>Malawi</b> (Save the Children)	Quasi-experimental step-wedge with comparison at midline but all areas with intervention at endline
7. <b>Malawi</b> (South Africa Medical Research Council on behalf of UNICEF)	Pre-test/post-test no comparison area
8. <b>Mozambique</b> (Save the Children)	Quasi-experimental post-test only with comparison area
9. <b>Niger</b> (South Africa Medical Research Council on behalf of UNICEF)	Pre-test/post-test no comparison area
10. <b>Rwanda</b> (International Rescue Committee)	Pre-test/post-test no comparison area
11. <b>Sierra Leone</b> (International Rescue Committee)	Semi-randomized stepped wedge trial design.
12. <b>Sierra Leone</b> (UNICEF)	Quasi-experimental pre-test/post-test
13. <b>South Sudan</b> (International Rescue Committee)	Quasi-experimental pre-posttest intervention area, comparison area post-test only
14. <b>South Sudan</b> (Malarial Consortium)	Quasi-experimental pre-posttest intervention area, comparison area post-test only
15. <b>South Sudan</b> (Save the Children)	Quasi-experimental pre-posttest intervention area, comparison area post-test only
16. <b>Uganda Central</b> (Malaria Consortium and UNICEF)	Quasi-experimental pre-test/post-test
17. <b>Uganda East</b> (Special Programme for Research and Training in Tropical Diseases, WHO, Makerere University)	Cluster-randomized trial
18. <b>Uganda West</b> (Malaria Consortium)	Quasi-experimental pre-test/post-test
19. <b>Zambia</b> (Malaria Consortium)	Quasi-experimental, comparison at post test
20. <b>Ethiopia</b> (South Africa Medical Research Council on behalf of UNICEF)	Pre-test/post-test no comparison area
21. <b>Mali</b> (South Africa Medical Research Council on behalf of UNICEF)	Pre-test/post-test no comparison area
22. <b>Mozambique</b> (South Africa Medical Research Council on behalf of UNICEF)	Pre-test/post-test no comparison area
23. <b>Mozambique</b> (Malaria Consortium)	Pre-test/post-test no comparison area
24. <b>Zambia</b> (Boston University)	Cluster-randomized controlled trial

agement, Africa, children” and also “integrated community case management, Africa, Children” and found a total of 213 articles of which only 14 were outcome or impact evaluations, or implementation research. All except 3 had already been identified by contacting researchers. The other three articles [13–15] were from one study, and were included as well for a total of 24 evaluations. We asked the principal investigator of each evaluation to complete a standardized Excel spreadsheet on the characteristics of their evaluation and the programs being evaluated. We asked each researcher to describe the study design, whether pre and post household surveys were conducted, if yes, what was the first and second level of selection, how were households selected, what were the sample sizes, who conducted the interviews, who designed the study and who did the training. We also asked whether or not there were comparison areas and how they were selected. We also asked the population size of the iCCM program area.

### Development of evaluation questions and framework

Although some studies assessed specific aspects of community-based treatment, we needed to first frame our review of research and evaluation designs by developing an overall evaluation question about iCCM. This question was:

1. *What is the contribution of iCCM to reduction of childhood morbidity and mortality in African countries?*

We then determined the set of questions that needed to be answered to address this overall evaluation question. These questions were:

- Did iCCM accelerate coverage of appropriate and timely treatment for pneumonia, malaria and diarrhea (or at least two of these conditions if only two conditions were being treated at the community level) in children? (i) If yes, how?, (ii) If no, why not?
- Did iCCM decrease the inequities in treatment coverage for pneumonia, malaria and diarrhea in children? (i) If yes, how?, (ii) If no, why not?

We then developed a monitoring and evaluation framework to answer the evaluation questions we proposed to allow us to categorize the study designs under review. This framework is based on the theory of change that framed the overall iCCM evidence symposium [16] and was also adapted from previous frameworks for evaluation of child health and community-based care programs (Figure 1) [17–19]. The data sources needed to assess different components of the model were listed and how these data components are related to process, outcome and impact evaluation are shown. We listed the sequence in which

**Table 2.** Process evaluation data criteria: Whether or not data element listed was collected as part of the study

Study number	IMPLEMENTATION STRENGTH			REPORTING DATA			COST, DEMAND, MANAGEMENT AND CONTEXTUAL DATA*			
	Number of CHWs and population covered	Supervision rates	Stock-outs	CHW reporting rates	Number of CHW treatments	Facility based treatments	Cost data*	Context – implementation† or impact‡ or both	Qualitative data caregiver§ or health provider¶	Program management#
1	Yes	Yes	Yes	Yes	Yes	Yes	No	Impact	No	Yes
2	Yes	Yes	Yes	No	Yes	No	No	Impact	Both	Yes
3	Yes	Yes	Yes	No	No	No	No	Both	Both	Yes
4	Yes	No	Yes	No	Yes	Yes	Yes	Impact	Both	Yes
5	Yes	Yes	Yes	No	Yes	No	Yes	Impact	Health provider	Yes
6	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
7	Yes	Yes	Yes	No	Yes	No	Yes	Both	Health provider	Yes
8	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
9	Yes	Yes	Yes	No	Yes	Yes	Yes	Both	Health provider	Yes
10	Yes	Yes	Yes	Yes	Yes	No	No	Both	Health provider	Yes
11	Yes	Yes	Yes	Yes	Yes	Yes	No	Impact	Health provider	Yes
12	Yes	Yes	Yes	No	Yes	Yes	No	Both	Both	Yes
13	Yes	Yes	Yes	Yes	Yes	No	No	Impact	No	Yes
14	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes
15	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes
16	Yes	Yes	Yes	Yes	Yes	Yes	No	Both	Both	Yes
17	Yes	No	Yes	No	Yes	No**	Yes	Impact	Both	Yes
18	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Impact	Both	Yes
19	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Both	Yes
20	Yes	Yes	Yes	No	Yes	No	Yes	Both	Health provider	Yes
21	Yes	Yes	Yes	No	Yes	Yes	Yes	Both	Health provider	Yes
22	Yes	Yes	Yes	No	Yes	No	Yes	Both	Health provider	Yes
23	Yes	Yes	Yes	No	Yes	No	Yes	Both	Both	Yes
24	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Both	No

\* Cost data were collected separately from the evaluations by Management Sciences for Health in Cameroon, Sierra Leone, South Sudan, and Zambia for purposes of comparison with the evaluation findings. These comparisons have not yet, however, been made.

† Collected information on outside influences that could affect implementation such as other programs in the area, national stock outs of medications, changes in policies.

‡ Collected information on factors that could affect impact such as socioeconomic status or health status of population.

§ Focus groups or key informant interviews from caregivers or community on health seeking practices and/or barriers.

¶ Focus groups or key informant interviews from health providers, implementers, health managers on aspects of program implementation.

# Able to report on training procedures, supervision procedures, supply/medicine logistics and distribution procedures.

\*\*Did report on malaria incidence in facilities but not on treatments.

evaluations should be done, starting with process evaluation to assess if program implementation was at scale and of adequate strength, then outcome evaluation to determine if there were increases in coverage and if CHWs contributed to this increase, and finally impact evaluation. Finally, we listed the study design options that may be considered to answer the evaluation questions.

## Analysis of evaluations

We assessed if the evaluation design and data collected, amongst the sample of evaluations identified, were consistent with our framework. Specifically we determined if they had sufficient data to conduct the process and outcome evaluations, if comparison areas were adequate and if results had been disseminated. Given that we did not have raw data and the paucity of dissemination, we did not assess the quality of the data or the quality of the analysis conducted.

First we classified evaluations based on their design, study area and time frame. Cluster randomized stepped wedge trials were those studies in which a sequential roll-out of

an iCCM program was implemented in randomly selected clusters over a number of time periods. By the end of the study, all clusters had received iCCM, although the order in which the cluster received iCCM was determined at random. A cluster randomized control trial was one in which entire unit or clusters of health care providers (eg, CHWs) rather than independent individuals were randomly allocated to intervention and comparison groups. (Pre-test was defined as having collected coverage data at baseline. Post-test was defined as having collected coverage data at the end of the evaluation period.). Quasi-experimental trials were those studies that had pre and post tests. Some of these studies had comparison areas.

After describing the programs, we reviewed the reported information based on a set of criteria for process evaluation and outcome evaluation. In addition, for those evaluations with comparison areas we also assessed if those comparison areas were adequate. Finally, we described the dissemination activities of each evaluation, to determine if final analysis, reports are completed and available to the public and what is planned for the future.

The criteria we used to assess process evaluation were based on whether there was data collected to assess the strength of program implementation, treatment rates, costs, context, demand, and program implementation. Because we used iCCM as a model, we based our data elements on those data needed to construct indicators in each of these areas as defined in the CCM indicator guide [17]. For implementation strength this included: data on number of CHWs per under 5 population; data on supervision (whether from routine reports or cross-sectional survey); data on stockouts (whether from routine reports or cross-sectional surveys). For treatment rates, we determined if there was routine reporting data from CHWs on number of treatments for pneumonia, malaria and diarrhea, rates of reporting from CHWs and routine reporting on treatments for these diseases from facilities. For the remaining data elements, we assessed whether costing data was available; whether there was qualitative data from caregivers on health seeking or from health staff, CHWs, health managers on impressions of the program; whether program man-

agement was documented (specifically whether training process, supervision procedures, supply logistics and distribution were described); and contextual data (specifically whether there was information collected on outside influences that can affect implementation such as natural disasters, fuel shortages, strikes, national level stockouts of medications, other programs in the same areas or factors that can affect impact such as socioeconomic status, immunization rates and other health status information).

A recent review of Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) assessed the extent to which large-scale national household surveys can serve as sources of baseline data for evaluating trends in community-based treatment coverage for childhood illnesses [20]. The authors suggested that the place and provider of treatment needed to be collected. This point of service information as well as additional criteria to ensure the program had been in place long enough to see outcomes; coverage data reflective of the program area and including timeliness of treatments (health care seeking with-

**Table 3.** Outcome (coverage) data: Whether or not data element listed was collected as part of the household survey data

Study number	Months of implementation at scale* by endline	PRE					POST				
		household survey	Includes point of service	Includes timeliness	Wealth data (assets)	Conducted in Intervention (and/ or control area)	Household survey	Includes point of service	Includes timeliness	Wealth data (assets)	Conducted intervention area (and or control area)
1	24	Yes†	No	No	No	Yes	Yes†	No	No	No	Yes
2	36	Yes‡	Yes§	No	Yes	Yes	Yes‡	Yes§ <sup>4</sup>	No	Yes	Yes
3	24	Yes‡	Yes	No	No	Yes	Yes‡	Yes	No	Yes	Yes
4	24	Yes†	No	No	No	Yes	Yes†	No	No	No	Yes
5	12	Yes¶	Yes	Yes**	No	Yes	Yes#	Yes	Yes	No	Yes
6	17	Yes‡	Yes	Yes**	Yes	Yes	Yes‡	Yes	Yes†	Yes	Yes
7	11	Yes¶	No	No	No	Yes	Yes#	Yes	Yes	No	Yes
8	28	Yes‡	No	No	No	No in control area	Yes‡	Yes	Yes**	No	Yes
9	35	Yes¶	Yes	Yes	Yes	Yes	Yes¶	Yes	Yes	Yes	Yes
10	42	Yes	No	Yes**	No	Yes	Yes	No	Yes**	No	Yes
11	24	Yes‡	No	No	No	Yes	Yes‡	No	No	No	Yes
12	17	Yes‡	Yes	No	Yes	Yes	Yes‡	Yes	No	Yes	Yes
13	>72	Yes‡	Yes	Yes	No	No in control area	Yes‡	Yes	Yes	No	Yes
14	12	Yes‡	Yes	Yes	No	No in control area	Yes‡	Yes	Yes	No	Yes
15	21	Yes‡	Yes	Yes	No	No in control area	Yes‡	Yes	Yes	No	Yes
16	22	Yes‡	Yes	Yes	Yes	Yes	Yes‡	Yes	Yes	Yes	Yes
17	24	Yes†	No	No	No	Yes	Yes†	No	No	No	Yes
18	22	Yes‡	Yes††	Yes	Yes	Yes	Yes‡	Yes††	Yes	Yes	Yes
19	24	Yes‡	Yes††	Yes	Yes	No in control area	Yes‡	Yes††	Yes	Yes	Yes
20	12	Yes¶	Yes	Yes	Yes	Yes	Yes¶	Yes	No	Yes	No
21	<12	Yes‡‡	Yes	Yes	Yes	Yes	Yes#	Yes	Yes	Yes	Yes
22	<12	Yes‡ <sup>3</sup>	Yes	No	Yes	Yes	Yes¶ <sup>5</sup>	Yes	No	Yes	Yes
23	24	Yes‡ <sup>3</sup>	No	Yes	Yes	Yes	Yes‡ <sup>3</sup>	No	Yes	Yes	Yes
24	12	Yes‡ <sup>3</sup>	Yes	Yes	Yes	Yes	Yes‡ <sup>3</sup>	Yes	Yes	Yes	Yes

\*80% of targeted Community Health Workers deployed and active.

†Demographic Sentinel Surveillance site collected mortality data biannually.

‡Household cluster survey conducted for the purposes of the evaluation.

§For Oral Rehydration Solution only.

¶Used existing national level household surveys such as Multiple Indicator Survey or Demographic and Health Survey. If program was not national restricted analysis to areas where intervention were taking place either at the district or regional area based on what was feasible from the original sampling design.

#Use Lot Quality Assurance Survey.

\*\*For Treatment of Fever and Pneumonia.

††Community Health Worker only.

‡‡Demographic Household Survey was aggregated into 5 regions where program was operating, but included urban areas (exclusive of Bamako).

in 24 hours); and socioeconomic status, are all important. Therefore, we assessed the outcome data elements based on whether there was: 1) greater than one year of implementation at scale (ie, 80% of the target CHWs were trained and deployed for greater than a year) before the endline survey was completed; 2) a baseline household survey of caregivers on health seeking and treatment; 3) information on where/from whom the treatment was received, timeliness of treatment and wealth captured at baseline; 4) an endline household survey of caregivers on health seeking and treatment; 5) information on where/from whom the treatment was received and timeliness of treatment and wealth captured in the endline survey; and 6) baseline and endline surveys conducted in areas representative of where the intervention took place (eg, in the district or village where iCCM was taking place rather than extrapolating from a regional or national survey).

We assessed comparison area adequacy based on the following criteria: 1) if the comparison area was appropriate for the research question; 2) if there were at least the same number of comparison areas as intervention areas, 3) how the comparison area was selected, and 4) if there were no issues with comparability reported by the researchers.

## RESULTS

Of the 24 evaluations, 5 used a stepped wedge randomized controlled design although there were slight variations in randomization procedures (Table 1). Two of these five studies had three arms comparing adding pneumonia treatment to malaria treatment. One of these five evaluations used a randomized cluster design with stratification by zone, one was a mixture of stepped-wedge and quasi-experimental and one was semi-randomized. Two studies were randomized control trials that were not stepped-wedge. Seventeen studies were quasi-experimental, 10 of which had comparison areas. Five studies conducted only a post coverage survey in the comparison area. Seven studies had pre and post survey data on coverage but no comparison areas.

Table 2 shows which of the data elements needed to conduct a process evaluation were collected for each evaluation. All, except one, of the evaluations were able to report on program implementation and 22 on all the implementation strength indicators. The most common missing data elements were: CHW reporting rates (12 missing), health facilities treatments (13 missing), costing (12 missing) and qualitative data from caregivers (14 missing). With regard to contextual factors data, 18 studies had data on factors that affect impact, whereas fewer (10) studies had data on factors that affect implementation.

We found that 7 studies were conducted of programs that were implementing at scale for a year or less (Table 3). Six

studies had no information on point of service, 10 did not collect data on timeliness and 12 did not have wealth information either in the baseline or endline survey. Of the 16 studies with comparison areas, 6 had no baseline survey in the comparison area (note that three studies in Southern Sudan used the same comparison area). Although all were conducted in the intervention areas, some relied on pooling regional data or using the rural component of larger surveys. Others just sampled from target areas, not necessarily ensuring that the selected clusters were in fact exposed to iCCM. Of those who conducted household surveys for the purposes of the iCCM evaluation only, most were two-stage cluster surveys but some used Lot Quality Assurance Sampling.

Among the 16 studies with comparison areas, 6 had comparison areas in which CHWs were providing treatments for at least one of the three illnesses, usually malaria, but this was appropriate for the study design (Table 4). Only 5 selected comparison areas randomly. Of the 16 studies with comparison areas, 11 reported that the comparison area was similar to the intervention area; however, 10 were appropriate comparison for the question being asked. The one study that did not have an appropriate comparison area was evaluating the outcome and impact of iCCM but had iCCM taking place in the comparison area. There were some differences in the number of intervention and comparison areas, they were not always evenly matched although all investigators claimed their studies were powered to test the main outcome (coverage).

Finally, regarding dissemination of findings, of the 14 evaluations that were completed (eg, all data analysis had been completed) seven evaluations were published in the peer-reviewed literature. The TDR WHO studies of Burkina Faso, Ghana and Uganda East had multiple publications based on endline evaluations [8,21–23] as did ZIMMAPS [13–15]. There were also publications of the midterm evaluation in Cameroon [24] and a component of the Ethiopian JHU evaluation [25]. Although Sierra Leone UNICEF had multiple publications, those only presented baseline data [26–29]. All the remaining completed evaluations had reports but none were available to the public. The other evaluations were in the process of finalizing endline reports.

## DISCUSSION

Our review of the process, outcome and contextual data elements from 24 recent evaluations and implementation research studies of iCCM found that the most commonly missing information for process data were reporting rates of CHWs, facility treatments, costing data and qualitative data. For outcome data, many of the surveys did not collect point of service, timeliness or wealth information, which would

**Table 4.** Description of studies with comparison areas

Study number	Comparison area without any iCCM	Number of comparison areas in relation to intervention area	Comparison area selection	Comparison area similar to intervention area at baseline	Appropriate comparison areas*
1	No, CHWs treating malaria	19 control clusters + 38 intervention clusters of 2 districts	Random	Yes	Yes
2	Yes	2 intervention + 1 control of 20 districts	Purposive sampling	Yes	Yes
3	No, CHWs treated diarrhea and malaria	16 intervention + 15 control woredas	Restricted randomized selection	Yes	Yes
4	Yes	1 district with 114 clusters of which 37 randomized to one intervention arm, 39 to another intervention arm and 38 to the control	Random	No	Yes
6	No at endline yes at midline	70 clusters of 20 households (1400 households total); evenly divided between phase 1 and phase 2 areas	Areas that were 8+ km from a health facility as identified by district health officials and who did not have an CHWs trained in iCCM	Yes	Yes
8	No	3 intervention + 1 comparison district	Selected because it is a large district adjacent to one of the intervention districts with few CHWs	Yes	Yes
11	Yes	4 of 12 districts	Semi-randomized	Yes	Yes
12	Yes	2 implementing + 2 control districts	Similarity to intervention areas on a several of key health indicators	No	No
13	Yes	1 intervention county + 1 control county	Similarity to intervention areas	No	No
14	Yes	1 intervention county + 1 control county	Similarity to intervention areas	No	No
15	Yes	2 intervention counties + 1 control county	Similarity to intervention areas	No	No
16	Yes	3 intervention + 3 control districts	Used comparison area that was already selected for Uganda west study	No	No
17	Yes	2 districts with villages randomized into control and intervention areas	Randomized	Yes	Yes
18	Yes	8 intervention and 3 control districts	Districts where iCCM has not been implemented but with similar demographic profile to intervention districts	Yes	Yes
19	No, districts where iCCM had been implementing for up to 8 months	4 intervention and 3 control districts (phased-in)	Districts where iCCM had been implementing for up to 8 months	Yes	No
24	No, CHWs treated for presumptive malaria based on fever	Yes	Yes	Yes	Yes

iCCM – integrated community case management, CHWs – community health workers

\*Appropriate for research question, similar to intervention area.

make it difficult to fully determine the contribution of CHWs with regard to coverage and equity. In addition, several of the household surveys were not reflective of the area where the program was taking place but rather a larger geographic area (eg, regional level data as a proxy for a district within the region) and ignored the possibility that randomly selected clusters may have altogether missed the communities exposed to iCCM if CHWs were only deployed in hard to reach areas. This was true among the evaluations, mostly UNICEF supported, which at the request of governments and due to donor funding constraints, pre-existing surveys were used to save on labor, time and cost. Only recently has point of service and timeliness been included in these larger household surveys (eg, DHS and MICS) [20]. Many of the designs observed did not include comparison areas. Some type of counterfactual is necessary to understand the contribution of CHWs to outcomes and impacts.

Of those that did have comparison areas, few were chosen randomly but slightly more than half of the researchers reported that the comparison area was similar to the intervention area at baseline. Additionally, the number of interventions and comparison areas was not always evenly matched although all investigators claimed their studies were powered to test the main outcome.

Our review informs the feasibility, opportunities, and constraints for design options (Table 5). Although realist evaluations are feasible and opportunities to conduct these exist, they are constrained by the need for additional contextual data to be collected and specific expertise to do such an analysis [11]. The evaluation platform may be an option in the future for conducting these evaluations, but has yet to be fully tested [12]. This type of evaluation will be especially useful in countries where iCCM is already taking place on a national scale. However, it is constrained by the underlying

data availability within districts. If current and new evaluations, and studies collect the data elements we assessed, it could contribute to the district level databases making this type of evaluation feasible. This approach is currently being tested in four African countries (Malawi, Niger, Tanzania, and Mozambique) by Johns Hopkins University.

The stepped wedge designs appeared promising. A systematic review of this design suggested that it can be used when interventions are likely to do more good than harm, when interventions are being implemented in a new setting, where evidence for their effectiveness in the original setting is available and for cost–effectiveness analyses of interventions that have already been shown to be effective [30]. With regard to opportunity, the evaluation of iCCM appears to be the ideal candidate for this design when a country is first scaling up the program. However, with regard to feasibility and constraints there are some issues, the stepped wedge design requires a longer trial duration than other designs, especially to allow for evaluating programs at scale. Additionally, there may not be an opportunity to randomize areas, and the design requires assistance from statisticians and researchers who have experience with this type of study design [30].

We identified three types of quasi–experimental study designs: 1) pretest–posttest designs without control groups, 2) pretest–posttest designs in the intervention area with control groups but the control group did not have a baseline survey and 3) pretest–posttest designs with control groups where both the intervention and control areas had baseline and endline surveys. The first design appears to be the simplest design and thus feasible; however, this de-

sign is constrained by the fact that it does not offer a counterfactual. The second design which may not always be feasible is constrained by the fact that it assumes the control area had similar rates of coverage to the intervention area at base line, but this may not be the case. Although the third design is stronger than the second design, it has constraints because the 2 groups were not selected randomly, selection bias may still exist and in fact we found some comparison areas were not similar to intervention areas [31].

Randomized control trials that are not stepped–wedge appear to be the least feasible, although there can be an opportunity to conduct such studies, especially, if the program is being implemented in a controlled environment such as a demographic sentinel surveillance site (DSS) [32]. In fact, two of our studies were randomized cluster control trials [8,13], one of which was in a DSS site in Ghana. There are constraints to conducting randomized control trials. They require specific technical expertise, and there is often an inability to completely prevent or fully measure contamination. Also because we are trying to evaluate the scale up iCCM in a real world scenario, this alternative will rarely present itself and if done in a DSS site, it will have limited generalizability.

Based on our review and the designs discussion, we propose the following options for future evaluation designs. At the least, a pre–posttest evaluation should be performed by 1) conducting a baseline household survey in the area where the intervention is taking place, which should include point of service and timeliness and socioeconomic status; 2) prospectively collect all the process and contex-

**Table 5.** Opportunities and constraints of possible study designs

STUDY DESIGN	OPPORTUNITIES	CONSTRAINTS
Realist	<ul style="list-style-type: none"> <li>• Can be adapted to the local setting</li> </ul>	<ul style="list-style-type: none"> <li>• Requires specific expertise</li> <li>• Results may be difficult to understand or explain</li> <li>• Requires extensive contextual information</li> <li>• No method to quantitatively/statistically compare to a control area</li> </ul>
Evaluation platform	<ul style="list-style-type: none"> <li>• Improvements in district level data collection increasing</li> <li>• Could be used for multiple programs</li> </ul>	<ul style="list-style-type: none"> <li>• Requires availability of high quality data from districts</li> <li>• Not yet tested</li> </ul>
Stepped–wedge design	<ul style="list-style-type: none"> <li>• When program is first being scaled up</li> </ul>	<ul style="list-style-type: none"> <li>• Need to allow for longer start–up periods</li> <li>• Randomization may not be allowable</li> </ul>
Quasi–experimental (1) pretest–posttest designs without control groups	<ul style="list-style-type: none"> <li>• Easier to implement than designs with control areas</li> <li>• Less costly than most designs</li> </ul>	<ul style="list-style-type: none"> <li>• No control area (although can consider modeling counterfactual)</li> </ul>
Quasi–experimental (2) pretest–posttest design in the intervention area with control groups at end line	<ul style="list-style-type: none"> <li>• Can select a control area in which you know the program did not exist</li> <li>• Less costly than having both baseline and end line data</li> </ul>	<ul style="list-style-type: none"> <li>• Assumes control area was similar at baseline</li> <li>• May have little information of activities in control area during intervention implementation period</li> </ul>
Quasi–experimental (3) pretest–posttest design with control groups where both the intervention and control areas had baseline and endline surveys.	<ul style="list-style-type: none"> <li>• usually acceptable to government</li> <li>• able to document activities in control area during implementation period</li> </ul>	<ul style="list-style-type: none"> <li>• Cannot guarantee lack of contamination of control area</li> <li>• Control area may not be well matched to intervention area</li> </ul>
Randomized cluster control trial (not step wedged)	<ul style="list-style-type: none"> <li>• Best in controlled environments such as DSS sites</li> <li>• If government agreeable to randomization at start of program</li> </ul>	<ul style="list-style-type: none"> <li>• Not feasible in most settings</li> <li>• May not be generalizable</li> <li>• Randomization may not be allowable</li> <li>• Resource intensive</li> </ul>

DSS – demographic sentinel surveillance

tual data elements we assessed; 3) periodically review and analyze the process information to determine if the program is at scale (scale should be defined locally but we suggest at least 80% of the target number of CHWs are active) and of high quality (supervision rates, CHW reporting rates, and no stock-out rates of over 80%) for at least one year; 4) use qualitative data and program implementation documentation to determine barriers for reaching scale, if scale has not been reached; 5) make changes based on these findings and re-do the process evaluation once these changes are implemented; 6) estimate start-up costs and recurrent costs per iCCM service and per capita as [33]; 7) once at scale for one year (with all the previous provisos regarding implementations strength) conduct an endline coverage survey; 8) analyze this coverage survey for improvements in timeliness and decreases in inequities of health care seeking and coverage as well as cost-effectiveness; 9) only proceed further to assess mortality impact if there is a significant increase in coverage that includes a proportion of CHWs providing those treatments. If there is no increased coverage, there is no need to proceed to measure or model mortality impact as such an evaluation will only substantiate your outcome findings.

As actual measurement of mortality rates through surveys is difficult and costly, will require larger sample sizes, require additional time of implementation before being able to see impact and also specific expertise, we suggest modelling mortality impact. We recommend that mortality measurement only be done if the circumstances are present as specified in the mortality article in this journal supplement [34]. Using a model, we can also create a counterfactual by comparing the actual coverage changes to a modeled scenario as though the program did not exist. Although there are a variety of models to choose from, we suggest using the Lives Saved Tool (LiST), which is a program to project the changes in child and maternal survival in accordance with changes in coverage of different child and maternal health interventions [35]. LiST is based on a linear, mathematical model that is deterministic [36]. The relationship between changes in intervention coverage and one or more outputs (eg, cause specific mortality, lives saved) is specified in terms of the effectiveness of the intervention for reducing the probability of that outcome. Many systematic reviews have been conducted to determine the effectiveness of interventions used in the model and the program is easy to use [35]. We first suggest quantifying the estimated number of lives saved overall and separately saved by treatments provided by CHWs. Then create a counterfactual in which the CHW's proportional contribution to increased coverage is removed but everything else is unchanged. An example of how to do this is provided in the LiST article in this supplement [37].

There are some circumstances where a comparison area is still possible. If the program is being introduced and there

is agreement to do so in a staggered way and at random, we suggest considering a stepped wedge design assuming appropriate technical support can be provided. If a similar comparison area to the intervention area can be identified, and evaluators have some control over the comparison to avoid contamination during the evaluation study period, a quasi-experimental design with control groups (type 3 above) can be considered.

Regardless of which of the proposed designs are used, all process, outcome and contextual data assessed in this review must be collected and periodic analysis of these data must be done to determine how well the program is functioning to make changes as needed, as has been suggested by other frameworks for implementation research [38,39]. For any evaluation or implementation research in maternal, newborn or child health the data collected must include the appropriate numerator and denominator data to measure globally accepted standardized indicators. In the case of iCCM, these are those described in the CCM indicator handbook [17] and highlighted in the monitoring paper in this supplement [40]. Once the outcome evaluation has demonstrated a positive impact, routine monitoring should continue and process evaluation should be done periodically to assess the program. A full evaluation with pre and post household surveys should not be necessary if process data, especially examining routine reporting data, are periodically analyzed and acted on.

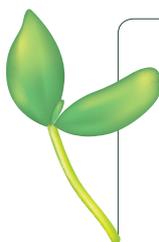
There are several limitations to our review. First, we did not have the raw data (eg, reporting data, household survey data, etc.) to determine the quality of the data elements. The quality is expected to be quite variable with some evaluations supported by academic institutions with experienced researchers and others mostly conducted by NGOs with variable expertise in evaluation methodologies and management. In addition, limited literacy of interviewers and CHWs and lack of qualified supervisors to manage interviewers in some countries may have compromised some reporting data and surveys. Although we did review the reports available to us, we did not assess the quality of the analysis that was done. However, we should note that all reports reviewed used a mixed method approach and did use some of the process data available in an attempt to explain the outcomes observed. We did not assess the use of global positioning devices (GPS) or information on distance from health facility as few evaluations used these devices, or had this information in their household surveys. GPS data, or data on distance from health facilities could be used to determine if CHWs are reaching the populations targeted (eg, hardest to reach areas) and can also be used in the analysis of inequities along with the wealth data.

Finally, we did not systematically review who was conducting the evaluation. For the most part, implementers col-

lected process data and evaluators collected outcome data but sometimes evaluators collected process data and implementers collected outcome data. In addition, sometimes implementers conducted the entire evaluation, and sometimes evaluators conducted the entire evaluation. It is now recommended that stakeholders, implementers, and evaluators should work together, plan prospectively for the evaluation and implementation research to ensure all data elements suggested are collected, that program management is well documented, and data are periodically reviewed and used for program improvement [38,39]. Evaluation and implementation research is most likely to be more comprehensive, useful and result in actual change if stake holders and implementers are not just a passive recipient of results.

At the time of writing of this article, many of these evaluations are not yet complete and of those that are completed, several have not been published or are not available to the public. Evaluation results need to be widely disseminated with iCCM program implementers and supporting partners as soon as possible after completion, so that others may learn and benefit from these evaluations. We suggest that these reports be made available to the public through the donor websites and websites dedicated to community based treatments in the developing world. We also encourage all the researchers to publish these data as soon as feasible.

Regardless of the availability of reports, there has been an increase in the number of evaluations of iCCM in Africa completed in the past 5 years. This has been driven by donors, for the most part, requesting impact evaluations, although our review demonstrated that process and contextual information is critical to better implement programs in real world settings. We were able to use most of these evaluations to do a multi-country review of aspects of iCCM that are associated with higher utilization of iCCM, also presented in this supplement; however, if an emphasis had been instead on process and outcome evaluations or implementation research using standardized indicators we would have been able to use all these studies and done a more in-depth analysis [41]. More engagement is needed with funders regarding the appropriateness of conducting impact evaluations too early in implementation phase and without complete process, contextual and outcome data because the results are likely to be misleading to policy makers and will not reflect the true potential of these interventions. If donors and governments requesting evaluations of iCCM in the Africa region provide sufficient resources to conduct evaluations and inform evaluators to follow our suggested key data, elements and design for future evaluations, we should be able to pool more data in the future to better determine the impact of iCCM on child morbidity and mortality in the Africa region.



**Collaborators:** iCCM Symposium impact outcome evaluation thematic group – Yolanda Barbera, International Rescue Committee, New York, USA; Agbessi Amouzou, UNICEF, Data and Analytics, New York, USA; Franco Pagnoni, World Health Organization, Global Malaria Program, Geneva, Switzerland, Abigail Pratt, Population Sciences International, Nairobi, Kenya, Saul Morris – Children’s Investment Fund Foundation, London, UK; Helen Counihan – Malaria Consortium, London, UK; David Collins, Management Sciences for Health, Boston, USA ; Zina Jarrah, Management Sciences for Health, Boston, USA;. Daniel Kadobera Department of Public Health Sciences, Division of Global Health (IHCAR), Karolinska Institute, Stockholm, Sweden; Elizeus Rutebemberwa Department of Health Policy, Planning and Management, School of Public Health, Makerere University College of Health Sciences, Kampala, Uganda; Mohamadou SIRIBIE Groupe de Recherche Action en Santé (GRAS), Ouagadougou, Burkina Faso; Sodiomon Bienvenu SIRIMA, Groupe de Recherche Action en Santé (GRAS), Ouagadougou, Burkina Faso School of Public Health; Margaret Amanua Chinbuah, Research and Development Division, Ghana Health Service, Accra, Ghana; John O. Gyapong, School of Public Health, University of Ghana, Accra, Ghana; University of Ghana (for Ghana); Paulin Basinga, Bill and Melinda Gates Foundation, Seattle, Washington, USA; Tanya Doherty, South African Medical Research Council, Cape Town, South Africa; Davidson H. Hamer, Center for Global Health and Development, Boston University, Boston, Massachusetts, USA; Kojo Yeboah–Antwi, Center for Global Health and Development, Boston University, Boston, Massachusetts, USA.

**Acknowledgements:** The authors thank Mickey Chopra, Colin Kirk, Debra Jackson, and Alyssa Sharkey from UNICEF for their critical reading of the manuscript.

**Funding:** This review was supported by the Department of Foreign Affairs Trade and Development Canada.

**Authorship declaration:** TD, NO, MM and TG conceptualized the review, NO, MM and TG collected the data, TD wrote the manuscript and NO, MM and TG reviewed and modified the manuscript. All members of the outcome impact evaluation group provided data and reviewed the manuscript and made modifications.

**Competing interest:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). They report no competing interests.

- 1 Oxman AD, Bjørndal A, Becerra-Posada F, Gibson M, Block MA, Haines A, et al. A framework for mandatory impact evaluation to ensure well informed public policy decisions. *Lancet*. 2010;375:427-31. Medline:20113827 doi:10.1016/S0140-6736(09)61251-4
- 2 Bryce J, Victora CG. Ten methodological lessons from the multi-country evaluation of integrated management of Childhood Illnesses. *Health Policy Plan*. 2005;20 Suppl 1:i94-105. Medline:16306075 doi:10.1093/heapol/czi056
- 3 Victora CG, Schellenberg JA, Huicho L, Amaral J, El Arifeen S, Pariyo G, et al. Context matters: interpreting findings in child Survival evaluations. *Health Policy Plan*. 2005;20 Suppl 1:i18-31. Medline:16306066 doi:10.1093/heapol/czi050
- 4 The Development Assistance Committee (DAC) Working Party on Aid Evaluation of OECD. Glossary of Key Terms in Evaluation and Results Based Management. Paris: OECD Publications, 2002. Available at: <http://www.oecd.org/development/peer-reviews/2754804.pdf>. Accessed: 1 October 2014.
- 5 Moore G, Audrey S, Barker M, Bond L, Bonell C, Cooper C, et al. Process evaluation in complex public health intervention studies: the need for guidance. *J Epidemiol Community Health*. 2014;68:101-2. Medline:24022816 doi:10.1136/jech-2013-202869
- 6 Druetz T, Siekmans K, Goossens S, Ridde V, Haddad S. The community case management of pneumonia in Africa: a review of the evidence. *Health Policy Plan*. 2013. Epub ahead of print. Medline:24371218 doi:10.1093/heapol/czt104
- 7 Theodoratou E, Al-Jilaihawi S, Woodward F, Ferguson J, Jhass A, Balliet M, et al. The effect of case management on childhood pneumonia mortality in developing countries. *Int J Epidemiol*. 2010;39:i155-71. Medline:20348118 doi:10.1093/ije/dyq032
- 8 Chinbuah MA, Kager PA, Abbey M, Gyapong M, Amina E, Nonvignon J, et al. Impact of community management of fever (using antimalarials with or without antibiotics) on childhood mortality: A cluster-randomized controlled trial in Ghana. *Am J Trop Med Hyg*. 2012;87(5 Suppl):11-20. Medline:23136273 doi:10.4269/ajtmh.2012.12-0078
- 9 World Health Organization. Recommendations for management of common childhood conditions: evidence for technical update of pocket book recommendations: newborn conditions, dysentery, pneumonia, oxygen use and delivery, common causes of fever, severe acute malnutrition and supportive care. Geneva: WHO, 2012.
- 10 Hamer DH, Qazi S, Kasungami D, Marsh DR, Peterson S, Diaz T, et al. Community case management of pneumonia in Africa—not so bad and steadily progressing. [Letter] *Health Policy Plan* 2013. Available at: [http://heapol.oxfordjournals.org/content/early/2013/12/25/heapol.czt104/reply#heapol\\_el\\_29](http://heapol.oxfordjournals.org/content/early/2013/12/25/heapol.czt104/reply#heapol_el_29). Accessed: 28 September 2014.
- 11 Pawson R, Tilley M. Realistic evaluation. London, UK: Sage Publications, 1997.
- 12 Victora CG, Black RE, Boerma JT, Bryce J. Measuring impact in the Millennium Development Goal era and beyond: a new approach to large-scale effectiveness evaluations. *Lancet*. 2011;377:85-95. Medline:20619886 doi:10.1016/S0140-6736(10)60810-0
- 13 Yeboah-Antwi K, Pilingana P, Macleod WB, Semrau K, Siazele K, Kalesha P, et al. Community case management of fever due to malaria and pneumonia in children under five in Zambia: A cluster randomized controlled trial. *PLoS Med*. 2010;7:e1000340. Medline:20877714 doi:10.1371/journal.pmed.1000340
- 14 Seidenberg PD, Hamer DH, Iyer H, Pilingana P, Siazele K, Hamainza B, et al. Impact of integrated community case management on health-seeking behavior in rural Zambia. *Am J Trop Med Hyg*. 2012;87 Suppl:105-10. Medline:23136285 doi:10.4269/ajtmh.2012.11-0799
- 15 Hamer DH, Brooks ET, Semrau K, Pilingana P, MaxLeod WB, Siazele K, et al. Quality and safety of integrated community case management of malaria using rapid diagnostic tests and pneumonia by community health workers. *Pathog Glob Health*. 2012;106:32-9. Medline:22595272 doi:10.1179/1364859411Y.0000000042
- 16 Diaz T, Aboubaker ES, Young M. Current scientific evidence for integrated community case management in Africa: Findings from the iCCM Evidence Symposium. *J Glob Health*. 2014;4:020101. doi:10.7189/jogh.04.020101
- 17 The Maternal and Child Health Integrated Program (MCHIP) Indicator Guide. Monitoring and Evaluating Integrated Community Case Management. MCHIP, July 2013. Available at: <http://www.mchip.net/node/2179>. Accessed: 31 August 2014.
- 18 Bryce J, Harris Requejo J, Moulton LH, Ram M, Black RE. A common evaluation framework for the African Health Initiative. *BMC Health Serv Res*. 2013;13 Suppl 2:S10. Medline:23819778 doi:10.1186/1472-6963-13-S2-S10
- 19 Bryce J, Victora CG, Boerma T, Petersa DH, Black RE. Evaluating the scale-up for maternal and child survival: A common framework. *Int Health*. 2011;3:139-46. Medline: 24038362 doi:10.1186/1472-6963-13-S2-S10
- 20 Hazel E, Requejo R, David J, Bryce J. Measuring coverage in MNCH: Evaluation of community-based treatment of childhood illnesses through Household Surveys. *PLoS Med*. 2013;10:e1001384. Medline:23667329 doi:10.1016/j.inhe.2011.04.003
- 21 Mukanga D, Tiono SB, Anyorigiya T, Kallander K, Konate AT, Oduro AR, et al. Integrated community case management of fever in children under five using rapid diagnostic tests and respiratory rate counting: A multi-country cluster randomized Trial. *Am J Trop Med Hyg*. 2012;87 Suppl:21-9. Medline:23136274 doi:10.4269/ajtmh.2012.11-0816
- 22 Kalyango JN, Rutebemberwa E, Karamagi C, Mworozzi E, Ssali S, Alfven T, et al. High adherence to antimalarials and antibiotics under integrated community case management of illness in children less than five years in Eastern Uganda. *PLoS ONE*. 2013;8:e0481. Medline:23555980 doi:10.1371/journal.pone.0060481

- 23 Kalyango JN, Alfvén T, Peterson S, Mugenyi K, Karamagi C, Rutebemberwa E. Integrated community case management of malaria and pneumonia increases prompt and appropriate treatment for pneumonia symptoms in children under five years in Eastern Uganda. *Malar J*. 2013;12:340. Medline:24053172 doi:10.1186/1475-2875-12-340
- 24 Littrell M, Moukam LV, Libite R, Youmba JC, Baugh G. Narrowing the treatment gap with equitable access: mid-term outcomes of a community case management program in Cameroon. *Health Policy Plan*. 2013;28:705-16. Medline:23144228 doi:10.1093/heapol/czs110
- 25 Miller NP, Amouzou A, Tafesse M, Hazel E, Legesse H, Degefie T, et al. Integrated community case management of childhood illnesses in Ethiopia: Implementation strength and quality of care. *Am J Trop Med Hyg*. 2014;91:424-34. Medline:24799369 doi:10.4269/ajtmh.13-0751
- 26 Diaz T, George AS, Rao SR, Bangura PS, Baimba JB, McMahon SA, et al. Healthcare seeking for diarrhea, malaria and pneumonia among children in four poor rural districts in Sierra Leone in the context of free health care: results of a cross-sectional survey. *BMC Public Health*. 2013;13:157. Medline:23425576 doi:10.1186/1471-2458-13-157
- 27 Bakshi SS, McMahon SA, George AS, Yumkella F, Bangura P, Kabano A. The role of traditional treatment on health care seeking by caregivers for sick children in Sierra Leone: Results of a baseline survey. *Acta Trop*. 2013;127:46-52. Medline:23545128 doi:10.1016/j.actatropica.2013.03.010
- 28 Scott K, McMahon S, Yumkella F, Diaz T, George AS. Navigating multiple options and social relationships in plural health systems: a qualitative study exploring healthcare seeking for sick children in Sierra Leone. *Health Policy Plan*. 2014;29:292-301. Medline:23535712 doi:10.1093/heapol/czt016
- 29 McMahon SA, George AS, Yumkella F, Diaz T. Spoiled breast milk and bad water; local understandings of diarrhea causes and prevention in rural Sierra Leone. *BMC Public Health*. 2013;13:1172-82. Medline:24330586 doi:10.1186/1471-2458-13-1172
- 30 Brown CA, Lilford RJ. The stepped wedge trial design: a systematic review. *BMC Med Res Methodol*. 2006;6:54. Medline:17092344 doi:10.1186/1471-2288-6-54
- 31 Harris AD, Bradham DD, Baumgarten M, Zuckerman IH, Fink JC, Perencevich EN. The use and interpretation of quasi-experimental studies in infectious diseases. *Clin Infect Dis*. 2004;38:1586-91. Medline:15156447 doi:10.1086/420936
- 32 Ramsey K, Hingora H, Kante M, Jackson E, Exavery A, Pemba S. The Tanzania Connect Project: a cluster randomized trial of the child survival impact of adding paid community health workers to an existing facility-focused health system. *BMC Health Serv Res*. 2013;13 Suppl 2:S6. Medline:23819587
- 33 Collins D, Jarrah Z, Gilmartin C, Saya U. The costs of iCCM programs: A multi-country analysis. *J Glob Health*. 2014;4:020407. doi:10.7189/jogh.04.020407
- 34 Amouzou A, Moulton A, Mukanga D, Morris S. Assessing the impact of the integrated community Case management (iCCM) programmes on child mortality: Review of early results and lessons learned in sub-Saharan Africa. *J Glob Health*. 2014;4:020411. doi:10.7189/jogh.04.020411
- 35 Walker N, Tam Y, Friberg IK. Overview of the Lives Saved Tool (LiST). *BMC Public Health*. 2013;13 Suppl 3:S1. Medline:24564438 doi:10.1186/1471-2458-13-S3-S1
- 36 Garnett GP, Cousens S, Hallett TB, Steketee R, Walker N. Mathematical models in the evaluation of health programmes. *Lancet*. 2011;378:515-25. Medline:21481448 doi:10.1016/S0140-6736(10)61505-X
- 37 Friberg IK, Walker N. Using the Lives Saved Tool as part of evaluations of community case management programs. *J Glob Health*. 2014;4:020412. doi:10.7189/jogh.04.020412
- 38 Peters DH, Tran NT, Adam T. Implementation research in health: a practical guide. Alliance for Health Policy and Systems Research. Geneva: World Health Organization, 2013.
- 39 The Global Fund to Fight AIDS, Tuberculosis and Malaria. Framework for Operations and Implementation Research in Health and Disease Control Programs. Geneva: The Global Fund to Fight AIDS, Tuberculosis and Malaria, 2008. Available at: [http://whqlibdoc.who.int/publications/2008/9292241109\\_eng.pdf?ua=1](http://whqlibdoc.who.int/publications/2008/9292241109_eng.pdf?ua=1). Accessed: 1 October 2014.
- 40 Guenther T, Barberá Láinez Y, Oliphant NP, Dale M, Raharison S, Miller L, et al. Routine monitoring systems for integrated community case management programs: Lessons from 18 countries in sub-Saharan Africa. *J Glob Health*. 2014;4:020301. doi:10.7189/jogh.04.020301
- 41 Oliphant NP, Muñiz M, Guenther T, Diaz T, Barberá Láinez Y, Cohlihan H, et al. Multi-country analysis of routine data from integrated community case management programs in sub-Saharan Africa. *J Glob Health*. 2014;4:020408. doi:10.7189/jogh.04.020408

# Demand generation and social mobilisation for integrated community case management (iCCM) and child health: Lessons learned from successful programmes in Niger and Mozambique

Alyssa B Sharkey<sup>1</sup>, Sandrine Martin<sup>2</sup>, Teresa Cerveau<sup>2</sup>, Erica Wetzler<sup>3</sup>, Rocio Berzal<sup>4</sup>

<sup>1</sup> UNICEF, New York, NY, USA

<sup>2</sup> Malaria Consortium, Maputo, Mozambique

<sup>3</sup> Save the Children, Maputo, Mozambique

<sup>4</sup> UNICEF, Niamey, Niger

**Aim** We present the approaches used in and outcomes resulting from integrated community case management (iCCM) programmes in Niger and Mozambique with a strong focus on demand generation and social mobilisation.

**Methods** We use a case study approach to describe the programme and contextual elements of the Niger and Mozambique programmes.

**Results** Awareness and utilisation of iCCM services and key family practices increased following the implementation of the Niger and Mozambique iCCM and child survival programmes, as did care-seeking within 24 hours and care-seeking from appropriate, trained providers in Mozambique. These approaches incorporated interpersonal communication activities and community empowerment/participation for collective change, partnerships and networks among key stakeholder groups within communities, media campaigns and advocacy efforts with local and national leaders.

**Conclusions** iCCM programmes that train and equip community health workers and successfully engage and empower community members to adopt new behaviours, have appropriate expectations and to trust community health workers' ability to assess and treat illnesses can lead to improved care-seeking and utilisation, and community ownership for iCCM.

The success of integrated community case management (iCCM) programmes to treat childhood illnesses requires attention to appropriate supply elements (including trained community health workers and adequate commodities) as well as demand elements that promote timely and appropriate care-seeking and treatment utilization [1–3]. The factors that influence demand for child health services are multiple and include financial barriers, non-financial barriers (such as geographic access, caregiver understanding of the illness, preferences for home management and alternative treatments, and limited decision-making autonomy to seek care), as well as caregiver perspectives on the quality of services provided

## Correspondence to:

Alyssa Sharkey  
Health Specialist  
UNICEF  
Three United Nations Plaza  
New York, NY 10017, USA  
asharkey@unicef.org

[4–10]. When attention is paid to dismantling these barriers, providing acceptable services and implementing strategies to mobilize and empower families and communities, care-seeking and treatment utilisation can be impacted in a positive way [6,11,12].

Published studies shed some light on the relationship between iCCM services and demand generation. For example, studies from Cameroon [13], Zambia [14,15] and Uganda [16] have reported increased levels of care-seeking for, and utilisation of, appropriate treatment of childhood illnesses where iCCM has been implemented compared to areas without these services. Concurrent reductions in the use of home care as a first treatment [13–15], public facilities [14,15] and ‘other’ services (including traditional healers) [14] as sources of care and treatment for childhood illnesses have been reported in sub-Saharan African settings as well. In addition, two studies from Uganda have reported improvements in the timeliness of care-seeking and treatment uptake in iCCM programme areas [16,17]. However, in Ethiopia, where an ambitious iCCM scale-up is currently being implemented, a recent study also noted that having community-based services in place was not enough to drive appropriate uptake by local populations, and that demand creation activities to promote use of services must be a key element [18].

In this paper, we present case studies of iCCM programmes in Niger and Mozambique that included a specific focus on demand generation and social mobilisation related-efforts. The Niger experience is based on a comprehensive approach incorporating behavioural change communication, social mobilisation and advocacy for eight key family practices. The Mozambique experience is based on a comprehensive approach combining community engagement strategies with efforts to ensure effective access to trained and equipped community health workers, particularly in areas with high levels of unmet need. Our hypothesis is that holistic iCCM programmes that not only address supply-side determinants of coverage, but also are responsive to demand-side elements at inception and with appropriate community engagement, can improve care-seeking and utilisation among families with sick children. The case studies show how this hypothesis was tested in two diverse settings.

## NIGER EXPERIENCE: BEHAVIOUR AND SOCIAL CHANGE FOR KEY FAMILY PRACTICES

### Setting

With a population of 17.1 million people in 2012, Niger has one of the lowest Human Development Index rankings in the world [19] and its under-5 mortality rate of 114 is

one of the world's highest [20]. However, Niger has also made significant reductions in under-5 mortality since 1990, and is amongst 23 of the 74 Countdown countries on track to achieve its millennium development goal for child mortality (MDG4) [21]. Key factors leading to this decline were the establishment of health posts (peripheral structures in villages with at least 5000 people and located more than 10 km from health centres) in 2000 and the establishment of free health care for pregnant women and children under 5 which began in 2006 [20]. Beginning in 2008, paid community health workers in public health posts were authorised to provide iCCM for children with fever or malaria, suspected pneumonia, and diarrhoea [20]. However, even following these advancements, challenges and barriers to effective care-seeking and treatment utilisation remained in Niger, and the overall level of child mortality continued to be unacceptably high.

### Overview of the approach

Between 2006 and 2008, the government of Niger in collaboration with UNICEF and other non-governmental and media partners began planning for a model programme of communication for social and behaviour change for child survival. At the national level, a multisectoral team was identified with representatives of the ministry of health, the ministry of communication, the ministry of water resources, and the ministry of education and decentralisation. Together the team identified the key family practices (*‘les pratiques familiales essentielles’* or *‘PFEs’*) critical to improve child survival: exclusive breastfeeding, sleeping under insecticide-treated bednets, oral rehydration solution (ORS) for treatment of diarrhoea, hand washing with soap, complementary feeding, use of preventive health services like vaccinations and treatment for childhood illnesses. (Promotion of birth spacing started in 2012 as the eighth key family practice (KFP).) In addition, the team identified a three pronged approach to promote social and behavioural change including: social and behaviour change communication, social mobilisation and advocacy efforts (**Box 1**). Together these partners worked to secure the necessary financial and human resources to test the approach, as well as to begin to establish coordination mechanisms at both national and local levels.

In 2008, the Maradi and Zinder regions were identified as the setting in which to test the approach. Within these regions, five communes (with 50 intervention villages and 25 comparison villages) were identified [22].

With the support of UNICEF, local government teams and non-governmental staff convened advocacy meetings in each village to introduce the approach and build local trust. In addition, community workers were elected (a two-day process based on defined criteria) and trained over a pe-

**Box 1** Niger's three pronged approach to promote social and behavioural change for child survival

### 1. Social and behaviour change communication

- Interpersonal communication (IPC) using *relais communautaires* and participatory communication mechanisms such as local and traditional media, cinema, theatre and community radio
- Community empowerment/participation for collective change through community learning activities, community-led design, and implementation and monitoring of action plans

### 2. Social mobilisation

- Creation of partnerships and networks (traditional chiefs, women and youth)
- Media campaigns and proximity media (cinema forum, community radios, theatre)

### 3. Advocacy

- Local (imams, traditional chiefs) and national partners

Tools utilised within the Niger programme are available at: <http://ccmcentral.com/iccm-symposium/tools/#tab14>

riod of seven days. These individuals were then charged with leading implementation of the approach and guiding activities locally.

Next, local core groups were created to promote the key family practices. In order to ensure that the approach was largely community-based and community-driven, *relais communautaires* (a cadre of community volunteers) were engaged along with key community leaders such as imams and traditional leaders. Together these partners conducted participatory community and household assessments to identify the main drivers of local behaviours and analyse barriers to high coverage of each of the eight family practices. Open dialogue is encouraged during these assessments, in order to ensure that both constraints and locally acceptable solutions are discussed, and that consensus regarding the need for change can be reached. Based on the findings of these assessments, the partners work together to develop village 'Plans of Action' (Figure 1).

Next, partnerships and networks were created with local media, mobile cinema vans, theatre, and community radio activities which encouraged local participation in 'debates' around key issues. In addition, *relais* organized lectures and home visits around the family practices, traditional chiefs were engaged to promote daily hygiene, and imams were engaged to promote breastfeeding before evening prayers. Mothers' and youths' peer-support groups were also convened.

Volunteers and local leaders monitored progress with tools created to assess household adoption of the key family practices and monthly village meetings were held to discuss progress. The information from this monitoring was also shared with health workers based at health centres. Annual village meetings were held to assess progress and revise action plans as needed. The core teams created annual celebrations of village and family 'champions,' established individuals as 'agents of change,' and identified 'model villages' when at least 70 percent of families had adopted three or more of the key family practices. 'Model mothers' in these areas are awarded with soap, mosquito nets or a radio.

### Scaling up the approach

By 2011, the government of Niger and UNICEF had worked together to extend the approach from five to 30 communes, representing a total population of more



**Figure 1.** A participatory community assessment in Niger. Photo credit: UNICEF Niger.

than 1 million people. As it was expanded, the approach was integrated into Commune Development Plans. Multi-sectoral and synergistic activities were incorporated into the approach in some communes based on other programmatic opportunities relating to building external partnerships (for example with the World Food Programme, World Bank or the Food and Agriculture Organisation) or intersectoral programmes. Examples included a cash transfer project, community led total sanitation (CLTS) activities, and the development of 'education for health' curricula for children.

## Data used and programme results

Several data sources were used to assess the approach. In 2011, a KFP survey was conducted in the 176 villages in which the intervention was implemented and in 25 control areas [22]. The objectives of this study were to 1) compare coverage of the KFPs with similar areas that were not exposed to the intervention, 2) provide information on the effectiveness of various strategies used in communication for social change and behavior, and 3) collect baseline data for a separate pilot project on social nets. In addition, between July 2011 and December 2012, a qualitative study was conducted in two villages in Maradi, two in Tahoua and one in Zinder to assess perceptions of KFPs and their related practices [23]. This qualitative study also assessed families' constraints and obstacles to the adoption of the KFPs, as well as the perceptions of the local population of the implementation of the program, including the role of key players such as project staff, health workers, community liaisons, and community leaders. In each setting, the research team met with local stakeholders to discuss the research plans and objectives, and later the preliminary research findings to obtain inputs and feedback. Finally, in

2012, UNICEF supported additional data collection within the national Demographic and Health Survey in order to ensure availability of disaggregated data for the intervention areas and to enable comparisons with the national situation [24]. This survey examined a representative sample of 5875 households consisting of twelve departments in the intervention areas and provided information on coverage of the key family practices.

**Table 1** shows some of the differences in uptake of some key family practices in the intervention areas and nationally in 2012.

Data from the 2006 and 2012 Enquête Démographique et de Santé et Indicateurs Multiples (EDSN–MICS) surveys indicate that, with the exception of antimalarial treatment following the change in policy to provide Artemisinin-based Combination Therapy (ACT) and use of rapid diagnostic tests (RDTs), there were improvements in several key family practices over time nationally (**Table 2**). These improvements were even more pronounced in the intervention areas. For example, **Figure 2** shows changes in the percent of children with symptoms of acute respiratory infections (ARI) for whom care was sought in the intervention zones vs the national average between 2006 and 2012.

Further, between 2006 and 2012, the average annual rate of decline in under-five mortality was 6.6% in the intervention areas compared to 6% nationally (**Figure 3**). While this difference of 0.6% may appear to be small, the implications are considerable in a country such as Niger which had the highest fertility rate in the world in 2012 [19]. In addition, the average annual rate of decline in neonatal mortality was nearly twice as high in the programme intervention areas as the national decline over the same time period (**Figure 3**).

**Table 1.** Uptake of some key family practices in Niger intervention and comparison areas, 2012 (percent and 95% confidence intervals, unweighted data)\*

KEY FAMILY PRACTICE	INTERVENTION AREAS	COMPARISON AREAS
Children ages 0–5 y with diarrhoea in the previous 2 weeks who received treatment with oral rehydration salts (ORS)	58.3 (51.4–65.1)	29.1 (20.6–37.6)
Children ages 0–5 y who were ill with fever in the previous 2 weeks and who received Artemisinin-based Combination Therapy (ACT) for treatment of malaria	5.3 (3.0–7.5)	0.4 (0.0–1.3)
Mother or caregivers who reported that their children ages 0–5 y slept under an insecticide-treated bednet the previous night	98.6 (97.3–99.3)	99.4 (97.4–99.9)
Children ages 12–23 mo who receiving complete vaccinations	47.8 (43.7–52.0)	38.5 (33.1–44.4)
Early breastfeeding initiation (within 1 h of delivery)	88.7 (85.9–91.5)	76.5 (71.2–81.7)
Exclusive breastfeeding (0 to 6 mo)	77.4 (73.6–81.1)	53.7 (47.1–60.3)
Complementary feeding (6 to 23 mo)	44.1 (40.5–47.6)	26.2 (21.6–30.8)
Knowledge of danger signs of diarrhoea, pneumonia and malaria	30.1 (26.8–33.4)	8.8 (5.9–11.8)

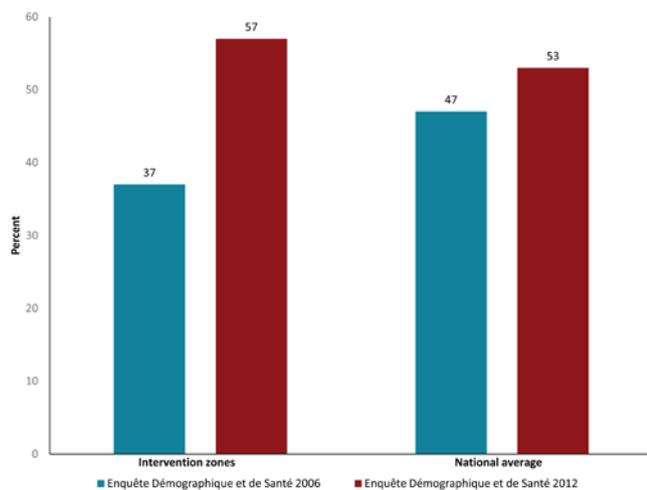
\*Source: Institut National De La Statistique – Niger (2012) Enquete Quantitative Relative à la Recherche Action sur les Pratiques Familiales Essentielles, La Nutrition et Les Dépenses de Consommation des Ménages dans les Régions de Maradi, Zinder, Tahoua et Tillabéri: Rapport d'analyse. Niamey: Institut National De La Statistique – Niger.

**Table 2.** Uptake of key family practices relating to pneumonia, diarrhoea and malaria in Niger, 2006 and 2012 (percent and 95% confidence intervals)\*

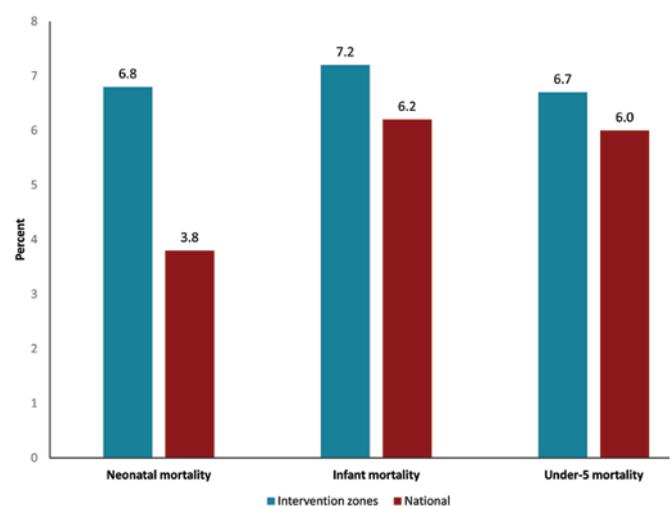
KEY FAMILY PRACTICE	NIGER, 2006	NIGER, 2012
Children ages 0–5 y with diarrhoea in the previous 2 weeks who received treatment with oral rehydration salts	17.6 (15.3–20.0)	44.3 (41.1–47.5)
Children ages 0–5 y with suspected pneumonia in the previous 2 weeks who were taken to an appropriate health–care provider†	46.5 (40.9–52.1)	53.1 (46.5–59.6)
Children ages 0–5 y who were ill with fever in the previous 2 weeks and who received any antimalarial medicine	33.0 (29.6–36.7)	19.2 (16.7–22.0)
Children ages 0–5 y who slept under an insecticide treated mosquito net the previous night	7.2 (6.1–8.4)	20.7 (18.5–23.0)
Children who received complete vaccinations (12–23 mo)	29.0 (25.5–32.5)	52.0 (48.6–55.3)

\*Source: Institut National de la Statistique (INS) et Macro International Inc. 2007. *Enquête Démographique et de Santé et Indicateurs Multiples du Niger 2006*. [Data set]. NIKR51FL.DTA. Calverton, Maryland, USA: INS et Macro International Inc.; Institut National de la Statistique (INS) [Niger], Unicef et ICF International 2012. *Enquête Démographique et de Santé dans les Zones d'Intervention du Programme de Coopération de l'Unicef au Niger, 2012*. [Data set]. NIKR61FL.DTA. Rockville, Maryland, USA: INS, Unicef et ICF International.

†Appropriate health–care provider refers to all public or private facilities, except for pharmacies and shops, traditional healers and other non–medical facilities.



**Figure 2.** Percent of children with symptoms of acute respiratory infections (ARI) for whom care was sought, intervention zones and national average, Niger 2006 to 2013. Sources: Institut National de la Statistique (INS) [Niger], Unicef et ICF International 2012. *Enquête Démographique et de Santé dans les Zones d'Intervention du Programme de Coopération de l'UNICEF au Niger, 2012*. Rockville, Maryland, USA: INS, Unicef et ICF International; and Institut National de la Statistique (INS) et Macro International Inc. *Enquête Démographique et de Santé et à Indicateurs Multiples du Niger 2006*. Calverton, Maryland, USA: INS et Macro International Inc.; Février 2007. <http://dhsprogram.com/pubs/pdf/FR193/FR193–NI06.pdf>.



**Figure 3.** Average annual rate of reduction in child mortality (percent) in the intervention zones compared to the national rate, Niger 2006–2012. Sources: Institut National de la Statistique (INS) [Niger], Unicef et ICF International 2012. *Enquête Démographique et de Santé dans les Zones d'Intervention du Programme de Coopération de l'UNICEF au Niger, 2012*. Rockville, Maryland, USA: INS, Unicef et ICF International; and Institut National de la Statistique (INS) et Macro International Inc. *Enquête Démographique et de Santé et à Indicateurs Multiples du Niger 2006*. Calverton, Maryland, USA: INS et Macro International Inc.; Février 2007. <http://dhsprogram.com/pubs/pdf/FR193/FR193–NI06.pdf>.

## Next steps and lessons learned

Available evidence suggests that these multi–faceted demand generation and social mobilisation activities contributed to improved utilisation of iCCM–related interventions in Niger. The findings from Niger's experience suggest that community involvement and commitment are critical to reduce relevant bottlenecks in the access and use of services. Community *relais* and local leaders are key actors to

ensure community engagement and empowerment. In addition, a better understanding of social norms can support efforts to reduce related bottlenecks relating to behaviours. Finally, efforts to strengthen local capacity in data analysis and use (for example, with user–friendly tools) can facilitate evidence–based programming.

Significant progress has been made towards reducing under–five mortality in Niger, although some challenges re-

main. Some of the most important demand-related barriers include lack of knowledge of danger signs, the competing household responsibilities of women, and continued confidence in the efficacy of traditional treatments, particularly in areas where there are no *relais* [25]. A recent case study examining Niger's success in decreasing under 5 mortality indicates that the use of community-based providers to provide high-impact promotive, preventive and curative interventions at the peripheral health posts was a key factor in improving timely care-seeking for and life-saving treatment of childhood illnesses [26]. The Niger government and its partners are continuing to focus on addressing these important issues in order to support further achievements in child survival.

## MOZAMBIQUE EXPERIENCE: THE NATIONAL COMMUNITY HEALTH WORKER PROGRAMME AND COMMUNITY ENGAGEMENT

### Setting

Mozambique's population reached 24.5 million people in 2012, and, similar to Niger, it has one of the lowest Human Development Index rankings in the world [18]. The under 5 mortality rate of 90 deaths per 1000 live births ranked 22nd highest in the world in 2012 [19], however this was a substantial decline from the rate of 219 per 1000 live births in 1997 [27]. The country is mostly rural (only 31 percent of the population lives in urban areas) and 60 percent of the population lives in poverty [19].

### Overview of the approach

The National Community Health Worker programme originally started in 1978 but was abandoned during the country's protracted civil war. The programme was revitalized in 2010 and since early 2014 the programme has been under expansion with approximately 3800 CHWs (known in Mozambique as '*Agentes Polivalentes Elementares*' or '*APEs*') slated for training. Under Ministry of Health policy, these CHWs should each serve between 500 and 2000 inhabitants, though in practice, many serve more than 2000. CHWs should also live within the communities they serve, and provide a range of services encompassing health promotion for behaviour change, preventive home visits, screening for malnutrition and integrated community case management for childhood illnesses such as malaria, diarrhoea, and pneumonia. The goal of the CHW programme is to reduce gaps in access to preventive and curative care for remote communities by extending health services to an additional 20 percent of the population, and promoting actions for health and social change.

At the core of the CHW programme is a strong link with the Ministry of Health's (MoH's) comprehensive community engagement approach, established in the National Strategy for Health Promotion [28] and Terms of Reference for Establishing Community Health Committees ('*Comités de Saúde Comunitário*') [29], which focuses on community mobilisation and community participation in decision-making on health issues and in the selection of CHWs. The programme views community engagement as a continuum, starting with extensive community awareness raising, and community participation in selection of CHWs, and moving towards community mobilisation and involvement around critical health issues.

Additional strategies of the MoH's community engagement approach are to build the capacity of both health personnel and partners in participatory methodologies, establish Co-management Committees which link facilities with communities, work in coordination with various community volunteers, local non-governmental organisations and community-based organisations, and to involve key community leaders (political, religious, traditional, teachers, and others) in decision-making and planning on health issues related to their communities.

Further, the programme works to ensure 'effective access' for services in order to increase care-seeking and treatment. According to the Mozambique Ministry of Health, in order to achieve 'effective access' the CHW must be equipped, accessible, available, motivated, and supervised.

### Programme methods and results

In 2009, the non-governmental organisations Malaria Consortium and Save the Children began supporting iCCM through the Ministry's CHW programme in Inhambane and Nampula Provinces respectively. In addition to supporting "effective access" elements, including training, supervision, monitoring and provision of medicines for CHWs, attention was also given to community mobilisation for uptake of the new services provided by CHWs.

A national Symposium was held in Maputo in July 2013, co-hosted by the CHW (APE) Programme-Ministry of Health, Malaria Consortium and Save the Children, which brought together a wide range of stakeholders, including major donors, non-government organisations, UN agencies and local research groups, to present and discuss results and lessons learned from this 3-year programme and implications for community-based health programming in the country. In addition, the endline survey results were shared with donors, non-government organisations, research groups and other stakeholders at a meeting in the United States in May 2013, where findings and lessons learned from the three countries (Mozambique, South Sudan and Malawi) that received grants from the Government of Canada were presented.

During the preparation phase in Inhambane Province, qualitative research studies were conducted to look at existing knowledge, attitudes and behaviours in relation to the prevention and management of diarrhoea, pneumonia and malaria in children. The results revealed some knowledge gaps and misconceptions among caregivers which contributed to inappropriate care-seeking and management practices. Most caregivers also showed awareness on a number of child health recommendations but low levels of self-efficacy in putting these recommendations in practice, especially in seeking medical treatment for their ill children. iCCM was generally highly acceptable to community members [30]. Findings also highlighted the lack of community support and involvement in the CHW programme at the time, reflecting low levels of community awareness and appreciation of the CHWs' roles and responsibilities [31]. To address these issues a public health communication intervention was designed to improve health-care seeking and prevention practices around child health, through individual and collective actions. The intervention is based on a socio-ecological approach, which conceptualises individual behaviour as the result of overlapping individual, social and environmental issues [32]. It combines two main complementary strategies: the diffusion of information through mass media (namely radio programming) and community dialogues (Figure 4). The community dialogue (CD) model, which is based on participatory learning and action approaches, was integrated in the existing iCCM programme in Inhambane province to strengthen the CHWs' health promotion activities. Intensive community sensitisation efforts were conducted prior to the 2011 deployment of 292 CHWs in Inhambane Province, which was followed about a year later by the introduction of the CD intervention. For each community (defined as the

CHW's catchment area), the CHW and his or her corresponding community leader were trained on a simple 10-step methodology and provided with visual tools (available at [www.ccmcentral.org](http://www.ccmcentral.org)) that allowed them to engage local communities in monthly participatory discussions around prevention and optimal management of childhood diseases through iCCM services and in collectively identifying barriers and solutions. To position CHWs' services in the public sphere and reinforce their community-level promotional activities, a daily radio edutainment programme was broadcasted in prime time from August to November 2012. The approach addresses a set of constructs, such as knowledge of disease and danger signs as well as services available, self-efficacy and social norms, including that CHWs can be a first choice for care.

A qualitative process evaluation of the intervention was conducted in 2013 using a method described by Saunders et al [33]. The evaluation consisted of 29 focus groups and 38 key informant interviews, complemented with secondary monitoring data, including structured CD observations, CD monitoring sheets and programme reports [34]. The evaluation found an increased awareness and appreciation of the CHWs by the community members, who consider them to be 'health leaders.' The model also seems to have contributed to filling some knowledge gaps. Community members interviewed considered CDs as a major source of information and demonstrated correct knowledge of the causes and prevention measures for diarrhoea and malaria, but pneumonia appeared to be rarely discussed in CDs. Among communities visited, people who had attended CDs considered CHWs as their first choice for care and indicated that using CHWs had become a habit. The findings also highlighted the importance of the local leadership: its presence and involvement in the activities legitimized the role of the CHWs

and gave more weight to the messages of health promotion and prevention conveyed by the CHWs. The evaluation indicates that CD is an effective tool for setting new social norms and moving from information to action through the commitments agreed upon in public. As an example, through CDs, one community agreed with traditional medicine practitioners that all sick young children and people presenting with cough should be redirected to a CHW.

In order to measure changes in care seeking behaviour, morbidity and access to appropriate treatment (either from a CHW or

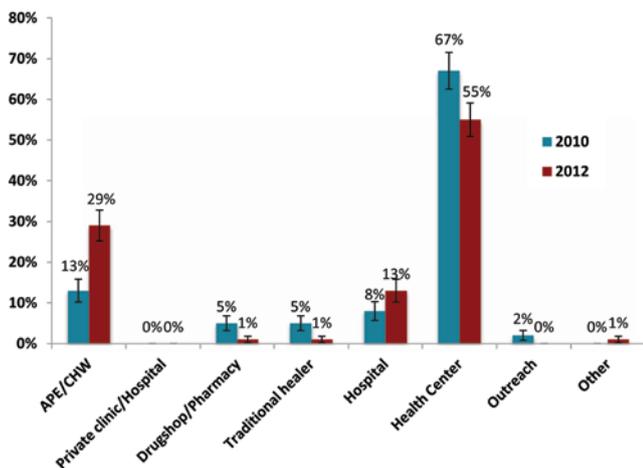


**Figure 4.** Overview of Mozambique's community engagement strategy in the province of Inhambane. CHW – community health worker.

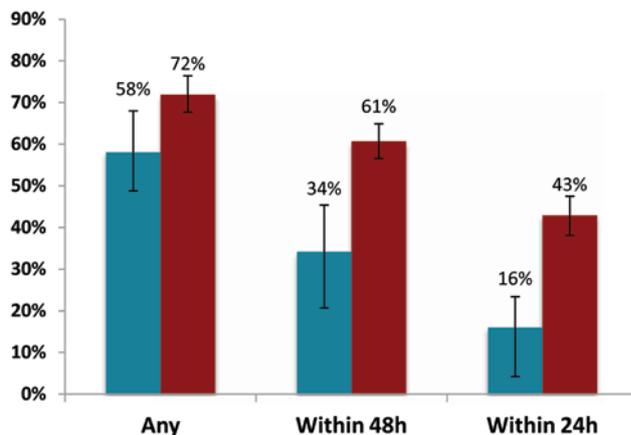
a health facility) for children under five sick with malaria, pneumonia or diarrhoea, an outcome evaluation of the CHW programme in the province of Inhambane was conducted in collaboration with the Provincial Health Directorate. The evaluation involved a baseline household survey, in 2010, just before the beginning of programme implementation, and an endline survey in 2012. A two-stage sampling design was used and data were collected from a sample of 1409 households at baseline [35] and from a sample of 3032 households at endline [36]. All rural districts of the province were included in the sampling frame.

Results indicated a trend of significant progress in both diagnosis and treatment seeking behaviours as a result of the presence of the CHWs in the communities. As shown in Figure 5, when care was sought for childhood illness, treatment provided by CHWs increased nearly 3-fold between 2010 and 2012, from 13% (95% confidence interval (CI) 10.2–15.8) to 29% (95% CI 25.2–32.8). While the public sector remained the primary source of care at endline, the use of private sector sources (including drug shops/ pharmacies and traditional healers) decreased in favour of the CHWs.

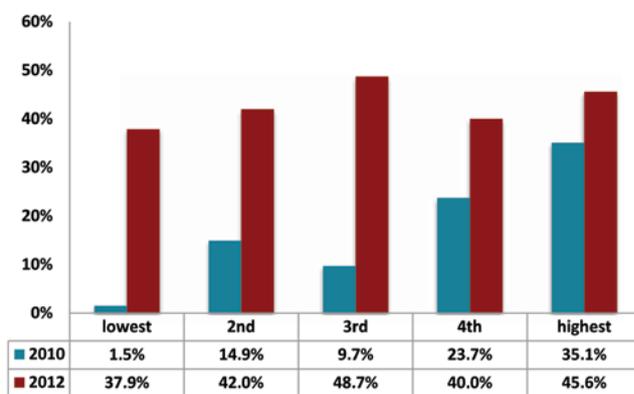
Furthermore, the deployment of CHWs had a positive effect on timeliness of care-seeking in the province: treatment seeking within the first 24 hours of symptom onset increased from 16% (95% CI: 8.6–27.8) in 2010 to 42.9% (95% CI: 38.3–47.7) in 2012 (Figure 6). As shown in Figure 7, this effect was particularly important for families living within the poorest quintiles. The equity ratio for treatment within 24 hours increased from 0.04 to 0.83 over the two year period so that this behaviour changed from being virtually non-existent among the poorest families to being almost as common as among the richest families. The survey also found that, among caretakers who had not mentioned the CHW as their primary source of treatment at endline survey, more than two thirds either did not know



**Figure 5.** Primary source of treatment when any assistance was sought, Inhambane Province Mozambique, 2010 and 2012.



**Figure 6.** Care-seeking for childhood illnesses, overall and by timeliness, Inhambane Province Mozambique, 2010 and 2012.



**Figure 7.** Care-seeking for childhood illnesses within 24 hours by wealth quintile, Inhambane Province Mozambique, 2010 and 2012.

the CHW in their community (44.7%; 95% CI 41.5–47.9) or preferred another source (23.9%; 95% CI 21.1–26.7). The other reasons for not using the CHW services were distance (11.5%; 95% CI 9.4–13.6), lack of medicines (10.6%; 95% CI 8.6–12.6) and non-availability (7.2%; 95% CI 5.5–8.9).

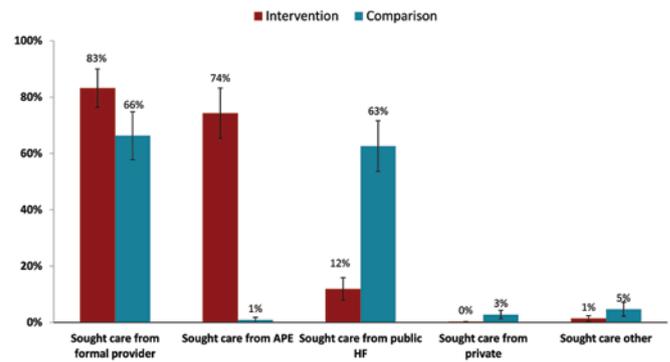
This indicates that a number of households are still not being reached regularly by community mobilisation interventions in a context where CHW catchment areas can be very large, and that the proportion of all ill children primarily seen by a CHW should further increase with better recognition of the CHW within the community and better supply of the CHWs with medicines. More efforts and investments need to be put in place to better understand barriers and expand service outreach, including through the training and deployment of additional CHWs combined with the continuation and intensification of community mobilisation activities to leverage greater results for child survival.

In 2010, Save the Children trained and deployed 291 CHWs in Nampula province. From August 2010 until December 2012, Save the Children provided supervision support to CHWs and key iCCM medicines (amoxicillin, ACTs and RDTs) to supplement the CHW medical kit. To support the MoH at district level, Save the Children contracted district supervisors to provide intensive supervision to CHWs during the initial stages of the program. At community level, Save the Children worked together with CHWs and community leaders to promote community engagement in the CHW programme.

In order to promote acceptability and uptake of iCCM services, in February and August 2012, 1330 Community Health Committee (CHC) members were trained on key community-related components of iCCM, including recognition of danger signs and prevention of the three iCCM illnesses targeted by the CHW program. In collaboration with the district health offices, Save the Children created a flipchart on identifying danger signs and corresponding actions for prompt and appropriate care-seeking. This flip chart was used as tool during the training and a 'job aid' for community health committee members after the training. The training package, which focused primarily on iCCM, was developed before the MOH's national comprehensive community engagement strategy was finalised. In February and August 2012, Save the Children also partnered with community radio stations to design, test and broadcast radio messages to raise communities' awareness on the iCCM services provided by the CHWs, the importance of early care-seeking, and to encourage communities to adopt appropriate preventive practices. Messages were broadcast twice weekly. Themes and content of messages were based on results of the project's baseline survey, conducted in 2010, and targeted specific areas where caregivers had limited knowledge related to prevention and care-seeking for the three iCCM illnesses.

In collaboration with the Nampula Provincial Health Department the project was evaluated in October 2012 in order to assess the effects of the iCCM programme on care seeking for childhood malaria, pneumonia and diarrhoea and appropriateness of treatment. The survey used a three-stage cluster sampling design stratified by intervention and comparison areas (600 households with children under five were sampled in each arm). The CHW catchment areas served as clusters in intervention areas while census enumeration areas (primary sampling units) eligible for iCCM served as clusters in comparison areas.

**Figure 8** shows that demand for iCCM services in the form of care seeking for fever from a formal provider was significantly higher in the Nampula intervention clusters (83.2%; 95% CI 76.3–90.0) than comparison areas (66.3%; 95% CI 57.8–74.9). In addition, CHWs were the main source



**Figure 8.** Care-seeking for fever among children under 5 years in intervention and comparison areas in Nampula Province Mozambique, 2012. APE – *Agentes Polivalentes Elementares*, HF – health facility.

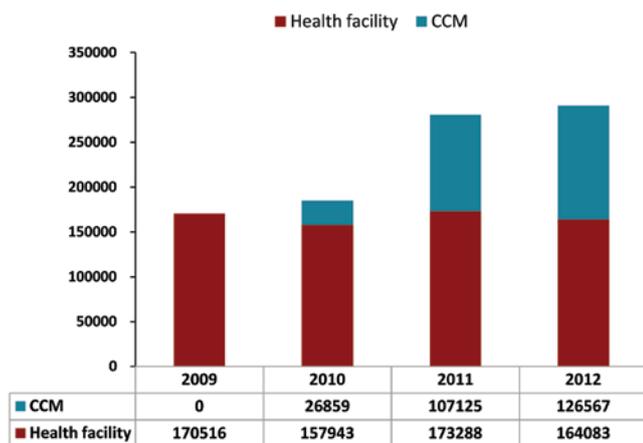
of care seeking in intervention areas with nearly three-quarters (74.3%; 95% CI 65.4–83.2) of all children with fever being taken to a CHW, accounting for 89.3% of total care seeking from public sector providers (269/301).

For each intervention cluster, a variable was created using data from a complementary survey of 30 CHWs. The variable indicated whether the CHW serving that cluster was active (residing in catchment area and a register review indicated that sick child cases were treated in the past 7 days) or inactive (not residing in catchment area and/or had not treated sick child cases in the past 7 days). Of the 30 intervention clusters, 24 had a CHW who met the criteria for active. Results showed that active care-seeking for fever was 34 percentage points higher among active CHWs (82% vs 48%).

Analysis of routine monitoring data from CHWs and health facilities over the time period from 2009 (when iCCM services for malaria were largely unavailable) to 2012 shows that demand from CHWs increased. By 2012, CHWs were treating 44% (126 567/290 650) of all malaria cases in the 10 districts of Nampula Province (**Figure 9**). At the same time, the number of cases treated at facilities remained relatively stable and did not show a pattern of demand replacement, ranging from 170 516 malaria treatments at facilities in 2009 to 164 083 in 2012.

### Next steps and lessons learned

Mozambique's experience shows that a comprehensive community engagement and empowerment strategy focused on improving health outcomes of young children, along with ensuring effective access to CHWs can result in positive results for families with young children, particularly those living in remote settings of the country with poor access to health services. In this experience, community readiness and support from local leadership was a key for accountability and social mobilisation, as was collabo-



**Figure 9.** Malaria treatment by source in 10 iCCM districts in Nampula Province, Mozambique, 2009 to 2012. CCM – community case management.

ration and coordination between CHWs and Community Health Committees. Mobilisation efforts utilised interpersonal dialogue with community members (ie, the teams went beyond simple ‘messaging’) and as a result, built trust, cooperation and programme ownership. Further, iCCM activities proved to be more effective because they were integrated into a comprehensive approach including health promotion and prevention, and into a larger community involvement programme. Finally, the Mozambique experience revealed that it was critical to ensure that CHWs have a regular supply of medicines and equipment in order to maintain demand once it was generated.

There are important issues to consider as the programme continues to expand throughout the country, including how best to respond to recurrent demands from community members for health posts in their communities, expansion of CHW roles to include additional tasks, and for better quality of care at health facilities.

## DISCUSSION

This analysis is subject to several limitations, including the fact that a case study approach was utilised, which is not generalizable and does not lend itself towards numerical representation.

The evaluations conducted in Niger and Mozambique assessed the overall impact of the iCCM programme in terms of increased access to appropriate treatment of sick children, but could not identify the respective contribution of each programme component separately. In Niger, although some process data were collected, documentation of these activities was limited. Further, data were not weighted in the specific survey conducted in Niger to assess outcomes based on the KFP intervention. Using weighted data might

have revealed additional (or different) findings for intervention vs control areas. However the availability of DHS data in 2012 provides another measure to validate the positive findings of the KFP survey.

In Mozambique, the endline and baseline surveys did not measure exposure to communication and community mobilisation interventions thus not allowing for dose–response efficacy analysis. The evaluation also suffered from the lack of agreed upon indicators and methods to measure the specific outcomes of community engagement activities. With the exception of the Community Dialogue intervention in Inhambane province for which Malaria Consortium developed specific monitoring and evaluation tools and sourced additional funding to evaluate it, process data on community mobilisation activities are scarce. Despite community engagement being a key component of the CHW programme in Mozambique, the national monitoring and evaluation system and tools do not capture process data which could further be analysed to monitor demand level and barriers and inform further programme improvements.

Still, the experiences of these two diverse settings may hold relevance to other resource–poor settings with a need to generate demand for life–saving child health interventions. In addition, the teams implementing the projects conducted rigorous analyses to demonstrate outcomes in the intervention and control areas.

Based on the experiences of these two case studies of iCCM and child survival demand generation and social mobilisation activities, several strategies appear to have worked well.

First, demand increased, both for iCCM services and other child health priorities, following the implementation of comprehensive social mobilisation efforts. These efforts incorporated interpersonal communication activities and community empowerment/participation for collective change, partnerships and networks among key stakeholder groups within communities, media campaigns and advocacy efforts with local and national leaders. In these settings, social mobilisation and community participation improved community ownership (something that may lead to improved programme sustainability) [37,38], and helped the community interact with and support the health system (for example, to discuss bottlenecks in access and quality of services, to identify locally relevant solutions, and to improve the flow of information across partners).

Second, these efforts involved a participatory process for community selection of local individuals to work as CHWs, something that can facilitate community acceptability of CHW services and for the CHWs themselves [39,40].

Third, community members were made aware of the skills and training of CHWs in order to build trust in the servic-

es they provide. Caregivers seek care from providers whose services they trust and respect, and who show respect for them [41–43]. In settings where caregivers have a variety of provider options (including where other provider types such as traditional healers and drug shops are well established), it can be particularly important that families understand who the CHWs are and what they offer.

Fourth, both approaches described here incorporated efforts to make community members aware of danger signs and appropriate treatments for illnesses, key factors in improving prompt and appropriate care-seeking [44–46].

Fifth, in these settings, CHWs were allowed to treat for more than one disease, something that may generate higher demand as families often seek care for more than one problem. One study in Uganda reported poor caregiver compliance to referral to facilities, as well as a negative impact on families' confidence in the community programme, when only malaria (and not pneumonia) treatment was offered in the community [47].

Finally, these approaches incorporated efforts to ensure availability of supply side elements that can influence demand. They worked to ensure local availability and appropriate density of CHWs as well as a consistent and high quality supply of medicines, both of which have been found to correlate to improved care-seeking and utilisation for iCCM services in other settings [13,15,17,48–51]. One Ugandan study reported that following a stock out in a CCM program, caregivers continued to bypass CHWs even after the drug supply problem was rectified [51].

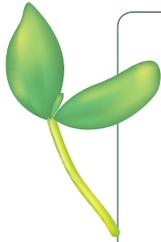
However, as Ensor and Cooper have noted [4], it is critical to address demand issues through demand side-specific interventions, not just as an adjunct to implementation but rather as a primary component within programme packages. Community mobilisation has been recognised as one of the key features for successful health interventions, and the literature confirms [52] that interventions designed to maximize community collaboration and participation can have a beneficial impact on child health. However evidence is still scarce on what does or does not work [53] and further research is needed which should pay specific attention to the collection of information on the continuum of community approaches and carefully evaluating the implementation processes [52].

Additional research is needed in order to understand how to maximize appropriate demand for iCCM services. Operational research to test and compare the respective impact of specific approaches would bring valuable insights to programme managers and help develop clear rationale for the selection of the most appropriate approach to each context. Other areas of interest include improving our understanding of the role of CHW gender in acceptability of iCCM services (which will be of particular importance as iCCM services expand to include maternal and neonatal treatments), how to improve caregiver understanding of the differences between simple cough and cold and pneumonia (in order to reduce demands for unnecessary antibiotic treatment) and how to use existing data sources to capture local demand for and barriers to iCCM services. Further, more information is needed on how best to promote adherence to treatment. In Uganda and Zambia, incorporating RDTs into iCCM programmes was found to have a positive impact [45,54].

## CONCLUSION

iCCM programmes, when implemented with careful attention to training CHWs, ensuring adequate drug supplies and mobilizing and engaging community members and stakeholders to access and participate in services, cannot only increase care-seeking among families with sick children, but they can also improve the timeliness and appropriateness of care-seeking. iCCM programmes can also replace facility-based care (thereby reducing facility caseloads) and care from other sources such as drug shops and traditional healers, improving timeliness and in some cases appropriateness of treatment.

Generating demand is not simple. The barriers to seeking appropriate treatment are complex and are affected by myriad factors, both financial and non-financial. As a result, it may not always be possible to see quick changes in care-seeking behaviors once iCCM services are made available. But the experiences described above show that iCCM programmes can positively influence demand for and uptake of treatment services, provided that CHWs are trained and equipped with interpersonal communication tools and methods and supported by wider community engagement approaches.



**Acknowledgements:** The authors wish to thank Tanya Guenther and Helen Counihan for their helpful inputs on drafts of this paper, Richard Kumapley for additional analyses of the Niger data, the Ministry of Health in Niger, the Ministry of Health in Mozambique, including Teresa Mapasse, National APE Programme Coordinator, as well as the peer reviewers.

**Ethical approval:** Ethical clearance for the surveys conducted in Mozambique was obtained from the National Ethics Committee of Mozambique. No other programmatic work described in this paper required ethical approval.

**Funding:** This work was made possible through a grant from the Department of Foreign Affairs, Trade and Development, Government of Canada (SC130207). Funding for support to the Niger KFP programme was provided by UNICEF France (SC140256), the Government of Canada (SC130194), the European Union (SC130821), the Government of Spain (SC2008/0836), and UNICEF Comité Español (SC120919). Funding for support to APE programme implementation in Mozambique, Inhambane and Nampula provinces, including baseline and endline surveys, was provided by the Government of Canada under purchase numbers 7052741 (Inhambane, Malaria Consortium) and number 7052731 (Nampula, Save the Children). Additional funding for evaluation of the community dialogue intervention in Inhambane province was provided by UKAid.

**Authorship declaration:** SM, TC, EW and RB participated in programme implementation and monitoring in Mozambique and Niger. ABS, SM, TC, EW and RB contributed to the conceptualisation and writing of this manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from ABS). We declare that we have no conflicts of interest.

## REFERENCES

- 1 Wilson SE, Morris SS, Gilbert SS, Mosites E, Hackleman R, Weum KLM, et al. Scaling up access to oral rehydration solution for diarrhea: learning from historical experience in low- and high-performing countries. *J Glob Health*. 2013;3:010404. Medline:23826508 doi:10.7189/jogh.03.010404
- 2 Guenther T, Sadruddin S, Chimuna T, Sichamba B, Yeboah-Antwi K, Diakite B, et al. Beyond distance: an approach to measure effective access to case management for sick children in Africa. *Am J Trop Med Hyg*. 2012;87:77-84. Medline:23136281 doi:10.4269/ajtmh.2012.11-0747
- 3 World Health Organization/UNICEF. Joint statement: Integrated community case management (iCCM). An equity-focused strategy to improve access to essential treatment services for children. New York: UNICEF; June 2012. Available at: [www.unicef.org/health/files/iCCM\\_Joint\\_Statement\\_2012.pdf](http://www.unicef.org/health/files/iCCM_Joint_Statement_2012.pdf). Accessed: 1 October 2014.
- 4 Ensor T, Cooper S. Review article. Overcoming barriers to health service access: influencing the demand side. *Health Policy Plan*. 2004;19:69-79. Medline:14982885 doi:10.1093/heapol/czh009
- 5 Rutherford ME, Mulholland K, Hill PC. How access to health care relates to under-five mortality in sub-Saharan Africa: systematic review. *Trop Med Int Health*. 2010;15:508-19. Medline:20345556 doi:10.1111/j.1365-3156.2010.02497.x
- 6 Ridde V, Morestin F. A scoping review of the literature on the abolition of user fees in health care services in Africa. *Health Policy Plan*. 2011;26:1-11. doi:10.1093/heapol/czq021. Medline:20547653
- 7 Ansah EK, Narh-Bana S, Asiamah S, Dzordzordzi V, Biantey K, Dickson K, et al. Effect of removing direct payment for health care on utilisation and health outcomes in Ghanaian children: A randomised controlled trial. *PLoS Med*. 2009;6:e1000007. Medline:19127975
- 8 Bassani DG, Arora P, Wazny K, Gaffey MF, Lenters L, Bhutta ZA. Financial incentives and coverage of child health interventions: a systematic review and meta-analysis. *BMC Public Health*. 2013;13 Suppl 3:S30. Medline:24564520 doi:10.1186/1471-2458-13-S3-S30
- 9 Scott K, McMahon S, Yumkella F, Diaz T, George T. Navigating multiple options and social relationships in plural health systems: a qualitative study exploring healthcare seeking for sick children in Sierra Leone. *Health Policy Plan*. 2014;29:292-301. doi:10.1093/heapol/czt016. Medline:23535712
- 10 Gill CJ, Young M, Schroder K, Carvajal-Velez L, McNabb M, Aboubaker S, et al. Bottlenecks, barriers, and solutions: results from multicountry consultations focused on reduction of childhood pneumonia and diarrhoea deaths. *Lancet*. 2013;381:1487-98. Medline:23582720 doi:10.1016/S0140-6736(13)60314-1
- 11 Dhillon RS, Bonds MH, Fraden M, Ndahiro D, Ruxin J. The impact of reducing financial barriers on utilization of a primary health care facility in Rwanda. *Glob Public Health*. 2012;7:71-86. Medline:21732708 doi:10.1080/17441692.2011.593536
- 12 Dettrick Z, Firth S, Jimenez Soto E. Do strategies to improve quality of maternal and child health care in lower and middle income countries lead to improved outcomes? A review of the evidence. *PLoS ONE*. 2013;8:e83070. Medline:24349435 doi:10.1371/journal.pone.0083070

- 13 Littrell M, Moukam LV, Libite R, Youmba JC, Baugh G. Narrowing the treatment gap with equitable access: mid-term outcomes of a community case management program in Cameroon. *Health Policy Plan.* 2013;28:705-16. doi:10.1093/heapol/czs110. Medline:23144228
- 14 Seidenberg PD, Hamer DH, Iyer H, Pilingana P, Siazele K, Hamainza B, et al. Impact of integrated community case management on health-seeking behavior in rural Zambia. *Am J Trop Med Hyg.* 2012;87 Suppl:105-10. Medline:23136285 doi:10.4269/ajtmh.2012.11-0799
- 15 Yeboah-Antwi K, Pilingana P, Macleod WB, Semrau K, Siazele K, Kalesha P, et al. Community case management of fever due to malaria and pneumonia in children under five in Zambia: a cluster randomized controlled trial. *PLoS Med.* 2010;7:e1000340. Medline:20877714 doi:10.1371/journal.pmed.1000340
- 16 Kalyango JN, Alfven T, Peterson S, Mugenyi K, Karamagi C, Rutebemberwa E. Integrated community case management of malaria and pneumonia increases prompt and appropriate treatment for pneumonia symptoms in children under five years in Eastern Uganda. *Malar J.* 2013;12:340. Medline:24053172 doi:10.1186/1475-2875-12-340
- 17 Kalyango JN, Lindstrand A, Rutebemberwa E, Ssali S, Kadobera D, Karamagi C, et al. Increased use of community medicine distributors and rational use of drugs in children less than five years of age in Uganda caused by integrated community case management of fever. *Am J Trop Med Hyg.* 2012;87 Suppl:36-45. Medline:23136276 doi:10.4269/ajtmh.2012.11-0733
- 18 Miller NP, Amouzou A, Tafesse M, Hazel E, Legesse H, Degefie T, et al. Integrated community case management of childhood illness in Ethiopia: implementation strength and quality of care. *Am J Trop Med Hyg.* 2014;91:424-34. Medline:24799369 doi:10.4269/ajtmh.13-0751
- 19 United Nations Development Programme. Human development report 2013. The rise of the south: human progress in a diverse world. New York, NY: United Nations Development Programme; 2013. Available at: [www.hdr.undp.org/en/2013-report](http://www.hdr.undp.org/en/2013-report). Accessed: 1 October 2014.
- 20 United Nations Children's Fund. The state of the world's children 2014 in numbers. Every child counts. Revealing disparities, advancing children's rights. New York, NY: UNICEF; 2014. Available at: [www.unicef.org/sowc/](http://www.unicef.org/sowc/). Accessed: 1 October 2014.
- 21 Requejo J, Bryce J, Victora C. Countdown to 2015. Maternal, newborn and child survival. Building a future for women and children. The 2012 report. Washington DC: World Health Organization and UNICEF; 2012. Available at: <http://www.countdown2015mnch.org/documents/2012Report/2012-Complete.pdf>. Accessed: 1 October 2014.
- 22 Institut National de la Statistique Niger. Enquete quantitative relative à la recherche action sur les pratiques familiales essentielles, la nutrition et les dépenses de consommation des ménages. Niamey: UNICEF; 2012.
- 23 Hamani O, Amadou B. La promotion des *Pratiques Familiales Essentielles* (PFE) au Niger. Analyse socio-anthropologique. Niamey, Niger: Laboratoire d'études et recherches sur les dynamiques sociales et le développement local (LASDEL), 2012.
- 24 Institut National de la Statistique (INS) Niger. UNICEF, ICF International 2012. Enquête démographique et de santé dans les zones d'intervention du programme de coopération de l'UNICEF au Niger, 2012. Rockville, MD, USA: INS, UNICEF and ICF International, 2012.
- 25 Bedford KJA, Sharkey AB. Local barriers and solutions to improve care-seeking for childhood pneumonia, diarrhoea and malaria in Kenya, Nigeria and Niger: a qualitative study. *PLoS ONE.* 2014;9:e100038. Medline:24971642 doi:10.1371/journal.pone.0100038
- 26 Amouzou A, Habi O, Bensaid K; Niger Countdown Case Study Working Group. Reduction in child mortality in Niger: a Countdown to 2015 country case study. *Lancet.* 2012;380:1169-78. Medline:22999428 doi:10.1016/S0140-6736(12)61376-2
- 27 Gaspar MdC, Cossa HA, Ribeiro dos Santos C, Manjate RM, Schoemaker J. Moçambique, Inquérito Demográfico e de Saúde, 1997. Calverton, Maryland, USA: Instituto Nacional de Estatística e Macro International Inc; 1998. Available at: <http://dhsprogram.com/publications/publication-FR92-DHS-Final-Reports.cfm>. Accessed: 1 October 2014.
- 28 Ministério de Saúde. Estrategia Nacional de Promoção da Saúde. Maputo, Mozambique: Ministério de Saúde, 2010.
- 29 Ministério de Saúde, Direcção Nacional de Saúde Pública. Termos de referência para o estabelecimento e funcionamento dos comités de saúde. Maputo, Mozambique: Ministério de Saúde, 2012.
- 30 Nweti & Malaria Consortium. Relatório da pesquisa qualitativa: CAPC sobre o manejo de casos de malária, pneumonia e diarreia na comunidade, Província de Inhambane, Moçambique. Maputo: Nweti & Malaria Consortium, 2010.
- 31 Muiambo A. Consultative mapping of APes' perspectives on motivation, performance, retention and information utilization in Inhambane province. Maputo, Mozambique: Malaria Consortium; 2010. Available at: [http://www.malariaconsortium.org/inscale/local/downloads/consultative\\_mapping.pdf](http://www.malariaconsortium.org/inscale/local/downloads/consultative_mapping.pdf). Accessed: 1 October 2014.
- 32 Martin S. 'Community dialogues for healthy children: encouraging communities to talk.' The learning papers series. London: Malaria Consortium; 2012. Available at: <http://www.malariaconsortium.org/media-downloads/180/>. Accessed: 1 October 2014.
- 33 Saunders RP, Evans MH, Joshi P. Developing a process-evaluation plan for assessing health promotion program implementation: a how-to guide. *Health Promot Pract.* 2005;6:134-47. Medline:15855283 doi:10.1177/1524839904273387

- 34 Leitão J, Martin S. Relatório final da avaliação qualitativa de processo do diálogo comunitário na província de Inhambane, Moçambique. Maputo: DPS–Inhambane & Malaria Consortium, 2014.
- 35 Malaria Consortium. Malaria prevention with ITN, anaemia and malaria parasite prevalence and management of childhood illnesses in three provinces of Mozambique: a representative household survey. London: Malaria Consortium, 2012.
- 36 Malaria Consortium. Evaluation of community-based management of childhood illnesses in Inhambane province, Mozambique. Maputo, Mozambique: Malaria Consortium, 2013.
- 37 Leffers J, Mitchell E. Conceptual model for partnership and sustainability in global health. *Public Health Nurs.* 2011;28:91-102. Medline:21198819 doi:10.1111/j.1525-1446.2010.00892.x
- 38 Lovell SA, Kearns RA, Rosenberg MW. Community capacity building in practice: constructing its meaning and relevance to health promoters. *Health Soc Care Community.* 2011;19:531-40. Medline:21623984 doi:10.1111/j.1365-2524.2011.01000.x
- 39 Strachan DL, Källander K, Ten Asbroek AH, Kirkwood B, Meek SR, Benton L, et al. Interventions to improve motivation and retention of community health workers delivering integrated community case management (iCCM): stakeholder perceptions and priorities. *Am J Trop Med Hyg.* 2012;87(5 Suppl):111-9. Medline:23136286 doi:10.4269/ajtmh.2012.12-0030
- 40 Abbey M, Bartholomew LK, Nonvignon J, Chinbuah MA, Pappoe M, Gyapong M, et al. Factors related to retention of community health workers in a trial on community-based management of fever in children under 5 years in the Dangme West District of Ghana. *Int Health.* 2014;6:99-105. Medline:24532651 doi:10.1093/inthealth/ihu007
- 41 Gilson L. Acceptability, trust and equity. In: McIntyre D, Mooney G, editors. *The economics of health equity.* New York: Cambridge University Press, 2007. p 124–36.
- 42 Tibandebage P, Mackintosh M. The market shaping of charges, trust and abuse: health care transactions in Tanzania. *Soc Sci Med.* 2005;61:1385-95. Medline:16005774 doi:10.1016/j.socscimed.2004.11.072
- 43 King M, Smith A, Gracey M. Indigenous health part 2: the underlying causes of the health gap. *Lancet.* 2009;374:76-85. Medline:19577696 doi:10.1016/S0140-6736(09)60827-8
- 44 Källander K, Tomson G, Nsabagasani X, Sabiiti JN, Pariyo G, Peterson S. Can community health workers and caretakers recognise pneumonia in children? Experiences from western Uganda. *Trans Roy Soc Trop Med Hyg.* 2006;100:956-63. Medline:16455119 doi:10.1016/j.trstmh.2005.11.004
- 45 Taffa N, Chepngeno G. Determinants of health care seeking for childhood illnesses in Nairobi slums. *Trop Med Int Health.* 2005;10:240-5. Medline:15730508 doi:10.1111/j.1365-3156.2004.01381.x
- 46 de Savigny D, Mayombana C, Mwangeni E, Masanja H, Minhaj A, Mkilindi Y, et al. Care-seeking patterns for fatal malaria in Tanzania. *Malar J.* 2004;3:27. Medline:15282029 doi:10.1186/1475-2875-3-27
- 47 Källander K, Nsungwa-Sabiiti J, Peterson S. Symptom overlap for malaria and pneumonia—policy implications for home management strategies. *Acta Trop.* 2004;90:211-4. Medline:15177148 doi:10.1016/j.actatropica.2003.11.013
- 48 Kalyango JN, Rutebemberwa E, Karamagi C, Mworozzi E, Ssali S, Alfven T, et al. High adherence to antimalarials and antibiotics under integrated community case management of illness in children less than five years in eastern Uganda. *PLoS ONE.* 2013;8:e60481. Medline:23555980 doi:10.1371/journal.pone.0060481
- 49 Mukanga D, Tibenderana JK, Peterson S, Pariyo GW, Kiguli J, Waiswa P, et al. Access, acceptability and utilization of community health workers using diagnostics for case management of fever in Ugandan children: a cross-sectional study. *Malar J.* 2012;11:121. Medline:22521034 doi:10.1186/1475-2875-11-121
- 50 Kalyango JN, Rutebemberwa E, Alfven T, Ssali S, Peterson S, Karamagi C. Performance of community health workers under integrated community case management of childhood illnesses in eastern Uganda. *Malar J.* 2012;11:282. Medline:22905758 doi:10.1186/1475-2875-11-282
- 51 Rutebemberwa E, Kadobera D, Katureebe S, Kalyango JN, Mworozzi E, Pariyo G. Use of community health workers for management of malaria and pneumonia in urban and rural areas in eastern Uganda. *Am J Trop Med Hyg.* 2012;87 Suppl:30-5. Medline:23136275 doi:10.4269/ajtmh.2012.11-0732
- 52 Farnsworth SK, Böse K, Fajobi O, Souza PP, Peniston A, Davidson LL, et al. Community engagement to enhance child survival and early development in low- and middle-income countries: an evidence review. *J Health Commun.* 2014;19 Supplement 1:67-88. Medline:25207448 doi:10.1080/10810730.2014.941519
- 53 Rifkin SB. Lessons from community participation in health programmes: a review of the post Alma-Ata experience. *Int Health.* 2009;1:31-6. Medline:24036293 doi:10.1016/j.inhe.2009.02.001
- 54 Hamer DH, Brooks ET, Semrau K, Pilingana P, MacLeod WB, Siizele K, et al. Quality and safety of integrated community case management of malaria using rapid diagnostic tests and pneumonia by community health workers. *Pathog Glob Health.* 2012;106:32-9. Medline:22595272 doi:10.1179/1364859411Y.0000000042

# Assessing the impact of integrated community case management (iCCM) programs on child mortality: Review of early results and lessons learned in sub-Saharan Africa

Agbessi Amouzou<sup>1</sup>, Saul Morris<sup>2</sup>,  
Lawrence H Moulton<sup>3</sup>, David  
Mukanga<sup>4</sup>

<sup>1</sup> Data and Analytics, UNICEF, New York, NY, USA

<sup>2</sup> Children's Investment Fund Foundation, London, UK

<sup>3</sup> Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

<sup>4</sup> Bill & Melinda Gates Foundation, Seattle, WA, USA

## Correspondence to:

Agbessi Amouzou, PhD  
Data and Analytics  
UNICEF  
3 UN Plaza  
New York, NY 10017, USA  
aamouzou@unicef.org

**Aim** To accelerate progress in reducing child mortality, many countries in sub-Saharan Africa have adopted and scaled-up integrated community case management (iCCM) programs targeting the three major infectious killers of children under-five. The programs train lay community health workers to assess, classify and treat uncomplicated cases of pneumonia with antibiotics, malaria with antimalarial drugs and diarrhea with Oral Rehydration Salts (ORS) and zinc. Although management of these conditions with the respective appropriate drugs has proven efficacious in randomized trials, the effectiveness of large iCCM scale-up programs in reducing child mortality is yet to be demonstrated. This paper reviews recent experience in documenting and attributing changes in under-five mortality to the specific interventions of a variety of iCCM programs.

**Methods** Eight recent studies have been identified and assessed in terms of design, mortality measurement and results. Impact of the iCCM program on mortality among children age 2–59 months was assessed through a difference in differences approach using random effect Poisson regression.

**Results** Designs used by these studies include cluster randomized trials, randomized stepped-wedge and quasi-experimental trials. Child mortality is measured through demographic surveillance or household survey with full birth history conducted at the end of program implementation. Six of the eight studies showed a higher decline in mortality among children 2–59 months in program areas compared to comparison areas, although this acceleration was statistically significant in only one study with a decline of 76% larger in intervention than in comparison areas.

**Conclusion** Studies that evaluate large scale iCCM programs and include assessment of mortality impact must ensure an appropriate design. This includes required sample sizes and sufficient number of program and comparison districts that allow adequate inference and attribution of impact. In addition, large-scale program utilization, and a significant increase in coverage of care seeking and treatment of targeted childhood illnesses are preconditions to measurable mortality impact. Those issues need to be addressed before large investments in assessing changes in child mortality is undertaken, or the results of mortality impact evaluation will most likely be inconclusive.



The fourth Millennium Development Goal (MDG4) of reducing child mortality by two-thirds provided an impetus to countries to develop and scale-up focused strategies and programs to accelerate reduction in child mortality with increased international support [1]. However, in the mid-2000s, slow progress was observed in many countries, especially in sub-Saharan Africa where child mortality is highest. This meant that focus must not only be directed at scaling up high impact life-saving interventions targeting main killers of children, but also on the monitoring and evaluation of these programs [1–3]. Integrated community case management (iCCM) is one such approach that is expected to produce immediate impact on mortality if implemented in optimal conditions, given that it directly tackles the key proximate determinants of child survival. It increases access of children to prompt and effective care and treatment for the three main killer infections using effective interventions, while also managing acute malnutrition. Therefore, if high quality iCCM is properly delivered by well-trained community health workers, targeting children who are most in need (those with limited or no access to care), and if the program is utilized by a large portion of the target population, accelerated reduction in child mortality should be expected [4,5]. This impact model is theoretically plausible and appealing, especially given that each individual intervention included in iCCM has already been proven efficacious in controlled trials.

Countries in sub-Saharan Africa, where the burden of child death is the largest, were therefore encouraged to adopt and scale-up iCCM, focusing on pneumonia, diarrhea and malaria, and in many cases also malnutrition [6]. However, there is currently no demonstrated impact of large scale iCCM on child survival in Africa. The success of efficacy trials of individual interventions does not always translate into effectiveness of either the individual interventions or integrated programs. This can be explained by health system constraints and demand side barriers that are often faced in large scale “real-life” programs.

Furthermore, previous impact evaluation studies of CCM were mainly conducted in Asian contexts, focusing in general on a single or two diseases [7]. Three meta-analyses of CCM of pneumonia conducted between 1992 and 2010 included only one study from a country in sub-Saharan Africa, among the 15 countries reviewed [8–10]. More recent studies have demonstrated the feasibility of CCM for a single disease (or two diseases) in Africa and usefulness of using community health workers for the provision of CCM [11–15].

A recent review of the evidence of the effectiveness of CCM in reducing pneumonia burden suggested the lack of evidence in Africa and poor adherence of community health workers to the guidelines [16]. The review focused mostly

on pneumonia and did not include several other studies that showed feasibility of the use of community health workers (CHWs) and acceptable quality of care provided by CHWs in comparison to care provided at first level health facilities [17,18]. One could view iCCM of childhood illnesses as an adaptation of the integrated management of childhood illnesses (IMCI) program at community level with focus on community health worker. In 2010, UNICEF and WHO endorsed the iCCM program as a key strategy for reaching larger populations with effective care and reducing inequity [4].

However, the implementation of IMCI has not always been associated with demonstrable changes in child mortality [19,20]. The multi-country evaluation of the IMCI in Bangladesh, Brazil, Peru, Tanzania, and Uganda used various designs across these countries but showed positive impact of child mortality in Tanzania only [21]. In Bangladesh, where the evaluation used the strongest design, based on a cluster randomized trial with health facility catchment areas randomized to intervention and comparison areas, no statistically significant effect was found on child mortality. This absence of demonstrable effect stands in contrast to positive effects at health facility level in terms of health worker skills and health system support, and at community level in terms of family and community practices [22].

Therefore, the large support and investment in the scale-up of iCCM in Africa was under some pressure to demonstrate mortality impact of the program within a short time period. Countries and implementing partners faced a dual challenge. They needed to ensure the implementation of high quality large scale iCCM programs, targeting mothers and children that had hitherto poor or no access to health care. They also needed to be open to an evaluation design that allowed rigorous assessment of the impact of the program on child mortality. The evaluation of a large scale “real-life” program such as iCCM comes with added challenges that must be borne in mind at the design stage, especially when a mortality impact assessment component is included. The opportunities for a randomized design are rare, and even quasi-experimental designs are becoming increasingly difficult to implement, given the difficulty in identifying adequate comparison areas. In the rare cases where it is possible to randomize, there is also a risk to external validity as the evaluation may become so controlled and context specific that its generalizability can be questioned [20,23,24].

In 2013, the Bill & Melinda Gates Foundation (BMGF) and UNICEF launched an initiative to conduct a comprehensive review of the evidence in support of iCCM in Sub-Saharan Africa, take stock of the experience and lessons learned in terms of program implementation and evaluation. As a part of this initiative, we reviewed recent studies

or program evaluations that incorporated an assessment of mortality impact of iCCM, whether already published or unpublished. We assessed the strength of the evidence in these studies by rigorously looking at how the mortality component of the study was designed and implemented within the overall evaluation design. We provide a summary of lessons learned and recommendation for iCCM mortality impact evaluation designs in the future.

## METHODS

We started the review by searching the literature for studies that assessed the mortality impact of integrated community case management programs. We searched PubMed, EMBASE, BIOSIS, Web of Science and Cochrane library to identify relevant studies reported in English, and published at any time until September 2013. The subject headings are listed in **Box 1**.

This search did not identify any study that actually tested the impact of iCCM based on the three main diseases of interest. Only one study, conducted in Ghana, tested the

**Box 1** Subject headings for systematic search of the studies that evaluated the impact of the iCCM programs on child mortality

Community Health Aide and Mortality; Community Health Worker and Mortality; Village Health Worker; Volunteer Health Worker; Malaria Pneumonia Diarrhea Integrated; malaria and pneumonia and diarrhea and impact; Village Health Volunteer; Home Management of Fever and Impact; Community Health Volunteer; Lay Health Worker; Community Case Management and Mortality; and, integrated community case management and mortality.

management of pneumonia and malaria vs malaria alone, using a comparison area with no iCCM and cluster randomized control design [25]. We then contacted Non-governmental organizations (NGOs) or academic institutions known to have conducted recent evaluations of iCCM programs that included child mortality assessment. Although these studies were not yet published, all data collection had been completed and most were at the data analysis stage or at the report writing stage. We used three criteria for retention of a study for review: (i) the evaluation design must include an intervention area where the iCCM is implemented and a comparison area, (ii) the evaluation must include rigorous assessment of mortality impact through primary data collection using either household survey with full birth or pregnancy history, or population surveillance; and (iii) the researchers must be willing to share their micro-data on mortality to allow data quality assessment of the data sets and reanalysis.

As criteria for mortality data quality, we excluded all studies in which the measured baseline mortality rate was substantially lower than the mortality of the entire rural population of the same country at the same time. We did not consider studies in which only a handful of providers had been trained, regarding them as unlikely to be informative about the impact of large-scale national or sub-national programs. Eventually, we identified a total of eleven recently completed iCCM impact evaluation studies. Of these studies, three were excluded for poor mortality data quality (South Sudan), different mortality assessment method (Sierra Leone/IRC), or unavailability of micro data sets (Uganda Eastern). Only the remaining eight studies are discussed in this paper. **Table 1** includes the list of the eight

**Table 1.** Evaluation studies included in the analysis

COUNTRY	PARTNER SUPPORT	STUDY YEAR	STUDY TITLE
Burkina Faso	Groupe de Recherche Action en Santé and WHO/Tropical Disease Research (TDR)	2010–2013	Home and community management of fevers/malaria and pneumonia in children under-five: a cluster randomised controlled trial of an integrated approach in a rural district of Burkina Faso
Cameroon	Population Services International	2009–2012	Cameroon CCM Endline Evaluation 2012: outcomes and impact in Doumé and Nguelemendouka districts after three years of program implementation
Ethiopia	Johns Hopkins University	2011–2013	Independent evaluation of the Integrated Community Case Management of common childhood illnesses in Oromia region, Ethiopia
Ghana	Ghana Health Services and WHO/Tropical Disease Research (TDR)	2006–2009	Impact of Community Management of Fever (Using Antimalarials With or Without Antibiotics) on Childhood Mortality: A Cluster-Randomized Controlled Trial in Ghana
Sierra Leone	UNICEF	2010–2012	Health for the Poorest quintile – Sierra Leone
Uganda (Central)	UNICEF and Malaria Consortium	2010–2011	Health for Poorest Quintile Project – Uganda
Uganda (Western)	Malaria Consortium	2009–2012	Improving Access For Under-Fives To Life Saving Treatment Through Integrated Community Case Management For Malaria, Pneumonia And Diarrhoea – Uganda
Zambia	Malaria Consortium	2010–2012	Improving Access For Under-Fives To Life Saving Treatment Through Integrated Community Case Management For Malaria, Pneumonia And Diarrhoea – Zambia

studies, along with the organization that carried out the evaluation and the study year.

Six of the eight studies included an endline mortality data based on household survey with full birth history module administered to women aged 15–49. Full birth history module consists of questions to women age 15–49 on all live births they ever had, the date of birth, and the survival status for each birth. For children who had died, age at death was also collected. The full birth history data has the advantage of allowing direct child mortality computation on retrospective periods up to 15–25 years preceding the survey, thus providing the possibility of measuring mortality on defined baseline and endline periods. We therefore used endline mortality data to compute mortality among children 2–59 months at baseline and endline, in intervention and comparison areas. The use of a single data set to measure child mortality at baseline and endline is very convenient. It avoids differential measurement errors that could have resulted from the use of two different data sets. The age group 2–59 months was used, because it is the main target of the iCCM program. The mortality measurement period at endline was determined from the time when at least 80% of the community health workers (CHWs) were trained in iCCM and deployed to provide services. This period was retained to ensure that mortality was assessed when the program was functioning at full scale and likely to be producing effect in the target population [20]. Once the endline measurement period was defined, we retrospectively defined a baseline period that was anterior to the program implementation and was identical in length and season. This was necessary to rule out any seasonality effect on the assessment of the mortality impact.

We used a cross-sectional random effects Poisson model to estimate the ratio of ratios in death occurrence among children aged 2–59 months between baseline and endline, and also across intervention and comparison areas. The ratio was estimated as the interaction coefficient between the time (endline vs baseline) and intervention (intervention area vs comparison area). The analysis adjusted for clustering at district level by introducing a district-level random intercept. Computations were conducted using STATA 12.0.

## RESULTS

### Overall design of mortality studies

The eight recent studies reviewed cover West and Central Africa (Burkina Faso, Cameroon, Ghana and Sierra Leone) and East Africa (Ethiopia, Uganda and Zambia) and thus represent a variety of African contexts (Tables 1 and 2). They were all conducted at subnational level, ranging from a few to many districts, and do not represent evaluations

of their entire national iCCM scale-up programs. Although all the studies were conducted to determine the effectiveness of iCCM in reducing child mortality, some countries such as Ethiopia have already moved to full national scale-up based on recommendations from WHO and UNICEF [4]. Three of the studies (Burkina Faso, Ethiopia and Ghana) used randomized controlled trial design and the remaining used quasi-experimental design with non-random selection of intervention and comparison areas. The three studies that used the strongest evaluation design have some particularities worth noting. The Burkina Faso and Ghana studies were designed and carried out in collaboration with WHO/TDR in a district each, covering populations of respectively 380 000 and 1 10 000 individuals. Villages or groups of communities served as clusters and were randomized to intervention and control areas. In addition, the Ghana study included only CCM of fever, while the Burkina Faso study included CCM of fever and pneumonia. Both studies used a randomized stepped-wedge approach and ran for approximately three years. Further details of the approach are described elsewhere [25]. To ensure analytic comparability to other studies reviewed, the analysis of data from the Ghana study was restricted to the period when fever was managed with an antimalarial drug in combination with antibiotics. In Burkina Faso, the analysis was restricted to the period when CCM of both fever and pneumonia was implemented in the intervention area, while the control area received no CCM. The Ethiopia study was conducted by researchers from the Johns Hopkins University in two zones covering 31 districts and a population larger than 4.2 million. All 31 districts were randomly assigned to intervention and comparison areas. Although the intervention areas received the enhanced iCCM program, which was initiated in Ethiopia in 2010 and included CCM of all three illnesses (malaria, pneumonia and diarrhea), the comparison areas received the existing CCM of malaria and diarrhea. Thus, in theory, the main difference between the intervention and the comparison areas was the introduction of CCM for pneumonia in the intervention area. However, the iCCM program in Ethiopia had been completely redesigned, with five day refresher training of the community health workers, continuous provision of drugs and commodities, and improved monitoring and supervision. Details about the Ethiopia study are provided elsewhere [18].

The remaining five studies used a quasi-experimental design, with only a few districts where intervention was implemented and a few districts for comparison. In general, the number of intervention districts was higher than the number of comparison districts.

Sample sizes varied tremendously across the studies. Of the studies that used household surveys with full birth history

for mortality assessment, the study in Ethiopia had the largest sample size (28 000 households). The smallest sample size was assembled in Sierra Leone. The two studies conducted in DSS sites covered the entire population of the district.

## Mortality measurement

The Burkina Faso and Ghana studies were conducted in a district with on-going demographic surveillance system and therefore relied on the surveillance approach for mortality assessment. In both countries, a biannual census of the entire study district was conducted, complemented with continuous monitoring of births and deaths by key informants. While surveillance of births and deaths in communities generally suffers from under-reporting and leads to child mortality rates that can be grossly underestimated, complementing the approach with biannual census of the target population helps to improve completeness [26,27]. However, unless a well-functioning DSS is in place, it is impractical to rely on vital events surveillance for mortality assessment in most African countries. All other six studies have therefore relied on full birth histories for child mortality assessment.

**Table 2** presents the length of the mortality measurement period for each study. Across all eight studies, this period ranges from 11 months in the Burkina Faso, Ghana and Central Uganda studies to 35 months in the Cameroon study. Except in Cameroon, this period is under two-years for all studies and under one year for three studies (Burkina Faso, Ghana, and Uganda Central). It should be noted that for Burkina Faso and Ghana the period represents only the first phase in the stepped wedge design and does not represent the entire duration of the implementation scheme.

**Table 2** also presents the estimate of the mortality rate ratios among children age 2–59 months between intervention and comparison areas. Six of the eight studies show a ratio below 1 suggesting consistently larger mortality decline among children 2–59 months in intervention compared to comparison areas. However, this acceleration is statistically significant only in the study in Ghana, where there was an excess decline of 76% in intervention compared to comparison areas. Interestingly, in Cameroon and Zambia mortality among children 2–59 months appears to have declined much more slowly in intervention areas than in comparison areas.

**Table 2.** Characteristics of the design of iCCM) evaluation studies

COUNTRY	STUDY DESIGN	NUMBER OF INTERVENTION DISTRICTS/ CLUSTERS	NUMBER OF COMPARISON DISTRICTS/ CLUSTERS	TYPE OF CHWs PROVIDING iCCM	METHOD FOR MORTALITY MEASUREMENT	SAMPLE SIZE FOR THE ENDLINE MORTALITY SURVEY (No. HHs)	MORTALITY MEASUREMENT PERIOD	DIFFERENCE IN DIFFERENCES ESTIMATE OF MORTALITY RATE RATIO AMONG CHILDREN AGE 2–59 MO AND 95%CI
Burkina Faso	RCT	19 × 19*	19*	Volunteers	DSS	76 000#	11 mo	0.95 (0.57–1.59)
Cameroon	Quasi-experimental	2	1	Volunteers	Census with FBH	18 177	35 mo	1.05 (0.85–1.29)
Ethiopia	RCT	16	15	Paid Government CHW	Survey with FBH	28 000	18 mo	0.85 (0.62–1.18)
Ghana	RCT	39 × 37†	38†	Volunteers	DSS	22 000#	11 mo	0.24 (0.06–0.96)
Sierra Leone	Quasi-experimental	2	2	Volunteers	Survey with FBH	6 000	18 mo	0.79 (0.41–1.51)
Uganda (Central)	Quasi-experimental	8	3	Volunteers	Survey with FBH	8 000	11 mo	0.70 (0.18–2.78)
Uganda (Western)	Quasi-experimental	9	3	Volunteers	Survey with FBH	8 000	22 mo	0.66 (0.32–1.40)
Zambia	Quasi-experimental	4	3	Volunteers	Survey with FBH	8 000	16 mo	1.45 (0.86–2.46)

iCCM – integrated community case management, CHW – community health worker, HH – households, FBH – full birth history, DSS – Demographic Surveillance Systems, mo – months

\*in Burkina Faso, 57 clusters consisting of villages were randomized to three arms for a stepped wedge design: during the initial phase, 19 clusters were randomly allocated to intervention areas consisting of CCM of fever with antimalarial (artemeter/lumefantrine) and pneumonia with antibiotics (Co-trimoxazole); 19 clusters were allocated to another intervention areas consisting of CCM of fever with antimalarial drug, and 19 clusters were allocated to control.

†In Ghana, 114 clusters consisting of group of communities were randomized to three arms for a stepped wedge design: during the initial phase 39 clusters to intervention consisting of CCM of fever with an antimalarial (Artesunate Amodiaquine) plus an antibiotic (amoxicillin), 37 clusters to intervention consisting of CCM of fever with antimalarial only (Artesunate Amodiaquine), and 38 clusters served as control.

#Represents an estimate of the total number of households in the district where the demographic surveillance system is implemented. It was determined by dividing the total population by an estimated average household size of 5.

## DISCUSSION

Although iCCM programs are being scaled up in many African nations, the effectiveness of the strategy in accelerating decline in mortality among children under-five is yet to be fully demonstrated. We reviewed recent studies that attempted to measure the mortality impact of iCCM in the African context. A total of eight studies were identified and included in the current review. Six of these studies assessed real-life iCCM programs that included the management of the three high-burden illnesses – pneumonia, malaria and diarrhea. Two studies were implemented and carried out in a demographic surveillance system site, assessing the effectiveness of CCM of fever (and pneumonia) with antimalarial drugs and antibiotics. The eight studies used different evaluation designs, including randomized cluster designs, randomized stepped-wedge designs and quasi-experimental designs. The large heterogeneity in the programs being evaluated and the evaluations design precluded a meta-analysis of the mortality results. However, six of the eight studies showed greater decline in mortality among children 2–59 months in intervention areas compared to comparison areas, although this acceleration was statistically significant in only one study.

This review demonstrated that some strategies have worked well in evaluating the mortality impact of iCCM programs. First, the collection of mortality data using full birth histories is a promising approach for the evaluation of iCCM programs.

Birth history data, collected at a single moment in time towards the end of the program implementation period, permits the reconstruction of the evolution of mortality in the target population over at least the previous two decades, with the possibility of zooming in on specific periods. The ability to understand mortality trends before the introduction of the iCCM program aids the interpretation of the evaluation findings. The fact that both pre-implementation and implementation data are collected from the same households favours a valid statistical analysis. Second, in some of the studies, the intervention was introduced in a mosaic of small geographic areas, rather than in a few large areas such as districts. Those intervention ‘clusters’ were then compared to a similar number of non-program or ‘comparison’ areas. The strategy permitted relatively straightforward inference about the likely impact of the same intervention across a larger population. It also generally resulted in intervention and comparison groups starting at similar levels of pre-program mortality. Finally, some studies included the collection of a comprehensive data set including not only mortality but also changes in treatment coverage (for both iCCM and non-iCCM interventions) and detailed program utilization data. This greatly facilitated the interpretation of the mortality findings [28,29].

However, we noted several limitations in the impact evaluation studies. Collecting birth histories in minimally literate populations requires careful training of fieldworkers and intensive supervision of the data collection process, which was not achieved in all cases. Since it is difficult to detect poor quality mortality data after it has been collected, we relied entirely on an assessment of the plausibility of the levels of mortality assessed at baseline; likely, some moderately poor quality data passed this test, which lacks sensitivity. Two studies took advantage of existing Demographic Surveillance Systems (DSS) but these are special opportunities that are not readily available everywhere or in large areas.

There were basic flaws in the evaluation design of the majority of studies, making it very difficult to draw any inference from the results. Comparison areas were either different from the interventions at baseline, and/or the program was allocated to a very small number of relatively large geographic areas, making it impossible to rule out the influence of idiosyncratic local changes on the findings. It is also possible that the comparison areas received some form of CCM, as was the case in Ethiopia. In several cases, the program delivered in the intervention areas was so different from the standard model of iCCM that the value of comparing across studies has to be questioned. This is one of the main reasons why we avoided an attempt at meta-analysis of all 8 studies to establish an effectiveness of iCCM in sub-Saharan Africa in “real life” condition.

Because mortality is a rare event, virtually none of the studies was adequately powered to detect a statistically significant impact of the program following a short implementation period. Power calculations, which are a basic step in the development of an evaluation plan, were either simply not done, or were based on out-of-date or over-optimistic assumptions, or did not take the evaluation design into account. In addition, program exposure periods were either far too short to accumulate sufficient numbers of deaths in the study population, and/or did not give the targeted populations time to get used to using the new providers.

The programs took place in areas with very rapidly evolving health systems and epidemiological contexts. Thus, they often no longer met basic assumptions required to demonstrate mortality impact as described in the paragraph below.

These early iCCM mortality impact evaluation studies provide several lessons for future evaluations. iCCM programs intervene to directly prevent deaths from the most common life-threatening diseases in resource-constrained communities. As such, it might be assumed that iCCM programs will result in lower mortality rates. However, in order for this to be demonstrated, three sets of conditions must be

met. First, the program must be delivered at an intensity sufficient to generate impact at a population level. The theory of change for an iCCM program indicates that, in order to generate mortality impact, there must be a substantial change in the proportion of sick children in the target population who receive safe, effective and timely treatment. In order for treatment coverage to increase, utilization of the new providers must be high and their service quality reliably adequate. Furthermore, the number of iCCM providers deployed must be sufficient to have substantially increased overall density of service delivery points. These basic preconditions have not always been met. Second, iCCM program design must be appropriate for the context, including treatment for all of the most important life-threatening conditions, medicines that are locally effective, effective targeting at children who are truly at risk of dying, and a relative scarcity of alternative providers. This set of assumptions has also not universally been met, with many programs continuing to use cotrimoxazole for the treatment of pneumonia, for example, in spite of ample evidence of bacterial resistance to cotrimoxazole. In addition, some studies have shown that substantial proportion of children with non-severe pneumonia may only have wheeze or non-bacterial pneumonia and do not require antibiotics treatment at all [30]. Third, the methods of assessing mortality impact must be reliable, precise and generalizable.

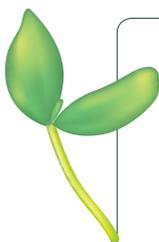
Mortality impacts in the studies reviewed vary considerably, from a (statistically significant) 76% reduction in mortality, to a (non-significant) 43% increase in mortality, with a median reduction of 21%. We believe that much of this apparent variation is due to inappropriate program and evaluation design. Mortality measurement is a very specialized activity requiring well-trained interviewers, close supervision of fieldwork, and — above all — very large survey sample sizes. Measuring directly mortality for impact assessment requires a large investment.

There is a logical chain of iCCM results in which high utilization of quality services is the precondition for high coverage of safe, effective, and timely treatment of sick children. The latter is, in turn, the precondition for observing reduced mortality. Mortality measurement should not be undertaken unless it can be demonstrated that the other preconditions have already been met. As a rule, mortality outcomes should probably not be considered for any programs likely to have been implemented for less than two years.

Because of rapidly changing health systems and epidemiological contexts, it is much easier to interpret mortality data if companion data on treatment coverage, program utilization, and other contextual variables were also collected. Those indicators are desirable for program monitoring in any case.

Program design considerations often conflict with the basic premises of good evaluation. For example, one program decided to introduce iCCM in two districts and compare their mortality experience with one comparison district. This “2 versus 1” comparison is known in the evaluation literature to produce results which are impossible to interpret. Likewise, pushing programs into the highest mortality districts inevitably means that comparison areas will not be truly comparable at baseline, creating extreme difficulties of interpretation of evaluation findings later on.

If a strong evaluation context can be guaranteed, full birth histories — or, better still, full *pregnancy* histories — are the ideal way of collecting data on child mortality. They should be analyzed by compartmentalizing both deaths and person-years at risk into multiple sequential time periods. A single birth history survey can produce information both for the program implementation period and for the pre-program period.



**Acknowledgements:** We thank the principal investigators of the specific studies reviewed in the paper for making available their micro datasets for analysis. These include Sodiomon B. Simira, Megan Littrel, John Gyapong, Theresa Diaz, Geoffrey Namara and Helen Counihan. We also thank Jon Pedersen for providing the mortality data that we used in the data quality assessment.

**Funding:** No funding support was obtained for this review.

**Authorship declaration:** SM conceptualized the review, SM and AA conducted the analysis, AA drafted the paper. DM conducted the literature search and LHM provided technical assistance in the analysis. All authors reviewed the final manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). They report no competing interest.

- 1 United Nations. The Millennium Development Goals Report. New York: UN, 2014.
- 2 Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS; Bellagio Child Survival Study Group. How many child deaths can we prevent this year? *Lancet*. 2003;362:65-71. Medline:12853204 doi:10.1016/S0140-6736(03)13811-1
- 3 Bryce J, el Arifeen S, Pariyo G, Lanata CF, Gwatkin D, Habicht JP, et al. Reducing child mortality: can public health deliver? *Lancet*. 2003;362:159-64. Medline:12867119 doi:10.1016/S0140-6736(03)13870-6
- 4 World Health Organization, United Nation Children's Fund. Integrated community case management (iCCM). Geneva: WHO & UNICEF, 2012.
- 5 Bryce J, Victora CG, Boerma T, Peters DF, Black RE. Evaluating the scale-up for maternal and child survival: a common framework. *Int Health*. 2011;3:139-46. Medline:24038362 doi:10.1016/j.inhe.2011.04.003
- 6 Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet*. 2012;379:2151-61. Medline:22579125 doi:10.1016/S0140-6736(12)60560-1
- 7 Bang AT, Bang RA, Tale O, Sontakke P, Solanki J, Wargantiwar R, et al. Reduction in pneumonia mortality and total childhood mortality by means of community-based intervention trial in Gadchiroli, India. *Lancet*. 1990;336:201-6. Medline:1973770 doi:10.1016/0140-6736(90)91733-Q
- 8 Sazawal S, Black RE. Meta-analysis of intervention trials on case management of pneumonia in community settings. *Lancet*. 1992;340:528-33. Medline:1354286 doi:10.1016/0140-6736(92)91720-S
- 9 Sazawal S, Black RE; Pneumonia Case Management Trials Group. Effect of pneumonia case management on mortality in neonates, infants, and preschool children: a meta-analysis of community-based trials. *Lancet Infect Dis*. 2003;3:547-56. Medline:12954560 doi:10.1016/S1473-3099(03)00737-0
- 10 Theodoratou E, Al-Jilaihawi S, Woodward F, Ferguson J, Jhass A, Balliet M, et al. The effect of case management on childhood pneumonia mortality in developing countries. *Int J Epidemiol*. 2010;39 Suppl. 1:i155-71. Medline:20348118 doi:10.1093/ije/dyq032
- 11 Marsh DR, Gilroy KE, Van de Weerd R, Wansi E, Qazi S. Community case management of pneumonia: at a tipping point? *Bull World Health Organ*. 2008;86:381-9. Medline:18545741 doi:10.2471/BLT.07.048462
- 12 Ajayi IO, Browne EN, Bateganya F, Yar D, Happi C, Falade CO, et al. Effectiveness of artemisinin-based combination therapy used in the context of home management of malaria: a report from three study sites in sub-Saharan Africa. *Malar J*. 2008;7:190. Medline:18822170 doi:10.1186/1475-2875-7-190
- 13 Mukanga D, Tiono AB, Anyorigiya T, Kallander K, Konate AT, Oduro AR, et al. Integrated community case management of fever in children under five using rapid diagnostic tests and respiratory rate counting: a multi-country cluster randomized trial. *Am J Trop Med Hyg*. 2012;87:21-9. Medline:23136274 doi:10.4269/ajtmh.2012.11-0816
- 14 Winch PJ, Gilroy KE, Wolfheim C, Starbuck ES, Young MW, Walker LD, et al. Intervention models for the management of children with signs of pneumonia or malaria by community health workers. *Health Policy Plan*. 2005;20:199-212. Medline:15965032 doi:10.1093/heapol/czi027
- 15 Yeboah-Antwi K, Pilingana P, Macleod WB, Semrau K, Siazeele K, Kalesha P, et al. Community case management of fever due to malaria and pneumonia in children under five in Zambia: a cluster randomized controlled trial. *PLoS Med*. 2010;7:e1000340. Medline:20877714 doi:10.1371/journal.pmed.1000340
- 16 Druetz T, Siekmans K, Goossens S, Ridde V, Haddad S. The community case management of pneumonia in Africa: a review of the evidence. *Health Policy Plan*. 2013. Epub ahead of print. Medline:24371218 doi:10.1093/heapol/czt104
- 17 Gilroy KE, Callaghan J, Cardemil C, Nsona H, Amouzou A, Mtimuni A, et al. Quality of sick child care delivered by community-based health workers in Malawi. *Health Policy Plan*. 2013;28:573-85. Medline:23065598 doi:10.1093/heapol/czs095
- 18 Miller NP, Amouzou A, Tafesse M, Hazel E, Legasse H, Degefie T, et al. Integrated community case management of childhood illness in Ethiopia: Implementation strength and quality of care. *Am J Trop Med Hyg*. 2014;91:424-34. Medline:24799369 doi:10.4269/ajtmh.13-0751
- 19 Bryce J, Victora CG, Habicht JP, Vaughan JP, Black RE. The multicountry evaluation of integrated management of childhood illness strategy: lessons for the evaluation of public health interventions. *Am J Public Health*. 2004;94:406-15. Medline:14998804 doi:10.2105/AJPH.94.3.406
- 20 Bryce J, Victora C. Ten methodological lessons from the multi-country evaluation of the integrated management of childhood illness. *Health Policy Plan*. 2005;20 Suppl 1:i94-105. Medline:16306075 doi:10.1093/heapol/czi056
- 21 Armstrong Schellenberg JR, Adam T, Mshinda H, Masanja H, Kabadi G, Mukasa O, et al. Effectiveness and cost of facility-based Integrated Management of Childhood Illness (IMCI) in Tanzania. *Lancet*. 2004;364:1583-94. Medline:15519628 doi:10.1016/S0140-6736(04)17311-X
- 22 Arifeen SE, Hoque DME, Akter T, Rahman M, Hoque ME, Begum K, et al. Effect of the Integrated Management of Childhood Illness strategy on childhood mortality and nutrition in a rural area in Bangladesh: a cluster randomised trial. *Lancet*. 2009;374:393-403. Medline:19647607 doi:10.1016/S0140-6736(09)60828-X
- 23 Victora CG, Habicht JP, Bryce J. Evidence-Based Public Health: Moving Beyond Randomized Trials. *Am J Public Health*. 2004;94:400-5. Medline:14998803 doi:10.2105/AJPH.94.3.400
- 24 Victora CG, Black RE, Boerma T, Bryce J. Measuring impact in the Millennium Development Goal era and beyond: a new approach to large-scale effectiveness evaluations. *Lancet*. 2011;377:85-95. Medline:20619886 doi:10.1016/S0140-6736(10)60810-0

- 25 Chinbuah MA, Kager PA, Abbey M, Gyapong M, Awini E, Nonvignon J, et al. Impact of community management of fever (using antimalarials with or without antibiotics) on childhood mortality: a cluster-randomized controlled trial in Ghana. *Am J Trop Med Hyg.* 2012;87(5 Suppl):11-20. Medline:23136273 doi:10.4269/ajtmh.2012.12-0078
- 26 Hill K. Approaches to the measurement of childhood mortality: a comparative review. *Popul Index.* 1991;57:368-82. Medline:12284630 doi:10.2307/3643873
- 27 Amouzou A, Banda B, Kachaka W, Joos O, Kanyuka M, Hill K, et al. Monitoring child mortality through community health worker reporting of births and deaths in Malawi: validation against a household mortality survey. *PLoS ONE.* 2014;9:e88939. Medline:24558453 doi:10.1371/journal.pone.0088939
- 28 Diaz T, Guenther T, Oliphant NP, Muriz M. iCCM Symposium impact outcome evaluation thematic group. A proposed model to conduct process and outcome evaluations and implementation research of child health programs in Africa using integrated community case management as an example. *J Glob Health.* 2014;4:020409. doi:10.7189/jogh.04.020409
- 29 Guenther T, Barberá LZ, Oliphant N, Dale M, Raharison S, Miller L, et al. Routine monitoring systems for integrated community case management programs: lessons from 18 countries in sub-Saharan Africa. *J Glob Health.* 2014;4:020301. doi:10.7189/jogh.04.020301
- 30 Hazir T, Nisar YB, Abbasi S, Ashraf YP, Khurshid J, Tariq P, et al. Comparison of oral amoxicillin with placebo for the treatment of world health organization-defined nonsevere pneumonia in children aged 2-59 months: a multicenter, double-blind, randomized, placebo-controlled trial in Pakistan. *Clin Infect Dis.* 2011;52:293-300. Medline:21189270 doi:10.1093/cid/ciq142

# Using the Lives Saved Tool as part of evaluations of community case management programs

Ingrid K. Friberg, Neff Walker

Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

**Background** Integrated community case management (iCCM) has been recommended by the World Health Organization to reduce mortality among children in populations with limited access to facility-based health care providers. Although many countries have introduced iCCM, interpretation of the impact is difficult due to many other activities occurring in the community. This paper suggests a method for using the Lives Saved Tool to model the independent impact of iCCM on child mortality.

**Model** The Lives Saved Tool (*LiST*) is a multi-cause model of mortality which allows users to look at the potential impacts of one or many interventions on one or many causes of death without double counting their impact. *LiST* uses changes in intervention coverage and cause-specific effectiveness estimates on mortality and risk factors to model overall changes in mortality as well as to attribute mortality reduction to specific interventions. Collecting data on the source of the care seeking behaviors is critical to being able to model and interpret the changes observed.

**Discussion** The complexity of implementation of iCCM in the environment of broader health changes requires modeling to understand the program specific impacts. Using *LiST* results as additional data in combination with observed coverage change and mortality reduction can help explain the isolated impact of a given iCCM program when other changes are ongoing. *LiST* is unable to determine why the changes in health care seeking behaviors occur, but can be useful in helping to explain whether or not the changes were beneficial.

## Correspondence to:

Ingrid Friberg, PhD MHS  
 Johns Hopkins Bloomberg School of Public Health  
 Department of International Health  
 Division of Global Disease Epidemiology and Control  
 Rm E5518  
 615 N. Wolfe St.  
 Baltimore, MD 21205, USA  
[ingrid.friberg@jhu.edu](mailto:ingrid.friberg@jhu.edu)

Under-5 mortality is a continuing problem globally, with over 6.6 million children still dying annually [1]. In Africa, the most common causes of death include pneumonia, diarrhea, malaria and prematurity [2]. The World Health Organization published a position paper in 2012 promoting implementation of community case management of childhood illnesses to reach populations with limited access to facility-based health care providers with the aim of reducing child mortality [3]. Typically, integrated community case management (iCCM) includes antibiotics for pneumonia, oral rehydration salts and zinc for diarrhea and appropriate antimalarial drugs (artemesinin combination therapy, with or without use of rapid diagnostic tests, RDTs). Many countries have been expand-

ing the role of community health workers to include iCCM [4–6] (ie, Ethiopia, Malawi). For further expansion, the likely impact of this new delivery strategy needs to be quantified and made available to potential implementers, funders and international organizations such as WHO and UNICEF [5,7].

Much of the data regarding changes in mortality come from two sources: controlled studies of implementation of a project [8,9] and large national surveys of mortality and health intervention coverage [10]. Both have limitations with respect to understanding the potential impact of a specific program on mortality rates. Controlled studies often only measure the exact program, not the wider environment while national surveys typically estimate population wide mortality rates, but do not necessarily know the source of the changes [1, 6]. In both types of data, the impact of the specific implementation program is confounded by fluctuations within the wider health care system, including stockouts of medication or supplies, nonfunctioning equipment, health care worker strikes, and weather events [11,12]. Given these possibilities, neither an increase nor a decrease in coverage of a specific intervention will be adequate to estimate the impact of a given health service delivery mechanism or program.

In addition, a fully randomized trial evaluating the impact of an iCCM program is not possible under most circumstances. Instead quasi-experimental designs are used, and within both the intervention and comparison districts, other child health interventions such as vaccination, nutrition programs may be changing. In these studies, one must estimate the impact of changes in all of the interventions, not just the ones provided by iCCM programs in evaluating the impact of the program. In response to this type of complexity, it has been argued that the use of modeling will play a critical role in making causal inferences linking programs and impact [13].

This paper describes a methodology for using the Lives Saved Tool (*LiST*) to model the impact of iCCM within the wider changes of health intervention coverage.

## METHODS

### Overview of the Lives Saved Tool

The Lives Saved Tool (*LiST*) [14] models the impact that increased coverage of health interventions will have on under-5 mortality [15], neonatal mortality [16], maternal mortality [17] and stillbirths [18,19]. It is situated within the Spectrum Policy Modelling Software and utilizes formal links to the AIDS Impact Module (AIM), the Family Planning Module (FamPlan) and the Demography Module (DemProj) [14,20]. It has been characterized as a linear,

mathematical model that is deterministic. The fixed relationships between inputs and outputs will produce the same results each time one runs the model. The primary inputs are coverage of interventions while the outputs are changes in population levels of risk factors (such as wasting or stunting rates, birth outcomes such as prematurity or size at birth) and cause-specific mortality (neonatal, child mortality (1–59 months), maternal mortality and stillbirths). The relationship between a given input (change in intervention coverage) and one or more outputs is specified in terms of the effectiveness of the intervention in reducing the probability of that outcome. The overarching assumption in *LiST* is that mortality rates and cause of death structure will not change except in response to changes in coverage of interventions or other proximate determinants. The model assumes that changes in distal variables such as increase in per capita income or mothers' education will affect mortality by increasing coverage of interventions or reducing risk factors.

There are 68 separate interventions within *LiST*, affecting risk factors or causes of death; interventions can be linked to one or multiple outcomes. A key feature of *LiST* is that it allows one to look at the impact of scaling up coverage of multiple interventions simultaneously without double counting the impact, instead of only assessing a single intervention and a single cause of death as is done in many natural history models.

### Mortality reduction calculations with *LiST*

Several structural features of *LiST* must be considered in order to estimate the impact of scaling up coverage of multiple interventions and changes in risk factors on mortality. First, the effectiveness or efficacy of an intervention must be described in terms of reduction in cause-specific mortality rather than in overall mortality. With cause-specific estimates of effect, we can then compute the combined impact of interventions. When there is a single intervention, the calculation of impact is simple as one has change in coverage times the efficacy of the intervention and this impact is applied to the cause-specific mortality. For example, we may have population with 10 000 diarrhea deaths in children aged 1–59 months where we introduce a new vaccine that would be 50% effective in reducing diarrhea mortality. If we reach coverage of 50%, we would then reduce diarrhea deaths to 7500 ( $10\,000 - [10\,000 \times 0.5 \times 0.5]$ ). With a second or a third intervention, the same approach is followed except that the second diarrhea intervention would only be applied to the residual un-prevented diarrhea deaths. If the second new diarrhea intervention is also 50% effective and coverage reaches 50% we would then reduce diarrhea mortality to 5626 ( $7500 - [7500 \times 0.5 \times 0.5]$ ). By using cause-specific efficacy and applying each intervention to the residual deaths after we have estimated the

impact of previous interventions, we ensure that we are not double counting the overall impact of interventions on mortality.

### Attribution of lives saved by intervention

Another output of the *LiST* model is an attribution of lives saved to changes in coverage of interventions and risk factors. When a single intervention is scaled up, attribution is simple. However, when multiple interventions acting on the same cause of death are scaled up, one must have a consistent approach to make the attribution. In *LiST*, attribution is applied first to all preventive interventions (sequentially across the continuum of care, from periconceptual, through pregnancy, delivery and then postnatal preventions), and subsequently to the treatment interventions. Thus, if both a preventive and a treatment intervention are scaled up, the full effect of change in coverage of the preventive intervention is calculated and attributed to the preventive intervention. Then the residual deaths averted are attributed to the treatment scale up. When there are two or more interventions either in preventive or treatment categories, there is a second step in the attribution calculation. First we compute the number of lives saved by applying all preventive interventions. Then the attribution is based on the proportional impact of the preventive interventions, calculated as the increase in coverage times the effectiveness of the intervention.

In addition to reporting the impacts or attributions associated with a specific set of data, *LiST* can also be used to compare results from multiple scenarios and assess differences of multiple options. The choice of the exact two scenarios to be compared determines the interpretation of the results.

### How *LiST* has been used

One of the primary ways in which *LiST* has been used is to help countries develop strategic plans for maternal and child health. One example of this type of work was the development of possible scale up scenarios for high mortality countries in sub-Saharan Africa [19]. In this analysis, *LiST* was used to estimate the impact of a small set of effective interventions which could be delivered. The analyses were used by countries to help set priorities in their efforts to reach their MDG goals.

*LiST* has also been used to help explain which programs or activities led to measured reductions in mortality. For ex-

ample, in a recent analysis of Niger [21], the *LiST* model was used to help disambiguate a complex set of changes in coverage of many interventions at the national level that led to a 50% reduction in under-five mortality in the past 10 years. This analysis showed that while there were many interventions that had some impact on under-five mortality, the majority of the effect was due to scale up on interventions for malaria as well as reductions in stunting and wasting rates.

## RESULTS

### Use of *LiST* in the evaluation of iCCM Programs

*LiST for modeling observed outcomes.* The use of *LiST* in the evaluation of iCCM programs can be seen as a combination of the two methods (mortality reduction and attribution) briefly described above.

The introduction of iCCM into a population is intended to be a new delivery mechanism for ensuring the appropriate case management of childhood illnesses. This is often assumed to be in addition to existing sources of medication in a community, which can include health facilities and pharmacies. A typical national level survey would report total coverage of treatment, and would not differentiate the results by source in a standard results table [6]. This could indicate that total coverage of an intervention increased over time (as in **Table 1**: total coverage). However, this result would not differentiate between the ‘ideal results’, here used to indicate an effective iCCM program which reaches those not already accessing care, and other possible results that are less easy to interpret. The ideal results would show no change in coverage delivered via non iCCM mechanisms and thus the full impact could be assumed to be linked to the introduction of iCCM (as in **Table 1**: ideal results). It is more likely that results similar to the ‘potential results’ are driving the change in coverage.

A *LiST* analysis can be done with one additional piece of information from the survey – the source of the treatment to differentiate between these two options. With this additional question, *LiST* can quantify the impact, by comparing the total coverage changes observed over time to the total coverage delivered within facilities. Importantly, the total coverage of the intervention at baseline (before iCCM implementation; 30% in **Table 1**) modeled must be the

**Table 1.** Overall coverage of an intervention increased post introduction of community case management

	IDEAL RESULTS			POTENTIAL RESULTS	
	Total coverage	Community coverage	Facility coverage	Community coverage	Facility coverage
Before	30%	0%	30%	0%	30%
After	40%	10%	30%	2%	38%

same in the two comparison scenarios. The difference between these two scenarios (total coverage and observed facility coverage) would account for the impact of the community program. This is predicated on the assumption that the effectiveness of the intervention is the same given all possible delivery mechanisms.

*LiST for modeling hypothetical outcomes.* It is a more difficult situation to interpret when changes in the health system have occurred simultaneous to and independent of the introduction of the iCCM program. **Table 2** shows an example where total coverage has decreased over time, yet the apparent impact of the community delivery strategy is positive.

Using *LiST* and the information on the delivery strategy can help to identify the impact of the program. In this situation, the two scenarios to be compared are the same as the previous example. The first scenario will show the overall coverage, while the second will show the coverage expected if there were no change in the community interventions. The difference between these scenarios shows the impact of the community case management intervention. In both scenarios, additional deaths relative to baseline will be observed due to both a reduction in coverage and an assumed increase in population (**Figure 1**). The observed total situation based on data in **Table 2**, will be modeled by the red line in **Figure 1**, while the hypothetical line for what would have happened without the community based portion of coverage change is the blue line. The difference between these two scenarios is the impact of the community program. If the deaths modeled by assuming no change in the community programming are greater than those observed,

then the community program is having a positive impact regardless of the fact that the overall coverage is worse and overall deaths are increasing.

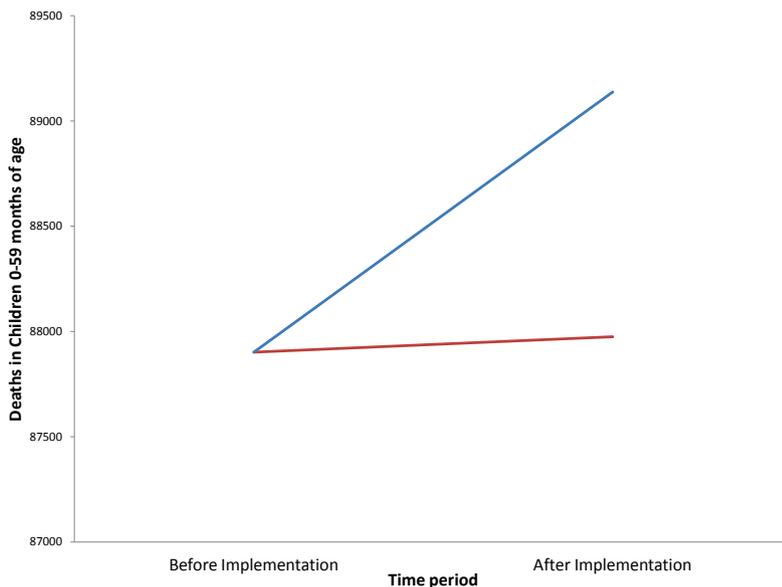
*LiST for modeling concomitant non-iCCM interventions.* Another key feature of *LiST* is the ability to distinguish the separate impacts of multiple interventions which are affecting a specific cause of death. One example is when assessing the impact of iCCM in communities where insecticide treated bednets (ITNs) are being rolled out simultaneously. A decline in malaria mortality will be observed regardless of the introduction of iCCM (**Table 3**). *LiST* can also determine which portion of the decline is likely due to iCCM and which is due to the ITNs. *LiST* results show that in the presence of ITNs (a prevention) the impact of antimalarials (a cure) will be smaller than when no ITNs are being deployed (2.9% vs 2.1% reduction in **Table 3**), indicating the critical nature of understanding the wider environment when assessing new programs. Similarly, it can distinguish if part of the overall mortality reduction is due to a change in the underlying prevalence of HIV within a community (not shown).

## DISCUSSION

The Lives Saved Tool is a multi-cause model of mortality which allows users to compare observed data with hypothetical comparison information. It allows users to isolate the impact of a particular program when looking at the observed mortality changes and coverage changes in a population. Integrated community case management is a new delivery mechanism which has the potential to reduce inequities by reaching the most marginalized within a community. *LiST*

can easily compare the difference between the observed situation and the hypothetical where iCCM did not exist. This is especially important in areas where external events confuse the overall impacts of a program, for example stockouts or strikes by facility workers. *LiST* does not have the ability to understand why the observed changes are occurring. However, the user can explicitly state the assumptions of what would likely have occurred without the new program. This is an advantage when trying to interpret mortality rates which may be unchanged or increase in the study area and or the comparison area.

The real world experience with iCCM has been difficult to interpret because the interventions that are part of iCCM are not being delivered in a vacuum. Other interventions may have also been scaled up and these interventions, not the iCCM, may drive measured mortality reduction. Additional issues



**Figure 1.** Predicted deaths modeled by *LiST*; observed data and hypothetical without community programming; based on data in **Table 2**. Red line – Scenario 1: predicted deaths using observed coverage changes, blue line – Scenario 2: predicted deaths using hypothetical coverage change, excluding community delivery.

**Table 2.** Overall coverage decreased in the after of a before and after study design

	Total coverage	Community coverage	Facility coverage	Comparison scenario
Before	52%	5%	47%	5%*+47% = 52%
After	48%	15%	33%	5%*+33% = 38%

\*The community coverage values at baseline and assuming no change over time.

**Table 3.** Percent reduction in mortality by iCCM alone vs with ITNs

	ITNs alone	iCCM alone	iCCM and ITNs
ITNs	3.7	–	3.7
Antimalarials	–	2.9	2.1
Case management of pneumonia	–	2.7	2.7
ORS + Zinc for diarrhea	–	2.4	2.4
Total Percent Mortality Reduction	3.7	7.9	10.9

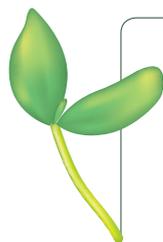
iCCM – integrated community case management, ITN – insecticide treated bednets, ORS – oral rehydration salts.

such as stockouts at the facility level could result in people shifting to using community health workers, simply because stock was available in the community and not the facility. The reality may be that there are no additional people seeking care from the community health worker. Another issue may be task shifting. People who are already seeking care simply prefer the convenience of the community workers and choose to use them instead of the facility workers. In both of these situations, assessing the utilization of the community health workers does not tell the complete story of the impact of iCCM. It is necessary to further describe the changes in total coverage of health interventions in order to understand whether or not a mortality benefit should be attributed to the new program.

It should also be noted that *LiST*, which focuses on mortality, only generates one type of data for understanding the impacts of any health program. These results should be used in combination with other data types, such as qualitative and quantitative data on program users as well as the costs of implementation, among others. Together, a broader understanding of total impact can inform all aspects of the relevant discussions on whether expansion is warranted and benefits are being accrued. This paper has extensively discussed the benefits of using *LiST* as one tool within an evaluation toolkit within iCCM. It can also be used prospectively to help identify what potential impacts an iCCM program could expect if a new program were implemented in a specific country or region. This can help the health programmers tailor the program correctly, in terms of focus, methods and location, as well as to understand what competing interventions would be critical to understand. This would help to ensure that all prospective survey data that were relevant were collected.

Using modeling to evaluate program specific mortality results has several limitations. First, comprehensive data

needs to be collected prospectively with an eye on the modeling needs. Those collecting survey data need to capture all information relevant to the causes of death of interest, even if they are not program specific interventions. This may make it more difficult to consider modeling retrospectively, which is the typical experience currently. It may also limit the ability to correctly interpret the predicted mortality rates due to the many unknowns, which may be very expensive and time consuming to collect. In addition, it is critical that one consider the quality of the data. The poorer the quality as well as the sparser the data, the less likely that meaningful results can be derived from modeling. A current additional limitation is the lack of empirical data quantifying the difference in effectiveness between delivery points for the iCCM interventions. There are likely to be differences in both the population receiving care by different providers and at different locations as well as in how effective the intervention is going to be when delivered by those providers. These combine to result in the true impact differences being greater or smaller than expected with the single effect size currently available. Studies of iCCM implementation may also be completed in atypical environments, which limit their generalizability while at the same time overall population based mortality data cannot answer the question about whether or not iCCM is driving the observed changes. The observed implementation data are often confounded by fluctuations within the wider health care system which are not under the control of an implementer. Thus, neither an increase nor a decrease in coverage of a specific intervention will be adequate to estimate the impact of a given health service delivery mechanism or program. The use of a modeling tool such as *LiST* can help to tease out the impacts which can be attributed to a given program. These data can be used by implementers, funders and international organizations as they discuss the merits of initiating an iCCM program in a particular community.



**Disclaimer:** This article reflects the research and work of NW and IKF. It does not reflect the official views of the Johns Hopkins Bloomberg School of Public Health.

**Funding:** The development and implementation of the Lives Saved tool is primarily supported by funding from the Bill and Melinda Gates Foundation.

**Authorship declaration:** This study was designed by NW and IKF. The first draft was written by IKF. NW and IKF were both responsible for subsequent drafts, editing and the final manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). The authors do not report relevant competing interests.

## REFERENCES

- 1 Interagency Working Group for Mortality Estimation. Levels and Trends in Child Mortality: Report 2013. Available at: [www.childmortality.org/files\\_v16/download/UNICEF%202013%20IGME%20child%20mortality%20Report\\_Final.pdf](http://www.childmortality.org/files_v16/download/UNICEF%202013%20IGME%20child%20mortality%20Report_Final.pdf). Accessed: 20 September 2013.
- 2 Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet*. 2012;379:2151-61. Medline:22579125 doi:10.1016/S0140-6736(12)60560-1
- 3 World Health Organization United Nations Children's Fund. Joint Statement: Integrated Community Case Management (iCCM). Geneva: Available at: [www.unicef.org/health/files/iCCM\\_Joint\\_Statement\\_2012.pdf](http://www.unicef.org/health/files/iCCM_Joint_Statement_2012.pdf). Accessed: 1 July 2014.
- 4 Miller NP, Amouzou A, Tafesse M, Hazel E, Legesse H, Degefie T, et al. integrated community case management of childhood illness in Ethiopia: Implementation strength and quality of care. *Am J Trop Med Hyg*. 2014;91:424-34. Medline:24799369 doi:10.4269/ajtmh.13-0751
- 5 de Sousa A, Tiedje KE, Recht J, Bjelic I, Hamer DH. Community case management of childhood illnesses: policy and implementation in Countdown to 2015 countries. *Bull World Health Organ*. 2012;90:183-90. Medline:22461713 doi:10.2471/BLT.11.093989
- 6 Hazel E, Requejo J, David J, Bryce J. Measuring coverage in MNCH: evaluation of community-based treatment of childhood illnesses through household surveys. *PLoS Med*. 2013;10:e1001384. Medline:23667329 doi:10.1371/journal.pmed.1001384
- 7 Bennett S, George A, Rodriguez D, Shearer J, Diallo B, Konate M, et al. Policy challenges facing integrated community case management in Sub-Saharan Africa. *Trop Med Int Health*. 2014;19:872-82. Medline:24750516 doi:10.1111/tmi.12319
- 8 Kalyango JN, Alfven T, Peterson S, Mugenyi K, Karamagi C, Rutebemberwa E. Integrated community case management of malaria and pneumonia increases prompt and appropriate treatment for pneumonia symptoms in children under five years in Eastern Uganda. *Malar J*. 2013;12:340. Medline:24053172 doi:10.1186/1475-2875-12-340
- 9 Kalyango JN, Rutebemberwa E, Karamagi C, Mworozzi E, Ssali S, Alfven T, et al. High adherence to antimalarials and antibiotics under integrated community case management of illness in children less than five years in eastern Uganda. *PLoS ONE*. 2013;8:e60481. Medline:23555980 doi:10.1371/journal.pone.0060481
- 10 Corsi DJ, Neuman M, Finlay JE, Subramanian SV. Demographic and health surveys: a profile. *Int J Epidemiol*. 2012;41:1602-13. Medline:23148108 doi:10.1093/ije/dys184
- 11 Hill J, Hoyt J, van Eijk AM, D'Mello-Guyett L, Ter Kuile FO, Steketee R, et al. Factors affecting the delivery, access, and use of interventions to prevent malaria in pregnancy in sub-Saharan Africa: a systematic review and meta-analysis. *PLoS Med*. 2013;10:e1001488. Medline:23935459 doi:10.1371/journal.pmed.1001488
- 12 Penfold S, Shamba D, Hanson C, Jaribu J, Manzi F, Marchant T, et al. Staff experiences of providing maternity services in rural southern Tanzania - a focus on equipment, drug and supply issues. *BMC Health Serv Res*. 2013;13:61. Medline:23410228 doi:10.1186/1472-6963-13-61
- 13 Garnett GP, Cousens S, Hallett TB, Steketee R, Walker N. Mathematical models in the evaluation of health programmes. *Lancet*. 2011;378:515-25. Medline:21481448 doi:10.1016/S0140-6736(10)61505-X
- 14 Walker N, Tam Y, Friberg IK. Overview of the Lives Saved Tool (LiST). *BMC Public Health*. 2013;13 Suppl 3:S1. Medline:24564438 doi:10.1186/1471-2458-13-S3-S1
- 15 Fox MJ, Martorell R, van den Broek N, Walker N. Assumptions and methods in the Lives Saved Tool (LiST). Introduction. *BMC Public Health*. 2011;11 Suppl 3:11. Medline:21501425 doi:10.1186/1471-2458-11-S3-11
- 16 Bhutta ZA, Das JK, Bahl R, Lawn JE, Salam RA, Paul VK, et al. Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost? *Lancet*. 2014;384:347-70. Medline:24853604 doi:10.1016/S0140-6736(14)60792-3
- 17 Homer CS, Friberg IK, Dias MA, Ten Hoop-Bender P, Sandall J, Speciale AM, et al. The projected effect of scaling up midwifery. *Lancet*. 2014;384:1146-57. Medline:24965814 doi:10.1016/S0140-6736(14)60790-X

- 18 Bhutta ZA, Yakoob MY, Lawn JE, Rizvi A, Friberg IK, Weissman E, et al. Stillbirths: what difference can we make and at what cost? *Lancet*. 2011;377:1523-38. Medline:21496906 doi:10.1016/S0140-6736(10)62269-6
- 19 Friberg IK, Kinney MV, Lawn JE, Kerber KJ, Odubanjo MO, Bergh AM, et al. Sub-Saharan Africa's mothers, newborns, and children: how many lives could be saved with targeted health interventions? *PLoS Med*. 2010;7:e1000295. Medline:20574515 doi:10.1371/journal.pmed.1000295
- 20 Stover J, McKinnon R, Winfrey B. Spectrum: a model platform for linking maternal and child survival interventions with AIDS, family planning and demographic projections. *Int J Epidemiol*. 2010;39 Suppl 1:i7-10. Medline:20348129 doi:10.1093/ije/dyq016
- 21 Amouzou A, Habi O, Bensaid K. Niger Countdown Case Study Working G. Reduction in child mortality in Niger: a Countdown to 2015 country case study. *Lancet*. 2012;380:1169-78. Medline:22999428 doi:10.1016/S0140-6736(12)61376-2

# Setting global research priorities for integrated community case management (iCCM): Results from a CHNRI (Child Health and Nutrition Research Initiative) exercise

Kerri Wazny<sup>1</sup>, Salim Sadruddin<sup>2</sup>, Alvin Zipursky<sup>3</sup>, Davidson H. Hamer<sup>4,5,6</sup>, Troy Jacobs<sup>7</sup>, Karin Kallander<sup>8,9,10</sup>, Franco Pagnoni<sup>11</sup>, Stefan Peterson<sup>10,12,13</sup>, Shamim Qazi<sup>14</sup>, Serge Raharison<sup>15,16</sup>, Kerry Ross<sup>15,16</sup>, Mark Young<sup>17</sup>, David R. Marsh<sup>2</sup>

<sup>1</sup> Centre for Global Child Health, the Hospital for Sick Children, Toronto, Canada

<sup>2</sup> Save the Children, Fairfield, CT, USA

<sup>3</sup> Programme for Global Paediatric Research, the Hospital for Sick Children, Toronto, Canada

<sup>4</sup> Zambia Center for Applied Health Research and Development, Lusaka, Zambia

<sup>5</sup> Center for Global Health and Development, Boston University, Boston, MA, USA

<sup>6</sup> Department of International Health, Boston University School of Public Health, Boston, MA, USA

<sup>7</sup> Global Health Bureau, United States Agency for International Development, Washington DC, USA

<sup>8</sup> Malaria Consortium, London, UK

<sup>9</sup> Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden

<sup>10</sup> Makerere University School of Public Health, Kampala, Uganda

<sup>11</sup> Global Malaria Programme, World Health Organization, Geneva, Switzerland

<sup>12</sup> International Women's and Children's Health, Uppsala University, Sweden

<sup>13</sup> Global Health, Karolinska Institutet, Sweden

<sup>14</sup> Department of Maternal, Newborn, Child and Adolescent Health, World Health Organization, Geneva, Switzerland

<sup>15</sup> John Snow, Inc., Washington DC, USA

<sup>16</sup> Maternal and Child Health Integrated Project (MCHIP), Washington, DC, USA

<sup>17</sup> Programme Division, United Nations Children's Fund, New York, USA

**Aims** To systematically identify global research gaps and resource priorities for integrated community case management (iCCM).

**Methods** An iCCM Child Health and Nutrition Research Initiative (CHNRI) Advisory Group, in collaboration with the Community Case Management Operational Research Group (CCM ORG) identified experts to participate in a CHNRI research priority setting exercise. These experts generated and systematically ranked research questions for iCCM. Research questions were ranked using a "Research Priority Score" (RPS) and the "Average Expert Agreement" (AEA) was calculated for every question. Our groups of experts were comprised of both individuals working in Ministries of Health or Non Governmental Organizations (NGOs) in low- and middle-income countries (LMICs) and individuals working in high-income countries (HICs) in academia or NGO headquarters. A Spearman's Rho was calculated to determine the correlation between the two groups' research questions' ranks.

**Results** The overall RPS ranged from 64.58 to 89.31, with a median score of 81.43. AEA scores ranged from 0.54 to 0.86. Research questions involving increasing the uptake of iCCM services, research questions concerning the motivation, retention, training and supervision of Community Health Workers (CHWs) and concerning adding additional responsibilities including counselling for infant and young child feeding (IYCF) and treatment of severe acute malnutrition (SAM) ranked highly. There was weak to moderate, statistically significant, correlation between scores by representatives of high-income countries and those working in-country or regionally (Spearman's  $\rho = 0.35034$ ,  $P < 0.01$ ).

**Conclusions** Operational research to determine optimal training, supervision and modes of motivation and retention for the CHW is vital for improving iCCM, globally, as is research to motivate caregivers to take advantage of iCCM services. Experts working in-country or regionally in LMICs prioritized different research questions than those working in organization headquarters in HICs. Further exploration is needed to determine the nature of this divergence.

## Correspondence to:

Salim Sadruddin  
Save the Children  
501 Kings Highway East  
Fairfield, CT 06825, USA  
ssadruddin@savechildren.org

Approximately 6.6 million children die before their fifth birthday every year [1,2]. Together, pneumonia, diarrhoea and malaria accounted for approximately one third of these deaths [1,2], and many of these deaths are

preventable. Although Millennium Development Goal 4 (MDG4) made reducing child deaths a global priority, calling for a two-thirds reduction of child deaths between 1990 and 2015, many countries are not on track to achieve this goal [2–6].

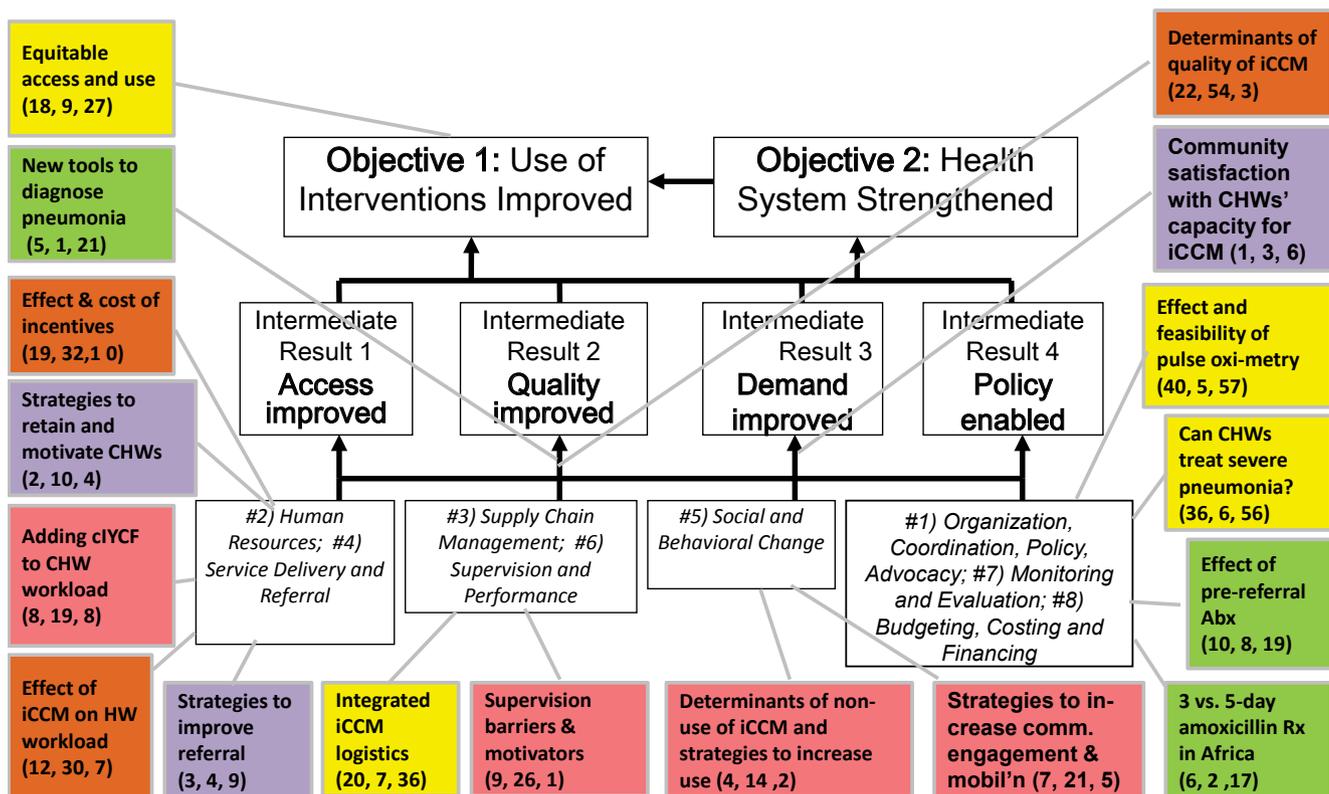
Diarrhoea and pneumonia, in particular, disproportionately affect impoverished and marginalized children who do not access treatment [1]. Existing interventions to prevent and treat childhood pneumonia, diarrhoea and malaria are efficacious [6]. Integrated community case management (iCCM) is a delivery strategy that utilizes community health workers (CHWs) to diagnose and treat multiple conditions, most commonly pneumonia, diarrhoea and malaria, in children under five. CHWs are based in the communities they serve, working as an easily accessible community-arm of a country's existing health care system [7,8].

Major donors and non-governmental organisations (NGOs), including the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) are promoting iCCM as a key strategy to reduce child mortality. CHWs have been lauded as “the world's most promising health workforce resource for enabling health systems in resource-constrained settings to reduce the burden of disease from serious, readily preventable or treatable condi-

tions” [5]. In addition to reducing pneumonia-specific mortality by 36% and malaria-specific mortality by 60%, a recent review found that CHWs can also effectively perform nutritional counselling activities [5,6].

Nepal's iCCM program has contributed to one of the most rapidly declining child mortality rates in the world [5]. Conversely, despite having a national-level, well-funded, community health workers program, Pakistan has not achieved satisfactory reductions in child mortality [9,10]. This divergence of results highlights the need to understand programmatic factors to strengthen programs delivering iCCM [11,12]. In their call for identification of research priorities in iCCM, Hamer and colleagues emphasize the need for the integration of research and program implementation in addition to a focus on long-term outcomes [11].

While research priorities have previously been developed and published by the Global CCM Operations Research Group (CCM ORG), the development of these priorities was constrained because the advisors were global level iCCM experts and the research priorities were not systematically evaluated [11]. Thus, we applied the Child Health and Nutrition Research Initiative's (CHNRI) method to identify and systematically evaluate research priorities for



**Figure 1.** Evaluation Framework matched to CHNRI research priority “top 10” questions by list ranking: overall, HQ/HIC and LMIC. Number in parentheses: rank overall, HQ/HIC and LMIC, respectively. HQ/HIC – organizational headquarters or high-income countries, LMIC – low- and middle-income countries. Key: blue – top 10 in all questions; green – top 10 overall and in HQ/HIC, red – top 10 overall and in LMIC, orange – top 10 in LMIC only, yellow – top 10 in HQ/HIC only.

iCCM. The CHNRI method has identified research gaps and resource priorities in a variety of contexts, including global childhood diarrhoea, birth asphyxia and childhood pneumonia [13–17]. To our knowledge, this is the first use of CHNRI to identify research gaps and resource priorities for a delivery strategy rather than an illness. Over seventy-five experts, representing academics, international organizations and Ministries of Health within countries already implementing iCCM participated in at least one of the steps of this exercise.

## METHODS

The CHNRI method was designed to assist policy makers and funders in identifying research gaps and resource priorities in a variety of contexts for health research, as well as the strengths and weaknesses of the research gaps identified. In the last decade, the CHNRI method has been widely used to identify research gaps in childhood illnesses, including global childhood diarrhoea, birth asphyxia and childhood pneumonia [13–17]. The exercise is comprised of four stages: (i) the context of the problem and the evaluation criteria are defined; (ii) technical experts generate and rank research questions against the proposed criteria; (iii) weighting of the evaluation criteria is decided through consultation with stakeholders; and, (iv) research priority scores are calculated for each research priority and agreement between experts is analyzed [18].

An iCCM CHNRI Advisory Group was formed to assist in the execution of this exercise. Together with the co-principal investigators (KW, SS, AZ), the Advisory Group attended a two-day meeting in New York where the criteria used in scoring was finalised and the final list of research questions to be scored was selected. A list of the iCCM CHNRI Advisory Group members and a detailed description of the activities during the New York meeting are presented in **Box 1**.

### 1. Context of the problem and evaluation criteria are defined

We modified the CHNRI criteria used in a previous CHNRI exercise [17], yielding criteria more applicable for evaluating research questions for a delivery system. We chose the following four criteria: (i) answerability; (ii) research feasibility; (iii) deliverability; and, (iv) importance/potential impact. **Table 1** displays the specific questions used to evaluate the research questions under each criterion.

### 2. Technical experts generate and rank research questions

We asked for members of the CCM ORG to nominate experts for participation in the exercise. We also included ex-

#### Box 1 Details of New York Meeting activities

The members of the iCCM CHNRI Advisory Group and the co-PIs of the CHNRI exercise met in New York on May 1 and 2, 2013. Members of the iCCM CHNRI Advisory Group are: Shamim Qazi, David Marsh, Franco Pagnoni, Mark Young, Kerry Ross, Karin Kallander, Serge Raharison and Troy Jacobs. The co-principal investigators are: Kerri Wazny, Salim Sadruddin and Alvin Zipursky.

The members combined and eliminated duplicate research priorities, both from the original ORG list [11, 12] and from those submitted through the CHNRI exercise, leaving 119 research priorities. These priorities were scored on a scale of 1–5 (1 being highest, 5 being lowest), by all of the meeting participants. The average score for each priority was calculated, and priorities with a score higher than average ( $\geq 2.6$ ) were retained for dissemination for scoring by the larger group of CHNRI participants.

The iCCM CHNRI Advisory Group and co-principal investigators also discussed the standard CHNRI criteria and modified CHNRI criteria used in a previous exercise [17], and finalized the criteria to be used in the iCCM CHNRI exercise. The group decided to use 4, rather than 5, criteria and to weight the criteria equally in the final analysis.

Finally, the group agreed to re-invite all those invited to submit research questions, regardless of whether they did, unless the participant expressed that they were unable to participate in the exercise.

perts who participated in a previous CHNRI exercise who are involved in iCCM implementation or research [17]. Finally, we invited experts who were referred from others we invited to participate. In total, we invited 127 experts in iCCM to generate research questions for our CHNRI exercise. Experts represented international organizations, ministries of health within low- and middle-income countries, academia and non-governmental organizations. All materials, including instructions and research questions, were translated into French by a professional translator to ensure francophone country participation. In total, 75 experts submitted 366 research questions.

We combined the submitted research questions with those previously generated by the CCM ORG and thematically organized and discussed the research questions during the iCCM CHNRI Advisory Group Meeting [11]. The Advisory Group members removed duplicates, combined similar questions, and then rated each question from 1 to 5. We calculated average scores and selected the 61 questions with above average scores for evaluation by the experts.

We invited all experts who were initially approached to submit research questions, aside from those who declined participation, plus any additional experts we identified after our call for research questions. In total, we invited 133 experts to score the 61 questions. To reduce the possibility

**Table 1.** Criteria for iCCM CHNRI exercise

CRITERION	SUB-QUESTIONS
Answerability	<ol style="list-style-type: none"> <li>1. Would you say that the research question is well-framed?</li> <li>2. Can a single study or a very small number of studies be designed to answer the research question?</li> <li>3. Do you think that a study needed to answer the proposed research question would obtain ethical approval without major concerns?</li> </ol>
Research Feasibility*	<ol style="list-style-type: none"> <li>1. Is it likely that, in the context of interest, there will be sufficient capacity to carry out this research?</li> <li>2. Is it feasible to provide the training required for staff to carry out the research in the context of interest?</li> <li>3. Is the cost and time required for this research reasonable within the context of interest?</li> </ol>
Deliverability	<ol style="list-style-type: none"> <li>1. Taking into the account the level of difficulty with delivery of the potential intervention or delivery strategy (for example, need for change of attitudes and beliefs, supervision, transport infrastructure), would you say that this intervention or delivery strategy will be <b>deliverable</b> within the context of interest?</li> <li>2. Taking into account the resources available to implement the intervention, would you say that the intervention or delivery strategy would be <b>affordable</b> within the context of interest?</li> <li>3. Would government capacity and partnership be essential to ensure the intervention or delivery strategy would be <b>sustainable</b>?†</li> </ol>
Importance/ Potential Impact	<ol style="list-style-type: none"> <li>1. Will the results of this research fill an important knowledge gap?</li> <li>2. Are the results from this research likely to shape future planning and implementation?</li> <li>3. Will the results from this research be relevant to most countries in the context of interest?</li> </ol>

iCCM – integrated community case management, CHNR – Child Health and Nutrition Research Initiative

\*For this criterion, the “context of interest” refers to countries that do, or would benefit from, implementation of iCCM.

†We eliminated this question from the calculation of the scores for Criterion 3, as described in the text.

that the order of research questions would affect scoring, we made eight versions of the scoring sheet, using a random number generator to shuffle the question order. The scoring sheets were otherwise identical.

Each criterion contained three sub-questions. We asked experts to score 1 for yes, 0 for no and 0.5 if undecided. If the experts did not feel sufficiently knowledgeable to answer a particular question, they were instructed to leave the cell blank. Seventy-five experts returned completed scoring sheets.

### 3. Weighting of criteria is decided

Prior to scoring, we chose to weigh all criteria equally in the analysis, as we felt they were of equal importance.

### 4. Research Priority Scores and Average Expert Agreement are calculated

All returned scoring sheets were checked for errors and then scores were entered into a master calculation sheet. The Research Priority Score (RPS) and Average Expert Agreement (AEA) were calculated for each research question. The RPS is a mean score given, across criteria and scorers, for a particular research question. The AEA is the proportion of scorers who chose the mode (the most common score) for each research question.

After distributing scoring sheets to the experts, some of the experts raised concerns regarding the third question of criterion 3 (Table 1). This question asks whether government partnership will be necessary to ensure sustainability of the

results of the research. A “yes” response indicates a positive answer for all other questions except this one. If government partnership is necessary to sustain research results, then a “yes” is a negative answer. Given the potential confusion over non-parallel construction, we excluded this question. Thus, we took the average scores for each criterion and then averaged those scores, weighting each criterion equally. For criterion 3, we calculated the average of questions 1 and 2 only. Calculating the RPS in this way, rather than taking the mean scores across the 11 sub-questions, allowed for each criterion to be weighted equally in the analysis.

We used the AEA rather than a Fleiss kappa statistic to calculate agreement among experts, which is in line with previous CHNRI exercises. Due to the large number of scorers and few scoring options, it is not possible to rule out chance with the Fleiss Kappa statistic even in cases with complete agreement. Although the AEA does not give an indication of statistical significance, we thought that policy makers and donors would find it more useful than the kappa statistic, as it can give a general idea of the degree of agreement between experts. The average expert agreement (AEA) was calculated as follows:

$$AEA = \frac{1}{11} \times \sum_{q=1}^{11} \frac{N(\text{scorers who provided the most frequent response})}{N(\text{scorers})}$$

where q is a question that experts are being asked to evaluate competing research investment options, ranging from 1 to 11.

## 5. Comparative analysis of scores given by in-country or regional participants and those working in high-income countries or organizational headquarters

We stratified the responses received into those received by participants working in-country or regionally (LMIC Group) and those working in organizational headquarters or high-income countries (HQ/HIC Group). A list of our participants, their organizations and their categorizations can be found in **Online Supplementary Document, Table S1**. We calculated the RPS for each research question separately in these groups and used a Spearman's Rho correlation coefficient to calculate the correlation of research questions' ranks between these groups. Spearman's Rho is used to determine the degree of correlation between two ranked sets of results. A correlation coefficient of 1 indicates high, positive correlation between two sets of results; a correlation coefficient of -1 indicates high, negative correlation

between two sets of results and a correlation coefficient of 0 indicates no correlation.

## RESULTS

We invited 133 experts to score research questions; 75 returned completed scoring sheets. Three experts declined participation at this stage. We received nearly equal responses from participants working in-country or regionally (n=36) and from those working in organizational headquarters or high-income countries (n=39).

The range of RPS across the 61 questions was 64.58 to 89.31 (median=81.43) out of a possible 100. The AEA ranged from 0.54 to 0.86 out of a possible 1.00. The top 20 research questions overall and their corresponding RPS and AEA scores are displayed in **Table 2**. **Online Supplementary Document, Table S2** contains all the ranked research questions, their scores in each criterion and their RPS and AEA scores.

**Table 2.** Overall rank and research priority scores for top 20 research questions

Overall Rank	RESEARCH QUESTION	RESEARCH PRIORITY SCORE (RPS)	AVERAGE EXPERT AGREEMENT (AEA)
1	Assess perceptions of beneficiaries and levels of community satisfaction in CHWs capacity to diagnose and treat sick child (with malaria, pneumonia, diarrhoea and severe malnutrition) at the community level.	89.31	0.84
2	Identify and evaluate strategies for retention and motivation of CHWs.	89.08	0.86
3	Identify and evaluate strategies for improving referral between communities and health facilities, including referral compliance.	88.94	0.84
4	Identify determinants of non-use of iCCM services by caretakers and develop strategies to increase the uptake of iCCM.	88.89	0.84
5	Identify and evaluate new diagnostic tools for improved classification of pneumonia (ie, different ARI timers, respiratory counting beads, etc.) at the community level that are most appropriate for various cadres.	88.83	0.85
6	Evaluate the effectiveness of 3-day vs 5-day amoxicillin treatment regimens in Africa.	88.61	0.84
7	Identify and evaluate innovative strategies to improve community engagement and mobilization for CCM.	87.49	0.83
8	Evaluate the feasibility, effectiveness and impact of adding community-based infant and young child feeding (ciYCF) counseling skills to the CHW workload.	87.26	0.82
9	Identify the primary barriers to CHW supervision and develop and evaluate strategies to motivate CHW supervisors to provide continuous support to CHWs.	87.18	0.82
10	What is the impact of pre-referral antibiotics on treatment outcomes of possible serious bacterial infections?	86.52	0.80
11	Assess perceptions, understanding and motivating factors for caregivers on the need for prompt treatment for the sick child.	86.41	0.82
12	What is the impact of iCCM on health facility worker workload, by disease?	86.37	0.81
13	Develop and evaluate strategies (for example, innovative packaging of drugs) to improve compliance and uptake of treatment.	86.00	0.81
14	Identify and evaluate strategies to improve supervision and quality of care using mHealth technology.	85.85	0.81
15	Identify and evaluate effective and feasible strategies for maintaining quality of case management by CHWs.	85.56	0.82
16	Identify and evaluate strategies for, and costs of, supervising the CHW supervisor.	85.35	0.79
17	Develop and evaluate strategies for using mHealth technology to improve drug supply and logistics for the CHWs.	85.28	0.79
18	Evaluate the impact of iCCM on equity in access and use of basic health services.	85.14	0.80
19	Identify and evaluate the effectiveness and cost of various incentive schemes and strategies for CHWs.	84.81	0.79
20	Identify and evaluate strategies to improve integration of iCCM logistics (diagnostics and drug supply) to the central procurement and supply system at the community level.	84.41	0.79

CHW – Community Health Workers, iCCM – integrated community case management

Several of the top 20 research priorities overall involved increasing uptake of iCCM services, through community motivation and satisfaction (#1, #7), identification of determinants of non-use (#4), motivating factors for care seeking behaviour (#11) and other strategies to improve compliance and uptake (#13).

Strategies to improve motivation, retention, training and supervision of CHWs were a priority (questions #2, 9, 13, 16 and 19). Identifying and evaluating strategies for retention and motivation of CHWs was 2nd overall, scoring highly in importance/potential impact (0.92) and had high agreement between scorers (AEA = 0.86). Two of the top 20 questions (#9 and 14) emphasized the need for supervision and support of CHWs. mHealth technology was proposed as a tool to strengthen drug supply and logistics systems (#17).

Research questions involving adding responsibilities to CHWs' workload also appeared in the top 25. Questions #8 and 21 address the feasibility, effectiveness and impact of adding counselling for infant and young child feeding (IYCF) and treatment of severe acute malnutrition (SAM), respectively.

Two of the top 10 research questions dealt specifically with pneumonia; question 5 asks to identify and evaluate new

diagnostics specific to different cadres of health workers (eg, respiratory counting beads and ARI timers) and question 6 asks to evaluate 3-day vs 5-day amoxicillin treatment in Africa.

### Importance/potential impact

**Table 3** displays the top 10 questions in the importance/potential impact criterion. Question #15 overall (identify and evaluate feasible and effective strategies for maintaining CHWs' quality of case management) ranked first, and question #15 (identify and evaluate new diagnostics for different CHW cadres) ranked second. Questions relating to adding newborn care and SAM to the CHWs' workload, which were ranked 21<sup>st</sup> and 24<sup>th</sup> overall, respectively, both received scores of 0.90, but these questions' scores in the answerability and deliverability criteria brought down their overall scores.

### Research feasibility and deliverability

We eliminated research questions that had scores of <0.8 in at least one of the following criteria: answerability, research feasibility and deliverability. We were aiming to investigate whether eliminating any research priorities that would either be difficult to design research studies to answer or to sustain in the post-research stage would change the results. In this

**Table 3.** Top 10 research priorities by importance/potential impact criterion

IMPORTANCE/ POTENTIAL IMPACT RANK	RESEARCH QUESTION	CRITERION 1 SCORE	CRITERION 2 SCORE	CRITERION 3 SCORE	CRITERION 4 SCORE	OVERALL RPS	OVERALL RANK
1	Identify and evaluate effective and feasible strategies for maintaining quality of case management by CHWs.	0.77	0.90	0.83	0.93	85.56	15
2	Identify and evaluate new diagnostic tools for improved classification of pneumonia (ie, different ARI timers, respiratory counting beads, etc.) at the community level that are most appropriate for various CHW cadres.	0.87	0.90	0.85	0.93	88.83	5
3	Identify and evaluate strategies for retention and motivation of CHWs.	0.85	0.94	0.89	0.92	89.08	2
4	Evaluate effectiveness of 3-day vs 5-day oral amoxicillin treatment regimens in Africa.	0.83	0.88	0.92	0.91	88.61	6
5	What are the feasibility, impact and costs of adding newborn care (including PNS, home visits, treatment of infection and Caring for the Newborn and Children in the Community) to the iCCM package?	0.78	0.86	0.77	0.90	82.74	24
6	Develop safe and effective treatment strategies in settings where referral is not possible.	0.62	0.79	0.73	0.90	75.88	52
7	Evaluate the effectiveness and feasibility of delivering treatment for Severe Acute Malnutrition (SAM) through iCCM.	0.82	0.84	0.81	0.90	84.41	21
8	Identify the primary barriers to CHW supervisions and develop and evaluate strategies to motivate CHW supervisors to provide continuous support to the CHWs.	0.81	0.93	0.86	0.90	87.18	9
9	Identify and evaluate the effectiveness and costs of various incentive schemes and strategies for CHWs.	0.81	0.88	0.81	0.89	84.81	10
10	Identify and evaluate determinants of quality of CCM services, including characteristics of health systems (and supporting environment) that are most important for delivering high quality iCCM programs at-scale with limited external support.	0.74	0.86	0.84	0.89	83.22	22

RPS – research priority score, iCCM – integrated community case management

analysis, six research priorities were eliminated from the top twenty-five overall. Research questions that ranked 7, 15, 18 and 22 in the overall list were eliminated due to low scores in the answerability category. Questions seventeen and twenty-four overall were eliminated due to a low score in the deliverability criterion and in both the deliverability and answerability criteria, respectively.

### In-country or regional participants vs participants from organizational headquarters or high-income countries

HQ/HIC Group scores (median 80.9, range: 63.3–91.1) were slightly lower than their LMIC counterparts (median 83.4, range: 63.5–93.1). The correlation of the research questions' ranks between the HQ/HIC group and the LMIC group was weak to moderately positive, though statistically significant (Spearman's  $\rho = 0.35045$ ,  $P < 0.01$ ).

While there was a divergence between research questions prioritized by the LMIC group vs the HQ/HIC group, both

groups of experts scored the first overall research question highly; otherwise, many of the research questions with the highest level of agreement between groups were ranked in the middle or bottom by both groups.

Research questions and their corresponding ranks by informant are displayed in **Online Supplementary Document, Table S3**. Within this table, research questions with the highest level of disagreement between both groups are shaded; blue indicates research priorities that were ranked highly by the HQ/HIC group but not by those in the LMIC group and research priorities shaded in orange indicate the reverse. **Table 4** and **Table 5** display the top 5 research questions ranked by those working in organizational headquarters/HICs and by experts working in-country or regionally, respectively.

We mapped the research questions that appeared in the top 10 (either overall, in the LMIC list or the HQ/HIC list) to the iCCM evaluation framework [19]. Spread across the life cycle of the project, the framework (**Figure 1**) has 8 health system components: (i) organization, coordination, policy

**Table 4.** Top 5 research priorities by organization HQ/HIC participants

HQ RANK	RESEARCH QUESTION	CRITERION 1	CRITERION 2	CRITERION 3	CRITERION 4	HQ RPS	OVERALL RANK
1	Identify and evaluate new diagnostic tools for improved classification of pneumonia (ie, different ARI timers, respiratory counting beads, etc.) at the community level that are most appropriate for various CHW cadres.	0.89	0.92	0.87	0.96	91.09	5
2	Evaluate the effectiveness of 3-day vs 5-day amoxicillin treatment regimens in Africa.	0.83	0.90	0.92	0.94	89.83	6
3	Assess perceptions of beneficiaries and levels of community satisfaction in CHWs' capacity to diagnose and treat sick children (with malaria, pneumonia, diarrhea and severe malnutrition) at the community level.	0.86	0.96	0.94	0.71	86.90	1
4	Identify and evaluate strategies for improving referral between communities and health facilities, including referral compliance.	0.79	0.94	0.85	0.90	86.86	3
5	Evaluate the effectiveness and feasibility of CHWs use of pulse oximetry to identify children with severe pneumonia.	0.90	0.89	0.79	0.89	86.57	40

HQ/HIC – organizational headquarters or high-income countries, RPS – research priority score, iCCM – integrated community case management, CHW – community health worker

**Table 5.** Top 5 research priorities by LMIC participants

COUNTRY RANK	RESEARCH QUESTION	CRITERION 1	CRITERION 2	CRITERION 3	CRITERION 4	COUNTRY RPS	OVERALL RANK
1	Identify the primary barriers to CHW supervision and develop and evaluate strategies to motivate CHW supervisors to provide continuous support to CHWs.	0.89	0.98	0.92	0.94	93.10	9
2	Identify determinants of non-use of iCCM services by caretakers and develop strategies to increase the uptake of iCCM.	0.90	0.95	0.96	0.90	92.61	4
3	Identify and evaluate determinants of quality of CCM services, including characteristics of health systems (and supporting environment) that are most important for delivering high quality iCCM programs at-scale with limited external support.	0.85	0.94	0.94	0.98	92.55	22
4	Identify and evaluate strategies for retention and motivation of CHWs.	0.92	0.96	0.85	0.96	92.27	2
5	Identify and evaluate innovative strategies to improve community engagement and mobilization for CCM.	0.84	0.99	0.96	0.90	92.19	7

LMIC – low- and middle-income countries, RPS – research priority score, iCCM – integrated community case management, CHW – community health worker

& advocacy; (ii) human resources; (iii) supply chain management; (iv) service delivery and referral; (v) social and behavioural change; (vi) supervision and performance; (vii) monitoring and evaluation; and, (viii) budgeting, costing and financing. The top 10 research questions in the LMIC and HQ/HIC lists appear in 7 of the 8 components. Listed under each research question in the Figure are the scores of that research question in the overall, HQ/HIC and LMIC lists, respectively. While some of the research questions have similar scores in all lists, the ranks of some of the research questions in the three lists are greatly divergent.

## DISCUSSION

This CHNRI exercise is the first one, to our knowledge, that uses the methodology to define research gaps and resource priorities for a delivery strategy, rather than a condition. Moreover, our exercise is the first to conduct a comparative analysis of the priorities of different groups of scorers. The results of this exercise will be important in defining the global research agenda for iCCM. Participation in this exercise was not limited to experts in HICs, but included experts based in low-income countries or at regional level, who are implementing or supporting iCCM programs.

Limitations to our exercise include representativeness of sampling and high non-response rate. Although we aimed to include as many experts as possible working in iCCM and issued several calls for names to be nominated, it is possible that we were not able to identify and invite all experts in iCCM. Furthermore, our response rate for the final scores was 56%. Conceivably, those who responded could be systematically different than those who did not. We believe the low response rate to be due to the time consuming nature of completing scoring sheets. However, our response rate was higher than those reported in previous CHNRI exercises [20–22].

Examining community perceptions and satisfactions with CHWs was the highest ranked research priority overall, and this research question had high scores in the deliverability and research feasibility criteria. However, it ranked 46<sup>th</sup> in the importance/potential impact criteria with a score of 0.78, thus providing a good example of how the CHNRI method can be used to expose the strengths and weaknesses of a particular research question. Additionally, the research question with the highest score for importance/potential impact scored low in the answerability criterion, which indicates a potential for difficulty in designing a study to address it.

Experts working in LMICs prioritized research questions that were mainly operational or delivery-based, including strengthening CHW supervision, motivation and retention,

increasing uptake of iCCM services by caretakers, improving community engagement and mobilization and improving the quality of CCM at the health systems level. Experts from organizational HQ/HICs prioritized more technical questions; the two research questions with the highest scores from this group were identifying and evaluating diagnostic tools for different cadres of CHWs and evaluating 3-day vs 5-day amoxicillin treatment in Africa. Again, this finding highlights the importance of the CHNRI exercise in allowing detections of differences in priority perceptions between groups of experts and thus allows the design of studies according to specific priorities.

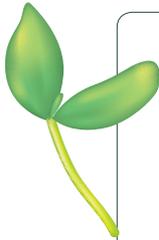
While many of the high-ranking questions in the CHNRI exercise mirror those proposed by the CCM ORG [11,12], there were some notable differences. Of the top 10 research questions, questions #1, 5, 8, and 9 were generated by the CHNRI exercise and were not present in the CCM ORG's original list of research questions. The research question that scored the second highest in the importance/potential impact category was also generated through the CHNRI exercise. For the research questions that were present in the CCM ORG's original list, the use of the CHNRI method to systematically rank the research priorities against pre-set criteria allowed further exploration of the strengths and weaknesses of each proposed research question and lending credibility to the findings.

To our knowledge, our exercise is the first to stratify analysis based on participants' location. The weak to moderate correlation between participants from HQ/HIC group and the LMIC group reveals that while there is some consensus on priorities, there is significant divergence that requires further examination. As it is often those working in organizational HQs or HICs who are responsible for setting the research agenda, the disconnect between their priorities and those of in-country or regional counterparts requires careful consideration. Although the differences could reflect different characteristics and interests between both groups, it could also indicate a larger problem. While we cannot say which groups' opinion on research priorities is has more utility, the discordance is important to highlight to donors and researchers when making decisions on which priorities to fund.

In addition to displaying the research priorities in a particular area, a secondary goal of research priority setting exercises is to stimulate interest and funding for research in that area. We are currently aware of two studies are currently being designed to answer research questions from this exercise. The first is a multi-site study that will explore strategies to improve supervision, retention and motivation of CHWs (questions #2 and 14 overall) and the second will study the effects of adding IYCF counselling skills to CHWs' workload (question #8 overall) (our unpublished data).

iCCM is capable of reducing a substantial number of unnecessary childhood deaths due to pneumonia, diarrhoea and malaria and improving equity in health care access for poor, rural and hard-to-reach communities. We hope that the results of our exercise will continue to direct and assist

fundors, policy-makers, program managers and researchers to identify research priorities, their potential strengths and weaknesses, and to stimulate interest and in furthering the iCCM research agenda.



**Acknowledgements:** We would like to acknowledge all the participants, listed in the Online Supplementary Document, Table S1, who generated and scored research questions for the exercise.

**Funding:** Our study group received funds from a research consortium (comprised of government and non-government agencies) to conduct this exercise and prepare and submit an article for publication (contract numbers MCH-98 and MCH-145). Funds were distributed through John Snow, Inc.

**Authorship declaration:** KW designed and coordinated the study and wrote the first draft of the manuscript. SS and AZ provided substantive technical expertise, assistance in designing and coordinating the study and contributed to drafting the manuscript. DH, TJ, KK, FP, DM, SP, SQ, SR, KR and MY were members of the Advisory Group for the study and as such, contributed to selection of the research questions to be scored, provided feedback during the study and contributed towards editing the manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). DH is currently the co-chair of the CCM Operational Research group and is a member of the CCM Task Force. DM chaired the CCM Operations Research Group and served on the Steering Committee of the Global CCM Task Force. KR is a member of the CCM Operations Research Group. TJ reports grants and non-financial support from the US Government (USAID) outside the submitted work. kw reports grants from John Snow, Inc, during the conduct of the study. AZ reports grants from USAID during the conduct of the study. KK, FP, SP, SQ, SS and MY have nothing to disclose.

## REFERENCES

- 1 UNICEF. Committing to child survival: A promise renewed. Progress Report 2013. New York, NY: UNICEF, 2013. Available at: [http://www.unicef.org/publications/files/APR\\_Progress\\_Report\\_2013\\_9\\_Sept\\_2013.pdf](http://www.unicef.org/publications/files/APR_Progress_Report_2013_9_Sept_2013.pdf). Accessed: 6 September 2014.
- 2 UN Inter-agency Group for Child Mortality Estimation. Levels and trends in child mortality: Report 2013. New York, NY: UN Inter-agency Group for Child Mortality Estimation, 2013. Available at: [http://www.childinfo.org/files/Child\\_Mortality\\_Report\\_2013.pdf](http://www.childinfo.org/files/Child_Mortality_Report_2013.pdf). Accessed: 6 September 2014.
- 3 Countdown to 2015. Accountability for maternal, newborn and child survival: The 2013 Update. Geneva: 2013. Available at: [http://www.countdown2015mnch.org/documents/2013Report/Countdown\\_2013-Update\\_with\\_profiles.pdf](http://www.countdown2015mnch.org/documents/2013Report/Countdown_2013-Update_with_profiles.pdf). Accessed: 6 September 2014.
- 4 Liu L, Johnson H, Cousens S, Perin J, Scott S, Lawn J, et al. Global, regional and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet*. 2012;379:2151-61. Medline:22579125 doi:10.1016/S0140-6736(12)60560-1
- 5 Perry H, Zulliger R. How effective are community health workers?: An overview of current evidence with recommendations for strengthening community health worker programs to accelerate progress in achieving the health-related Millennium Development Goals. Baltimore, MD: Johns Hopkins University, 2012 September 2012. Available at: [http://www.coregroup.org/storage/Program\\_Learning/Community\\_Health\\_Workers/review%20of%20chw%20effectiveness%20for%20mdgs-sept2012.pdf](http://www.coregroup.org/storage/Program_Learning/Community_Health_Workers/review%20of%20chw%20effectiveness%20for%20mdgs-sept2012.pdf). Accessed: 6 September 2014.
- 6 WHO. UNICEF WHO/UNICEF Joint statement on integrated community case management (iCCM): An equity-focused strategy to improve access to essential treatment services for children. New York, NY: 2012 June 2012. Available at: [http://www.unicef.org/health/files/iCCM\\_Joint\\_Statement\\_2012.pdf](http://www.unicef.org/health/files/iCCM_Joint_Statement_2012.pdf). Accessed: 6 September 2014.
- 7 Community case management essentials: Treating common childhood illnesses in the community. A guide for program managers. Washington, D.C.: CORE Group Save the Children BASICS MCHIP, 2010. Available at: <http://www.coregroup.org/storage/documents/CCM/CCMbook-internet2.pdf>. Accessed: 6 September 2014.
- 8 Lainez YB, Wittcoff A, Mohamud AI, Amendola P, Perry H, D'Harcourt E. Insights from community case management data in Six Sub-Saharan African countries. *Am J Trop Med Hyg*. 2012;87(5 Suppl):144-50. Medline:23136290 doi:10.4269/ajtmh.2012.12-0106
- 9 Lady Health Worker Programme. External evaluation of the national programme for family planning and primary health care: Summary of results. Oxford, UK: Oxford Policy Management, 2009. Available at: [http://www.opml.co.uk/sites/opml/files/Lady%20Health%20Worker%20Programme%20-%204th%20Evaluation%20-%20Summary%20of%20Results\\_0.pdf](http://www.opml.co.uk/sites/opml/files/Lady%20Health%20Worker%20Programme%20-%204th%20Evaluation%20-%20Summary%20of%20Results_0.pdf). Accessed: 6 September 2014.

- 10 National Institute of Population Studies. Measure DHS. Pakistan demographic and health survey 2012–13. Islamabad, Pakistan: 2013. Available at: <http://dhsprogram.com/pubs/pdf/FR290/FR290.pdf>. Accessed: 6 September 2014.
- 11 Hamer DH, Marsh D, Peterson S, Pagnoni F Integrated community case management: Next steps in addressing the implementation research agenda. *Am J Trop Med Hyg.* 2012;87(5 Suppl):151-3. Medline:23136291 doi:10.4269/ajtmh.2012.12-0505
- 12 Marsh DR, Hamer D, Pagnoni F, Peterson S. Introduction to a Special supplement: Evidence for the implementation, effects, and impact of the Integrated community case management strategy to treat childhood infection. *Am J Trop Med Hyg.* 2012;87(5 Suppl):2-5. Medline:23136271 doi:10.4269/ajtmh.2012.12-0504
- 13 Fontaine O, Kosek M, Bhatnagar S, Boschi-Pinto C, Chan KY, Duggan C, et al. Setting research priorities to reduce global mortality from childhood diarrhoea by 2015. *PLoS Med.* 2009;6:e41. Medline:19278292 doi:10.1371/journal.pmed.1000041
- 14 Kosek M, Lanata CF, Black RE, Walker DG, Snyder JD, Salam MA, et al. Directing diarrhoeal disease research towards disease–burden reduction. *J Health Popul Nutr.* 2009;27:319-31. Medline:19507747 doi:10.3329/jhpn.v27i3.3374
- 15 Lawn JE, Bahl R, Bergstrom S, Bhutta ZA, Darmstadt GL, Ellis M, et al. Setting research priorities to reduce almost one million deaths from birth asphyxia by 2015. *PLoS Med.* 2011;8:e1000389. Medline:21305038 doi:10.1371/journal.pmed.1000389
- 16 Rudan I, El Arifeen S, Bhutta ZA, Black RE, Brooks A, Chan KY, et al. Setting research priorities to reduce global mortality from childhood pneumonia by 2015. *PLoS Med.* 2011;8:e1001099. Medline:21980266 doi:10.1371/journal.pmed.1001099
- 17 Wazny K, Zipursky A, Black R, Curtis V, Duggan C, Guerrant R, et al. Setting research priorities to reduce mortality and morbidity of childhood diarrhoeal disease in the next 15 years. *PLoS Med.* 2013;10:e1001446. Medline:23690756 doi:10.1371/journal.pmed.1001446
- 18 Rudan I, Gibson JL, Ameratunga S, El Arifeen S, Bhutta ZA, Black M, et al. Setting priorities in global child health research investments: guidelines for implementation of CHNRI method. *Croat Med J.* 2008;49:720-33. Medline:19090596 doi:10.3325/cmj.2008.49.720
- 19 McGorman L, Marsh D, Guenther T, Gilroy K, Barat LM, Hammamy D, et al. A health systems approach to integrated community case management of childhood illness: Methods and Tools. *Am J Trop Med Hyg.* 2012;87(5 Suppl):69-76. Medline:23136280 doi:10.4269/ajtmh.2012.11-0758
- 20 Dean S, Rudan I, Althabe R, Girard A, Howson C, Langer A, et al. Setting research priorities for preconception care in low- and middle-income countries: Aiming to reduce maternal and child mortality and morbidity. *PLoS Med.* 2013;10:e1001508. Medline:24019762 doi:10.1371/journal.pmed.1001508
- 21 George A, Young M, Bang A, Chan KY, Rudan I, Victora CG, et al. Setting implementation research priorities to reduce preterm births and stillbirths at the community Level. *PLoS Med.* 2011;8:e1000380. Medline:21245907 doi:10.1371/journal.pmed.1000380
- 22 Tol WA, Patel V, Tomlinson M, Baingana F, Galappatti A, Panter-Brick C, et al. Research priorities for mental health and psychosocial support in humanitarian settings. *PLoS Med.* 2011;8:e1001096. Medline:21949644 doi:10.1371/journal.pmed.1001096



# Systematic literature review of integrated community case management and the private sector in Africa: Relevant experiences and potential next steps

Phyllis Awor<sup>1,2</sup>, Jane Miller<sup>3</sup>, Stefan Peterson<sup>1,4,5</sup>

<sup>1</sup> School of Public Health, College of Health Sciences, Makerere University, Kampala, Uganda

<sup>2</sup> Centre for International Health, Global Public Health and Primary Care, University of Bergen, Norway

<sup>3</sup> Malaria and Child Survival Department, Population Services International, Nairobi, Kenya

<sup>4</sup> Global Health, Karolinska Institutet, Stockholm, Sweden

<sup>5</sup> International Maternal and Child Health Unit, Uppsala University, Uppsala, Sweden

**Background** Despite substantial investments made over the past 40 years in low income countries, governments cannot be viewed as the principal health care provider in many countries. Evidence on the role of the private sector in the delivery of health services is becoming increasingly available. In this study, we set out to determine the extent to which the private sector has been utilized in providing integrated care for sick children under 5 years of age with community-acquired malaria, pneumonia or diarrhoea.

**Methods** We reviewed the published literature for integrated community case management (iCCM) related experiences within both the public and private sector. We searched PubMed and Google/Google Scholar for all relevant literature until July 2014. The search terms used were “malaria”, “pneumonia”, “diarrhoea”, “private sector” and “community case management”.

**Results** A total of 383 articles referred to malaria, pneumonia or diarrhoea in the private sector. The large majority of these studies (290) were only malaria related. Most of the iCCM-related studies evaluated introduction of only malaria drugs and/or diagnostics into the private sector. Only one study evaluated the introduction of drugs and diagnostics for malaria, pneumonia and diarrhoea in the private sector. In contrast, most iCCM-related studies in the public sector directly reported on community case management of 2 or more of the illnesses.

**Conclusions** While the private sector is an important source of care for children in low income countries, little has been done to harness the potential of this sector in improving access to care for non-malaria-associated fever in children within the community. It would be logical for iCCM programs to expand their activities to include the private sector to achieve higher population coverage. An implementation research agenda for private sector integrated care of febrile childhood illness needs to be developed and implemented in conjunction with private sector intervention programs.

## Correspondence to:

Phyllis Awor  
School of Public Health, College of Health Sciences  
Makerere University, PO Box 7072  
Kampala, Uganda  
aworphyllis@yahoo.co.uk

Despite substantial investments made over the past 40 years in low income countries, governments cannot be viewed as the principal health care provider in many countries [1]. Evidence on the role of the private sector in the delivery of health services is becoming more available [2,3].

Integrated community case management (iCCM) of malaria, pneumonia and diarrhoea is a public sector strategy aimed at improving timely access to treatment for sick children in resource limited settings [4]. It is now being scaled up across the African continent, largely by means of community health workers. However, in many low income countries, the first source of care for most children with fever is usually the private sector, mainly comprising of small drug shops which sell medicines as a business [5-8]. The quality of care provided at this level is also known to be low [7,9].

We set out to determine the extent to which the private sector has been utilized in providing integrated care for sick children under-5 years of age with community-acquired malaria, pneumonia or diarrhoea.

## METHODS

Where relevant, we followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement and checklist in designing and reporting our review [10]. We reviewed the published literature for iCCM related experiences within both the public and private sector. We searched PubMed and Google/Google Scholar for all relevant literature until July 2014. The search terms used were “malaria”, “pneumonia”, “diarrhoea”, “private sector” and “community case management”. In PubMed, we used the advanced search option. We combined the search terms and searched for private sector and public sector studies, respectively, using the following search phrases: “(((malaria) OR pneumonia) OR diarrhoea) AND private sector” and “(((diarrhoea) OR pneumonia) OR malaria) AND community case management.”

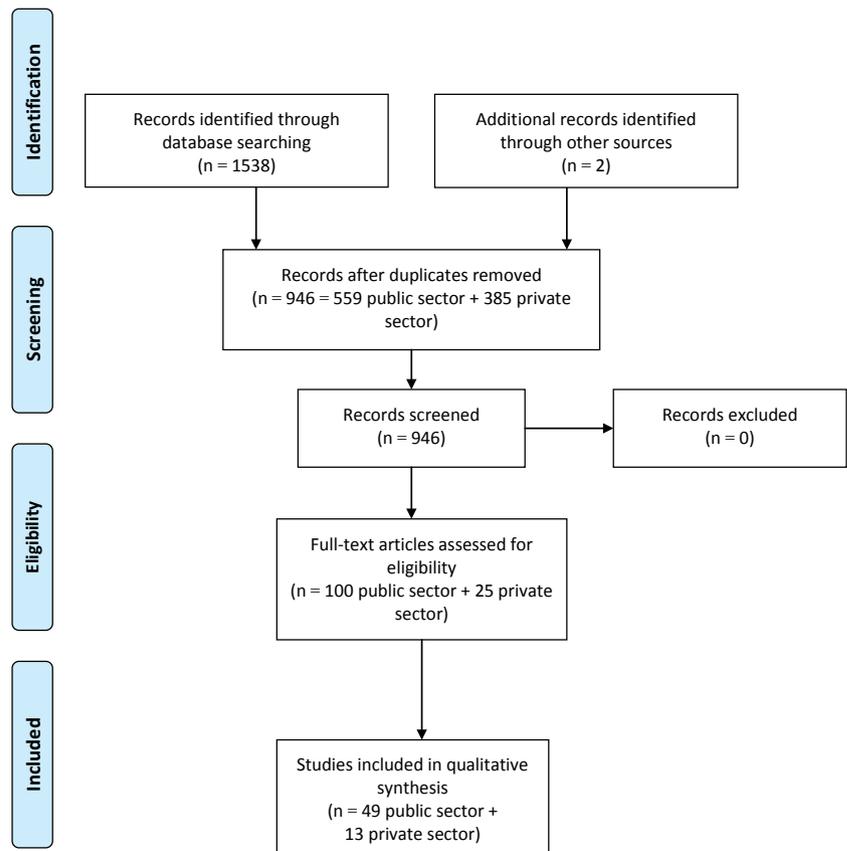
In the first step, we screened the titles of all the articles retrieved from both searches. The abstracts of the titles that included malaria, pneumonia or diarrhoea in the public or private sector were then selected and read. Finally, for articles where abstracts reported results from evaluation studies that met our inclusion criteria, we read through the full text to confirm this. Wherever clarification was needed, we re-

read through the full text of the relevant articles. We included all peer-reviewed studies reporting the evaluation of any intervention with drugs and or diagnostics for malaria, pneumonia or diarrhoea, or a combination of those illnesses in children within the private or public sector. We included the following types of studies: randomized controlled trials, quasi experimental studies, and studies with a pre-post design with or without a control group. We also accessed grey literature by searching websites of organizations involved in private sector work. The number and characteristics of studies in both private and public sector, reporting iCCM-related interventions either separately or in an integrated manner, are reported.

## RESULTS

A total of 944 papers were found by searching the databases. These included 385 private sector and 559 public sector papers. An additional 2 papers were included from the grey literature. After screening, 13 private sector and 49 public sector papers remained for final analysis (Figure 1). The final papers included were from studies conducted in 20 countries: 44 in Africa, 16 in Asia and 2 in Latin America. Most studies were conducted in rural settings.

We found 385 articles referring to malaria, pneumonia or diarrhoea in the private sector. The majority of these stud-



**Figure 1.** Flow diagram of literature search and screening.

**Table 1.** Studies reporting evaluation of interventions for malaria, pneumonia or diarrhoea in the private sector, by disease category

DISEASE(S)	AUTHOR	TITLE
<b>Malaria</b>	Thomson et al. 2014 [11]	Has Tanzania embraced the green leaf? Results from outlet and household surveys before and after implementation of the Affordable Medicines Facility–malaria
	Ikwuobe et al. 2013 [12]	The impact of rapid malaria diagnostic tests upon anti–malarial sales in community pharmacies in Gwagwalada, Nigeria
	Kangwana et al. 2013 [13]	The effect of an anti–malarial subsidy programme on the quality of service provision of artemisinin–based combination therapy in Kenya: a cluster–randomized, controlled trial
	Tougher et al. 2012 [14]	Effect of the Affordable Medicines Facility—malaria (AMFm) on the availability, price, and market share of quality–assured artemisinin–based combination therapies in seven countries: a before–and–after analysis of outlet survey data
	Talisuna et al. 2012 [15]	Closing the access barrier for effective anti–malarials in the private sector in rural Uganda: consortium for artemisinin–based combination therapy (ACT) private sector subsidy (CAPSS) pilot study
	Yeung et al. 2011 [16]	Socially marketed rapid diagnostic tests and ACT in the private sector: ten years of experience in Cambodia
	Littrel et al. 2011 [17]	Case management of malaria fever in Cambodia: results from national anti–malarial outlet and household surveys
	Rutta et al. 2011 [18]	Increasing access to subsidized artemisinin–based combination therapy through accredited drug dispensing outlets in Tanzania
	Kangwana et al. 2011 [19]	The impact of retail–sector delivery of artemether–lumefantrine on malaria treatment of children under five in Kenya: a cluster randomized controlled trial
	Alba et al. 2010 [20]	Improvements in access to malaria treatment in Tanzania after switch to artemisinin combination therapy and the introduction of accredited drug dispensing outlets – a provider perspective
	Abuya et al. 2010 [21]	Evaluating different dimensions of programme effectiveness for private medicine retailer malaria control interventions in Kenya
<b>Pneumonia</b>		No articles
<b>Diarrhoea</b>	Larson et al. 2012 [22]	Scaling up zinc treatment of childhood diarrhoea in Bangladesh: theoretical and practical considerations guiding the SUZY Project
<b>Malaria, pneumonia and diarrhoea integrated care</b>	Awor et al. 2014 [23]	Increased access to care and appropriateness of treatment at private sector drug shops with integrated management of malaria, pneumonia and diarrhoea: a quasi–experimental study in Uganda

ies (290) were only malaria related. Thirteen studies met the inclusion criteria (**Table 1**) and most of them (86%) evaluated only introduction of malaria drugs and/or diagnostics into the private sector [11–21]. There were no articles reporting community level interventions for pneumonia treatment or diagnosis within the private sector. Only one study evaluated a diarrhoea treatment intervention, using both private and public sector [22].

Moreover, there were limited iCCM–related experiences in the private sector within the published literature, where diagnosis of non–malaria fever was made and alternative treatment provided to sick children. We are aware of one study introducing diagnostics and pre–packaged drugs for malaria, pneumonia and diarrhoea into private sector drug shops [23]. Population Services International (PSI) is implementing iCCM in several countries [24] and Larsen et al. (in preparation) will report on improving quality of private sector case management of diarrhoea, pneumonia and malaria in Uganda using a Social Franchising approach.

In contrast, of 559 articles retrieved when we searched for iCCM–related experiences in the public sector, the majority were directly related to CCM of 2 or more illnesses (malaria, pneumonia and diarrhoea). Forty nine articles met the inclusion criteria of studies evaluating an intervention with drugs or diagnostics in the community, for malaria, pneumonia or diarrhoea. Only 13 (26%) of the included

studies on iCCM in the public sector evaluated an intervention for malaria only (**Table 2**).

## DISCUSSION

Experiences with integrated community case management of malaria, pneumonia and diarrhoea by means of public sector community health workers is increasingly reflected in the literature. Meanwhile, interventions in the private sector have so far targeted largely malaria diagnosis and management.

The community case management experience using community health workers in Africa was initiated by the Home Management of Malaria experience [36]. However, challenged by symptom overlap with other febrile illness [74] and spurred by the largely Asian success in community management of pneumonia [75], it then followed the example of integrated care in health facilities under IMCI to also become integrated in the community [4].

Meanwhile, interventions in the private sector have focused on malaria alone. This follows the historical pattern of Home Management of Malaria, and the hitherto sole malaria focus of major funders and initiatives such as the Global Fund's Affordable Medicine Facility malaria (AMFm) [14]. From a point of quality of care to the individual sick

**Table 2.** Studies reporting evaluation of interventions for malaria, pneumonia or diarrhoea in the public sector, by disease category

DISEASE(S)	AUTHOR	TITLE	
Malaria	Siekmans et al. 2013 [25]	Community case management of malaria: a pro-poor intervention in rural Kenya	
	Ndiaye et al. 2013 [26]	Community case management in malaria: review and perspectives after four years of operational experience in Saraya district, south-east Senegal	
	Blanas et al. 2013 [27]	Barriers to community case management of malaria in Saraya, Senegal: training, and supply-chains	
	Thiam et al. 2012 [28]	Scale-up of home-based management of malaria based on rapid diagnostic tests and artemisinin-based combination therapy in a resource-poor country: results in Senegal	
	Lim et al. 2012 [29]	Promoting community knowledge and action for malaria control in rural Cambodia: potential contributions of Village Malaria Workers	
	Tine et al. 2011 [30]	Impact of combining intermittent preventive treatment with home management of malaria in children less than 10 years in a rural area of Senegal: a cluster randomized trial	
	Chanda et al. 2011 [31]	Community case management of malaria using artemisinin-based combination therapy (ACT) and rapid diagnostic tests (RDT) in two districts in Zambia: achieving high adherence to test results using community health workers	
	Mubi et al. 2011 [32]	Malaria rapid testing by community health workers is effective and safe for targeting malaria treatment: randomised cross-over trial in Tanzania	
	Nusungwa-Sabiiti et al. 2007 [33]	Home-based management of fever and malaria treatment practices in Uganda	
	Chinbuah et al. 2006 [34]	Feasibility and acceptability of the use of artemether-lumefantrine in the home management of uncomplicated malaria in 6-59 month-old children in Ghana	
	Kolaczinski et al. 2006 [35]	Adherence of community caretakers of children to pre-packaged antimalarial medicines (HOMAPAK) among internally displaced people in Gulu district, Uganda	
	Kidane and Morrow 2000 [36]	Teaching mothers to provide home treatment of malaria in Tigray, Ethiopia: a randomised trial	
	Pneumonia	Kalyango et al. 2013 [37]	Integrated community case management of malaria and pneumonia Increases prompt and appropriate treatment for pneumonia symptoms in children under five years in Eastern Uganda
		Noordam et al. 2014 [38]	The use of counting beads to improve the classification of fast breathing in low-resource settings: a multi-country review
		Bari et al. 2011 [39]	Community case management of severe pneumonia with oral amoxicillin in children aged 2-59 months in Haripur district, Pakistan: a cluster randomised trial
		Soofi et al. 2012 [40]	Effectiveness of community case management of severe pneumonia with oral amoxicillin in children aged 2-59 months in Matiari district, rural Pakistan: a cluster-randomised controlled trial
Sylla et al. 2007 [41]		Low level educated community health workers training: a strategy to improve children access to acute respiratory treatment in Senegal	
Kallander et al. 2006 [42]		Can community health workers and caretakers recognize pneumonia in children? Experiences from western Uganda	
Hadi et al. 2002 [43]		Diagnosis of pneumonia by community health volunteers: experience of BRAC, Bangladesh	
Mehnaz et al. 1997 [44]		Detection and management of pneumonia by community health workers—a community intervention study in Rehri village, Pakistan	
Bang et al. 1990 [45]		Reduction in pneumonia mortality and total childhood mortality by means of community-based intervention trial in Gadchiroli, India	
Khan et al. 1990 [46]		Acute respiratory infections in children: a case management intervention in Abbottabad District, Pakistan	
Fagbule et al. 1994 [47]		Acute respiratory infections in Nigerian children: prospective cohort study of incidence and case management	
Bang et al. 1993 [48]		Pneumonia in neonates: can it be managed in the community?	
Bang et al. 1994 [49]		Management of childhood pneumonia by traditional birth attendants. The SEARCH Team	
Diarrhoea		Bhandari et al. 2005 [50]	A pilot test of the addition of zinc to the current case management package of diarrhea in a primary health care setting
	Sircar et al. 1991 [51]	An operational study on implementation of oral rehydration therapy in a rural community of West Bengal, India	
	Benavides et al. 1994 [52]	An operational evaluation of the Community Oral Rehydration Units in Peru	
	Gupta et al. 1994 [53]	Implementation of oral rehydration therapy (ORT): some problems encountered in training of health workers during an operational research programme	
Malaria and pneumonia	Kalyango et al. 2013 [54]	High adherence to antimalarials and antibiotics under integrated community case management of illness in children less than five years in eastern Uganda	
	Chinbuah et al. 2012 [55]	Impact of community management of fever (using antimalarials with or without antibiotics) on childhood mortality: a cluster-randomized controlled trial in Ghana	
	Mukanga et al. 2012 [56]	Integrated community case management of fever in children under five using rapid diagnostic tests and respiratory rate counting: a multi-country cluster randomized trial	
	Kalyango et al. 2012 [57]	Increased use of community medicine distributors and rational use of drugs in children less than five years of age in Uganda caused by integrated community case management of fever	
	Seidenberg et al. 2012 [58]	Impact of integrated community case management on health-seeking behavior in rural Zambia	
	Kalyango et al. 2012 [59]	Performance of community health workers under integrated community case management of childhood illnesses in eastern Uganda	
	Hamer et al. 2012 [60]	Quality and safety of integrated community case management of malaria using rapid diagnostic tests and pneumonia by community health workers	

Table 2. Continued

DISEASE(S)	AUTHOR	TITLE
	Mukanga et al. 2011 [61]	Can lay community health workers be trained to use diagnostics to distinguish and treat malaria and pneumonia in children? Lessons from rural Uganda
	Yeboah–Antwi et al. 2010 [62]	Community case management of fever due to malaria and pneumonia in children under five in Zambia: a cluster randomized controlled trial
<b>Malaria and diarrhoea</b>	Littrell et al. 2013 [63]	Narrowing the treatment gap with equitable access: mid–term outcomes of a community case management program in Cameroon
<b>Diarrhoea and Pneumonia</b>	Puett et al. 2012 [64]	Does greater workload lead to reduced quality of preventive and curative care among community health workers in Bangladesh?
	Ghimire et al. 2010 [65]	Community–based interventions for diarrhoeal diseases and acute respiratory infections in Nepal
	Cesar et al. 2002 [66]	Changes in child health indicators in a municipality with community health workers: the case of Itapirapuã Paulista, Vale do Ribeira, São Paulo State, Brazil
<b>Malaria, pneumonia and diarrhoea</b>	Mugeni et al. 2014 [67]	Nationwide implementation of integrated community case management of childhood illness in Rwanda
	Yansaneh et al. 2014 [68]	Influence of community health volunteers on care seeking and treatment coverage for common childhood illnesses in the context of free health care in rural Sierra Leone
	Miller et al. 2014 [69]	Integrated community case management of childhood illness in Ethiopia: implementation strength and quality of care
	Langston et al. 2014 [70]	Plausible role for community health worker (CHW) peer support groups in increasing care–seeking in an integrated community case management project in Rwanda: a mixed methods evaluation
	Lainez et al. 2012 [71]	Insights from community case management data in six sub–Saharan African countries
	Cardemil et al. 2012 [72]	Comparison of methods for assessing quality of care for community case management of sick children: an application with community health workers in Malawi
	Chandani et. al 2012 [73]	Factors affecting availability of essential medicines among community health workers in Ethiopia, Malawi, and Rwanda: solving the last mile puzzle

child, as well as to make drug use more rational, it seems logical to integrate service delivery for acute febrile illness for the main causes of fever to provide alternative appropriate treatment where malaria diagnostics are negative. Here, the iCCM strategy is one vehicle. The current Global Fund application round has not quite reached integrated care of febrile illness, but it opens the door to integration with other funders towards integrated management. In March 2014, a joint statement was signed by UNICEF, Global Fund and the RMNCH Strategy Coordination Team, expressing an intention to strengthen coordination around the implementation and financing of the integration agenda, with a focus on iCCM.

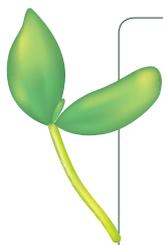
However, there have been many efforts to improve quality of care in the private sector. Shah et al. reviewed the experience with different interventions, finding limited effect of the most widely used intervention model – training – suggesting to include also incentives and accountability [76]. Social franchising allows a network of independently operated health outlets to provide services and commodities to clients with oversight by a coordinating agency [77]. It provides business incentive for the health outlets and increases accountability [78], but further research is needed on the effect of social franchising on quality of care [79]. Meanwhile, the equity aspects of private sector interventions need to be clarified [80]. Also, private providers become quite context specific, requiring context–relevant interventions [8]. This implies need for further research on iCCM in private sector, and the utility of iCCM in private sector interventions, within a

context of implementation research in conjunction with programs in different setting [24,81], along the lines of WHO's on–going RaCE evaluation of community health worker iCCM implementation [82].

A possible limitation of this review is that even though we tried to include all available literature/publications, some literature may not have been accessed, especially the most recent.

## CONCLUSION

While the private sector is an important source of care for children in low income countries, little has been done to harness the potential of this sector in improving access to care for non–malaria fever in children within the community. It is important for interventions and research within the private sector to provide integrated care for sick children, and not only focus on care for malaria. The iCCM strategy has the potential to act as a vehicle to improve both quality of care and make drug use more rational in the private sector, provided appropriate modification is done to reflect private sector specificities. It is also logical for iCCM programs to expand their activities to include the private sector to achieve higher population coverage. An implementation research agenda for private sector integrated care of febrile childhood illness needs to be developed and implemented in conjunction with private sector intervention programs.



**Funding:** No funding was directly sought for this review.

**Disclaimer:** The views expressed here are solely of the authors and not their institutions.

**Authorship contributions:** PA, JM, SP designed the study. PA led the review process. PA, SP interpreted the findings. The manuscript was written by PA, and all authors approved the final manuscript.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author). We declare that we have no conflicts of interest.

## REFERENCES

- 1 Walker D, Champion C, Hossain S, Wahed T, Gazi R, Koehlmoos T, et al. Establishing non–state sector research priorities in developing countries using a participatory methodology. Geneva: Alliance for Health Policy and Systems Research and WHO, 2009. Available at: <http://www.who.int/alliance-hpsr/projects/alliancehpsr-non-statepaper.pdf>. Accessed: 1 October 2014.
- 2 Forsberg BC, Montagu D, Sundewall J. Moving towards in–depth knowledge on the private health sector in low– and middle–income countries. *Health Policy Plan.* 2011;26 Suppl 1:i1-3. Medline:21729912 doi:10.1093/heapol/czr050
- 3 Forsberg BC, Montagu D. Further advances in knowledge on the role of the private sector in health systems. *Health Policy Plan.* 2014;29 Suppl 1:i1-3. Medline:25012793 doi:10.1093/heapol/czu018
- 4 Young M, Wolfheim C, Marsh DR, Hammamy D. World Health Organization/United Nations Children's Fund joint statement on integrated community case management: An equity–focused strategy to improve access to essential treatment services for children. *Am J Trop Med Hyg.* 2012;87(5 Suppl):6-10. Medline:23136272 doi:10.4269/ajtmh.2012.12-0221
- 5 Littrell M, Gatakaa H, Evance I, Poyer S, Njogu J, Solomon T, et al. Monitoring fever treatment behaviour and equitable access to effective medicines in the context of initiatives to improve ACT access: baseline results and implications for programming in six African countries. *Malar J.* 2011;10:327. Medline:22039892 doi:10.1186/1475-2875-10-327
- 6 Rutebemberwa E, Pariyo G, Tomson G, Kallander K. Utilization of public or private health care providers by febrile children after user fee removal in Uganda. *Malar J.* 2009;8:45. Medline:19284673 doi:10.1186/1475-2875-8-45
- 7 Awor P, Wamani H, Bwire G, Jagoe G, Peterson S. Private sector drug shops in integrated community case management of malaria, pneumonia, and diarrhea in children in Uganda. *Am J Trop Med Hyg.* 2012;87(5 Suppl):92-6. Medline:23136283 doi:10.4269/ajtmh.2012.11-0791
- 8 Gautham M, Shyamprasad KM, Singh R, Zachariah A, Singh R, Bloom G. Informal rural healthcare providers in North and South India. *Health Policy Plan.* 2014;29 Suppl 1:i20-9. Medline:25012795 doi:10.1093/heapol/czt050
- 9 Hetzel MW, Dillip A, Lengeler C, Obrist B, Msechu JJ, Makemba AM. Malaria treatment in the retail sector: knowledge and practices of drug sellers in rural Tanzania. *BMC Public Health.* 2008;8:157. Medline:18471299 doi:10.1186/1471-2458-8-157
- 10 Moher D, Liberati A, Tetzlaff J, Altman DG. PRISMA Group. Preferred reporting items for systematic reviews and meta–analyses: the PRISMA statement. *BMJ.* 2009;339:b2535. Medline:19622551 doi:10.1136/bmj.b2535
- 11 Thomson R, Festo C, Johanes B, Kalolella A, Bruxvoort K, Nchimbi H. Has Tanzania embraced the green leaf? Results from outlet and household surveys before and after implementation of the Affordable Medicines Facility–malaria. *PLoS ONE.* 2014;9:e95607. Medline:24816649
- 12 Ikwuobe JO, Faragher BE, Alawode G, Lalloo DG. The impact of rapid malaria diagnostic tests upon anti–malarial sales in community pharmacies in Gwagwalada, Nigeria. *Malar J.* 2013;12:380. Medline:24172163 doi:10.1186/1475-2875-12-380
- 13 Kangwana BP, Kedenge SV, Noor AM, Alegana VA, Nyandigisi AJ, Pandit J, et al. The effect of an anti–malarial subsidy programme on the quality of service provision of artemisinin–based combination therapy in Kenya: a cluster–randomized, controlled trial. *Malar J.* 2013;12:81. Medline:23452547 doi:10.1186/1475-2875-12-81
- 14 Tougher S; ACTwatch Group, Ye Y, Amuasi JH, Kourgueni IA, Thomson R, et al. Effect of the Affordable Medicines Facility – malaria (AMFm) on the availability, price, and market share of quality–assured artemisinin–based combination therapies in seven countries: a before–and–after analysis of outlet survey data. *Lancet.* 2012;380:1916-26. Medline:23122217 doi:10.1016/S0140-6736(12)61732-2
- 15 Talisuna AO, Daumerie PG, Balyeku A, Egan T, Piot B, Coghlan R, et al. Closing the access barrier for effective anti–malarials in the private sector in rural Uganda: consortium for ACT private sector subsidy (CAPSS) pilot study. *Malar J.* 2012;11:356. Medline:23107021 doi:10.1186/1475-2875-11-356
- 16 Yeung S, Patouillard E, Allen H, Socheat D. Socially–marketed rapid diagnostic tests and ACT in the private sector: ten years of experience in Cambodia. *Malar J.* 2011;10:243. Medline:21851625 doi:10.1186/1475-2875-10-243

- 17 Littrell M, Gatakaa H, Phok S, Allen H, Yeung S, Chuor CM, et al. Case management of malaria fever in Cambodia: results from national anti-malarial outlet and household surveys. *Malar J.* 2011;10:328. Medline:22039922 doi:10.1186/1475-2875-10-328
- 18 Rutta E, Kibassa B, McKinnon B, Liana J, Mbwasi R, Mlaki W, et al. Increasing access to subsidized artemisinin-based combination therapy through accredited drug dispensing outlets in Tanzania. *Health Res Policy Syst.* 2011;9:22. Medline:21658259 doi:10.1186/1478-4505-9-22
- 19 Kangwana BP, Kedenge SV, Noor AM, Alegana VA, Nyandigisi AJ, Pandit J, et al. The impact of retail-sector delivery of artemether-lumefantrine on malaria treatment of children under five in Kenya: a cluster randomized controlled trial. *PLoS Med.* 2011;8:e1000437. Medline:21655317 doi:10.1371/journal.pmed.1000437
- 20 Alba S, Dillip A, Hetzel MW, Mayumana I, Mshana C, Makemba A, et al. Improvements in access to malaria treatment in Tanzania following community, retail sector and health facility interventions — a user perspective. *Malar J.* 2010;9:163. Medline:20550653 doi:10.1186/1475-2875-9-163
- 21 Abuya TO, Fegan G, Amin AA, Akhwale WS, Noor AM, Snow RW, et al. Evaluating different dimensions of programme effectiveness for private medicine retailer malaria control interventions in Kenya. *PLoS ONE.* 2010;5:e8937. Medline:20126620 doi:10.1371/journal.pone.0008937
- 22 Larson CP, Koehlmoos TP, Sack DA, Abuya TO, Abuya TO, Abuya TO, Scaling Up of Zinc for Young Children (SUZY) Project Team CP. Scaling up zinc treatment of childhood diarrhoea in Bangladesh: theoretical and practical considerations guiding the SUZY Project. *Health Policy Plan.* 2012;27:102-14. Medline:21343236 doi:10.1093/heapol/czr015
- 23 Awor P, Wamani H, Tyyleskar T, Jagoe G, Peterson S. Increased access to care and appropriateness of treatment at private sector drug shops with integrated management of malaria, pneumonia and diarrhoea: a quasi-experimental study in Uganda. *PLoS ONE.* 2014, in press.
- 24 Population Services International. Integrated case management. Available from: <http://www.psi.org/our-work/healthy-lives/interventions/ccmimpact-program>. Accessed: 27 August 2014.
- 25 Siekmans K, Sohani S, Kisja J, Kiilu K, Wamalwa E, Nelima F, et al. Community case management of malaria: a pro-poor intervention in rural Kenya. *Int Health.* 2013;5:196-204. Medline:24030270 doi:10.1093/inthealth/iht017
- 26 Ndiaye Y, Ndiaye JL, Cisse B, Blanas D, Bassene J, Manga IA, et al. Community case management in malaria: review and perspectives after four years of operational experience in Saraya district, south-east Senegal. *Malar J.* 2013;12:240. Medline:23849053 doi:10.1186/1475-2875-12-240
- 27 Blanas DA, Ndiaye Y, Nichols K, Jensen A, Siddiqui A, Hennig N. Barriers to community case management of malaria in Saraya, Senegal: training, and supply-chains. *Malar J.* 2013;12:95. Medline:23497188 doi:10.1186/1475-2875-12-95
- 28 Thiam S, Thwing J, Diallo I, Fall FB, Diouf MB, Perry R, et al. Scale-up of home-based management of malaria based on rapid diagnostic tests and artemisinin-based combination therapy in a resource-poor country: results in Senegal. *Malar J.* 2012;11:334. Medline:23009244 doi:10.1186/1475-2875-11-334
- 29 Lim S, Yasuoka J, Poudel KC, Ly P, Nguon C, Jimba M. Promoting community knowledge and action for malaria control in rural Cambodia: potential contributions of Village Malaria Workers. *BMC Res Notes.* 2012;5:405. Medline:22863397 doi:10.1186/1756-0500-5-405
- 30 Tine RC, Faye B, Ndour CT, Ndiaye JL, Ndiaye M, Bassene C, et al. Impact of combining intermittent preventive treatment with home management of malaria in children less than 10 years in a rural area of Senegal: a cluster randomized trial. *Malar J.* 2011;10:358. Medline:22166001 doi:10.1186/1475-2875-10-358
- 31 Chanda P, Hamainza B, Moonga HB, Chalwe V, Pagnoni F. Community case management of malaria using ACT and RDT in two districts in Zambia: achieving high adherence to test results using community health workers. *Malar J.* 2011;10:158. Medline:21651827 doi:10.1186/1475-2875-10-158
- 32 Mubi M, Janson A, Warsame M, Mirtensson A, Källander K, Petzold MG, et al. Malaria rapid testing by community health workers is effective and safe for targeting malaria treatment: randomised cross-over trial in Tanzania. *PLoS ONE.* 2011;6:e19753. Medline:21750697 doi:10.1371/journal.pone.0019753
- 33 Nsungwa-Sabiiti J, Peterson S, Pariyo G, Ogwal-Okeng J, Petzold MG, Tomson G. Home-based management of fever and malaria treatment practices in Uganda. *Trans R Soc Trop Med Hyg.* 2007;101:1199-207. Medline:17945320 doi:10.1016/j.trstmh.2007.08.005
- 34 Chinbuah AM, Gyapong JO, Pagnoni F, Wellington EK, Gyapong M. Feasibility and acceptability of the use of artemether-lumefantrine in the home management of uncomplicated malaria in children 6–59 months old in Ghana. *Trop Med Int Health.* 2006;11:1003-16. Medline:16827701 doi:10.1111/j.1365-3156.2006.01654.x
- 35 Kolaczinski JH, Ojok N, Opwonya J, Meek S, Collins A. Adherence of community caretakers of children to pre-packaged antimalarial medicines (HOMAPAK) among internally displaced people in Gulu district, Uganda. *Malar J.* 2006;5:40. Medline:16700903 doi:10.1186/1475-2875-5-40
- 36 Kidane G, Morrow RH. Teaching mothers to provide home treatment of malaria in Tigray, Ethiopia: a randomised trial. *Lancet.* 2000;356:550-5. Medline:10950232 doi:10.1016/S0140-6736(00)02580-0
- 37 Kalyango JN, Alfven T, Peterson S, Mugenyi K, Karamagi C, Rutebemberwa E. Integrated community case management of malaria and pneumonia increases prompt and appropriate treatment for pneumonia symptoms in children under five years in Eastern Uganda. *Malar J.* 2013;12:340. Medline:24053172 doi:10.1186/1475-2875-12-340
- 38 Noordam AC, Barberá Láinez Y, Sadruddin S, van Heck PM, Chono AO, Acaye GL, et al. The use of counting beads to improve the classification of fast breathing in low-resource settings: a multi-country review. *Health Policy Plan.* 2014;pii:czu047. Epub ahead of print. Medline:24974104

- 39 Bari A, Sadruddin S, Khan A, Khan Iu, Khan A, Lehri IA, et al. Community case management of severe pneumonia with oral amoxicillin in children aged 2–59 months in Haripur district, Pakistan: a cluster randomised trial. *Lancet*. 2011;378:1796-803. Medline:22078721 doi:10.1016/S0140-6736(11)61140-9
- 40 Soofi S, Ahmed S, Fox MP, MacLeod WB, Thea DM, Qazi SA, et al. Effectiveness of community case management of severe pneumonia with oral amoxicillin in children aged 2–59 months in Matiari district, rural Pakistan: a cluster-randomised controlled trial. *Lancet*. 2012;379:729-37. Medline:22285055 doi:10.1016/S0140-6736(11)61714-5
- 41 Sylla A, Gučye EH, N'diaye O, Sarr CS, Ndiaye D, Diouf S, et al. Low level educated community health workers training: a strategy to improve children access to acute respiratory treatment in Senegal. [in French]. *Arch Pediatr*. 2007;14:244-8. Medline:17175144 doi:10.1016/j.arcped.2006.11.022
- 42 Källander K, Tomson G, Nsabagasani X, Sabiiti JN, Pariyo G, Peterson S. Can community health workers and caretakers recognise pneumonia in children? Experiences from western Uganda. *Trans R Soc Trop Med Hyg*. 2006;100:956-63. Medline:16455119 doi:10.1016/j.trstmh.2005.11.004
- 43 Hadi A. Diagnosis of pneumonia by community health volunteers: experience of BRAC, Bangladesh. *Trop Doct*. 2001;31:75-7. Medline:11321276
- 44 Mehnaz A, Billoo AG, Yasmeen T, Nankani K. Detection and management of pneumonia by community health workers—a community intervention study in Rehri village, Pakistan. *J Pak Med Assoc*. 1997;47:42-5. Medline:9071859
- 45 Bang AT, Bang RA, Tale O, Sontakke P, Solanki J, Wargantiwar R, et al. Reduction in pneumonia mortality and total childhood mortality by means of community-based intervention trial in Gadchiroli, India. *Lancet*. 1990;336:201-6. Medline:1973770 doi:10.1016/0140-6736(90)91733-Q
- 46 Khan AJ, Khan JA, Akbar M, Addiss DG. Acute respiratory infections in children: a case management intervention in Abbottabad District, Pakistan. *Bull World Health Organ*. 1990;68:577-85. Medline:2289294
- 47 Fagbule D, Parakoyi DB, Spiegel R. Acute respiratory infections in Nigerian children: prospective cohort study of incidence and case management. *J Trop Pediatr*. 1994;40:279-84. Medline:7807622 doi:10.1093/tropej/40.5.279
- 48 Bang AT, Bang RA, Morankar VP, Sontakke PG, Solanki JM. Pneumonia in neonates: can it be managed in the community? *Arch Dis Child*. 1993;68(5 Spec No):550-6. Medline:8323354 doi:10.1136/adc.68.5\_Spec\_No.550
- 49 Bang AT, Bang RA, Sontakke PG. Management of childhood pneumonia by traditional birth attendants. The SEARCH Team. *Bull World Health Organ*. 1994;72:897-905. Medline:7867135
- 50 Bhandari N, Mazumder S, Taneja S, Dube B, Black RE, Fontaine O, et al. A pilot test of the addition of zinc to the current case management package of diarrhea in a primary health care setting. *J Pediatr Gastroenterol Nutr*. 2005;41:685-7. Medline:16254536 doi:10.1097/01.mpg.0000182799.69675.92
- 51 Sircar BK, Deb BC, Sengupta PG, Mondal S, Gupta DN, Sarkar S, et al. An operational study on implementation of oral rehydration therapy in a rural community of West Bengal, India. *Indian J Med Res*. 1991;93:297-302. Medline:1778617
- 52 Benavides BM, Jacoby ER. An operational evaluation of the Community Oral Rehydration Units in Peru. *Health Policy Plan*. 1994;9:438-43. Medline:10139476 doi:10.1093/heapol/9.4.438
- 53 Gupta DN, SenGupta PG, Sircar BK, Mondal S, Sarkar S, Deb BC. Implementation of ORT: some problems encountered in training of health workers during an operational research programme. *Indian J Public Health*. 1994;38:69-72. Medline:7836000
- 54 Kalyango JN, Rutebemberwa E, Karamagi C, Mworozzi E, Ssali S, Alfven T, et al. High adherence to antimalarials and antibiotics under integrated community case management of illness in children less than five years in eastern Uganda. *PLoS ONE*. 2013;8:e60481. Medline:23555980 doi:10.1371/journal.pone.0060481
- 55 Chinbuah MA, Kager PA, Abbey M, Gyapong M, Awini E, Nonvignon J, et al. Impact of community management of fever (using antimalarials with or without antibiotics) on childhood mortality: a cluster-randomized controlled trial in Ghana. *Am J Trop Med Hyg*. 2012;87(5 Suppl):11-20. Medline:23136273 doi:10.4269/ajtmh.2012.12-0078
- 56 Mukanga D, Tiono AB, Anyorigiya T, Källander K, Konaté AT, Oduro AR, et al. Integrated community case management of fever in children under five using rapid diagnostic tests and respiratory rate counting: a multi-country cluster randomized trial. *Am J Trop Med Hyg*. 2012;87(5 Suppl):21-9. Medline:23136274 doi:10.4269/ajtmh.2012.11-0816
- 57 Kalyango JN, Lindstrand A, Rutebemberwa E, Ssali S, Kadobera D, Karamagi C, et al. Increased use of community medicine distributors and rational use of drugs in children less than five years of age in Uganda caused by integrated community case management of fever. *Am J Trop Med Hyg*. 2012;87(5 Suppl):36-45. Medline:23136276 doi:10.4269/ajtmh.2012.11-0733
- 58 Seidenberg PD, Hamer DH, Iyer H, Pilingana P, Siazele K, Hamainza B, et al. Impact of integrated community case management on health-seeking behavior in rural Zambia. *Am J Trop Med Hyg*. 2012;87(5 Suppl):105-10. Medline:23136285 doi:10.4269/ajtmh.2012.11-0799
- 59 Kalyango JN, Rutebemberwa E, Alfven T, Ssali S, Peterson S, Karamagi C. Performance of community health workers under integrated community case management of childhood illnesses in eastern Uganda. *Malar J*. 2012;11:282. Medline:22905758 doi:10.1186/1475-2875-11-282
- 60 Hamer DH, Brooks ET, Semrau K, Pilingana P, MacLeod WB, Siazele K, et al. Quality and safety of integrated community case management of malaria using rapid diagnostic tests and pneumonia by community health

- workers. *Pathog Glob Health*. 2012;106:32-9. Medline:22595272 doi:10.1179/1364859411Y.0000000042
- 61 Mukanga D, Babirye R, Peterson S, Pariyo GW, Ojiambo G, Tibenderana JK, et al. Can lay community health workers be trained to use diagnostics to distinguish and treat malaria and pneumonia in children? Lessons from rural Uganda. *Trop Med Int Health*. 2011;16:1234-42. Medline:21752163 doi:10.1111/j.1365-3156.2011.02831.x
  - 62 Yeboah-Antwi K, Pilingana P, Macleod WB, Semrau K, Siazeele K, Kalesha P, et al. Community case management of fever due to malaria and pneumonia in children under five in Zambia: a cluster randomized controlled trial. *PLoS Med*. 2010;7:e1000340. Medline:20877714 doi:10.1371/journal.pmed.1000340
  - 63 Littrell M, Moukam LV, Libite R, Youmba JC, Baugh G. Narrowing the treatment gap with equitable access: mid-term outcomes of a community case management program in Cameroon. *Health Policy Plan*. 2013;28:705-16. Medline:23144228 doi:10.1093/heapol/czs110
  - 64 Puett C, Coates J, Alderman H, Sadruddin S, Sadler K. Does greater workload lead to reduced quality of preventive and curative care among community health workers in Bangladesh? *Food Nutr Bull*. 2012;33:273-87. Medline:23424894
  - 65 Ghimire M, Pradhan YV, Maskey MK. Community-based interventions for diarrhoeal diseases and acute respiratory infections in Nepal. *Bull World Health Organ*. 2010;88:216-21. Medline:20428390 doi:10.2471/BLT.09.065649
  - 66 Cesar JA, Cavaleti MA, Holthausen RS, de Lima LG. Changes in child health indicators in a municipality with community health workers: the case of Itapirapua Paulista, Vale do Ribeira, Sao Paulo State, Brazil. [in Portuguese]. *Cad Saude Publica*. 2002;18:1647-54. Medline:12488892 doi:10.1590/S0102-311X2002000600019
  - 67 Mugeni C, Levine AC, Munyaneza RM, Mulindahabi E, Cockrell HC, Glavis-Bloom J, et al. Nationwide implementation of integrated community case management of childhood illness in Rwanda. *Glob Health Sci Pract*. 2014;2:328-41. Medline:25276592 doi:10.9745/GHSP-D-14-00080
  - 68 Yansaneh AI, Moulton LH, George AS, Rao SR, Kennedy N, Bangura P, et al. Influence of community health volunteers on care seeking and treatment coverage for common childhood illnesses in the context of free health care in rural Sierra Leone. *Trop Med Int Health*. 2014. Epub ahead of print. Medline:25243929 doi:10.1111/tmi.12383
  - 69 Miller NP, Amouzou A, Tafesse M, Hazel E, Legesse H, Degefie T, et al. Integrated community case management of childhood illness in Ethiopia: implementation strength and quality of care. *Am J Trop Med Hyg*. 2014;91:424-34. Medline:24799369 doi:10.4269/ajtmh.13-0751
  - 70 Langston A, Weiss J, Landegger J, Pullum T, Morrow M, Kabadege M, et al. Plausible role for CHW peer support groups in increasing care-seeking in an integrated community case management project in Rwanda: a mixed methods evaluation. *Glob Health Sci Pract*. 2014;2:342-54. Medline:25276593 doi:10.9745/GHSP-D-14-00067
  - 71 Lainez YB, Wittcoff A, Mohamud AI, Amendola P, Perry HB, D'Harcourt E. Insights from community case management data in six sub-Saharan African countries. *Am J Trop Med Hyg*. 2012;87(5 Suppl):144-50. Medline:23136290 doi:10.4269/ajtmh.2012.12-0106
  - 72 Cardemil CV, Gilroy KE, Callaghan-Koru JA, Nsona H, Bryce J. Comparison of methods for assessing quality of care for community case management of sick children: an application with community health workers in Malawi. *Am J Trop Med Hyg*. 2012;87(5 Suppl):127-36. Medline:23136288 doi:10.4269/ajtmh.2012.12-0389
  - 73 Chandani Y, Noel M, Pomeroy A, Andersson S, Pahl MK, Williams T. Factors affecting availability of essential medicines among community health workers in Ethiopia, Malawi, and Rwanda: solving the last mile puzzle. *Am J Trop Med Hyg*. 2012;87(5 Suppl):120-6. Medline:23136287 doi:10.4269/ajtmh.2012.11-0781
  - 74 Källander K, Nsungwa-Sabiiti J, Balyeku A, Pariyo G, Tomson G, Peterson S. Home and community management of acute respiratory infections in children in eight Ugandan districts. *Ann Trop Paediatr*. 2005;25:283-91. Medline:16297303 doi:10.1179/146532805X72430
  - 75 Sazawal S, Black RE; Pneumonia Case Management Trials Group. Effect of pneumonia case management on mortality in neonates, infants, and preschool children: a meta-analysis of community-based trials. *Lancet Infect Dis*. 2003;3:547-56. Medline:12954560 doi:10.1016/S1473-3099(03)00737-0
  - 76 Shah NM, Brieger WR, Peters DH. Can interventions improve health services from informal private providers in low and middle-income countries?: a comprehensive review of the literature. *Health Policy Plan*. 2011;26:275-87. Medline:21097784 doi:10.1093/heapol/czq074
  - 77 Bishai DM, Shah NM, Walker DG, Brieger WR, Peters DH. A social franchising to improve quality and access in private health care in developing countries. *Harvard Health Policy Review*. 2008;9:184-97.
  - 78 Montagu D. Franchising of health services in low-income countries. *Health Policy Plan*. 2002;17:121-30. Medline:12000772 doi:10.1093/heapol/17.2.121
  - 79 Koehlmoos TP, Gazi R, Hossain SS, Zaman K. The effect of social franchising on access to and quality of health services in low- and middle-income countries. *Cochrane Database Syst Rev*. 2009;(1):CD007136. Medline:19160323
  - 80 Patouillard E, Goodman CA, Hanson KG, Mills AJ. Can working with the private for-profit sector improve utilization of quality health services by the poor? A systematic review of the literature. *Int J Equity Health*. 2007;6:17. Medline:17988396 doi:10.1186/1475-9276-6-17
  - 81 UNITAID. Innovative financing to shape markets for HIV/AIDS, malaria and tuberculosis. 2013. Available at: <http://www.unitaid.eu/en/creating-a-private-sector-market-for-quality-assured-rdts-in-malaria-endemic-countries>. Accessed: 1 November 2014.
  - 82 World Health Organisation. Rapid Access Expansion 2015 programme (RAcE 2015) 2014. Available at: [http://www.who.int/malaria/areas/rapid\\_access\\_expansion\\_2015/en/](http://www.who.int/malaria/areas/rapid_access_expansion_2015/en/). Accessed: 24 August 2014.

Mildred Shieshia, Megan Noel, Sarah Andersson, Barbara Felling, Soumya Alva, Smisha Agarwal, Amnesty Lefevre, Amos Misomali, Boniface Chimphanga, Humphreys Nsona, Yasmin Chandani Strengthening community health supply chain performance through an integrated approach: Using mHealth technology and multilevel teams in Malawi	117
David Collins, Zina Jarrah, Colin Gilmartin, Uzaib Saya The costs of integrated community case management (iCCM) programs: A multi-country analysis	129
Nicholas P. Oliphant, Maria Muñiz, Tanya Guenther, Theresa Diaz, Yolanda Barberá Laínez, Helen Counihan, Abigail Pratt Multi-country analysis of routine data from integrated community case management (iCCM) programs in sub-Saharan Africa	140
Theresa Diaz, Tanya Guenther, Nicholas P Oliphant, Maria Muñiz and the iCCM Symposium impact outcome evaluation thematic group A proposed model to conduct process and outcome evaluations and implementation research of child health programs in Africa using integrated community case management as an example	150
Alyssa B Sharkey, Sandrine Martin, Teresa Cerveau, Erica Wetzler, Rocio Berzal Demand generation and social mobilisation for integrated community case management (iCCM) and child health: Lessons learned from successful programmes in Niger and Mozambique	163
Agbessi Amouzou, Saul Morris, Lawrence H Moulton, David Mukanga Assessing the impact of integrated community case management (iCCM) programs on child mortality: Review of early results and lessons learned in sub-Saharan Africa	177
Ingrid K. Friberg, Neff Walker Using the Lives Saved Tool as part of evaluations of community case management programs	186



**Journal of Global Health** is published biannually by the Edinburgh University Global Health Society (EUGHS). The aim of the EUGHS is to inspire and educate individuals, groups, organizations and communities about global health issues. Its key objectives are to provide a platform for University of Edinburgh students to share ideas and/or experiences in Global Health with each other; organize meetings and other events to raise awareness of Global Health issues within the University and more widely; and to give students opportunities to present their work. The society is affiliated to the Centre for Population Health Sciences of the University of Edinburgh, and it works closely with the Global Health Academy of the University of Edinburgh.



**Subscription** (including postage): GBP 30 per any single issue, GBP 50 for annual subscription, GBP 25 for students, GBP 20 for EUGHS members. Please contact JoGH office for details.

**Contact for subscription information:**

Journal of Global Health  
Rachael Atherton  
Edinburgh University Global Health Society  
Centre for Population Health Sciences  
The University of Edinburgh  
Teviot Place  
Edinburgh EH8 9AG, Scotland, UK  
Phone +44 131 651 1386 Fax +44 131 650 6909  
Rachael.Atherton@ed.ac.uk

**Journal design:** Snjezana Engelman Džafić for LASERplus, Zagreb, Croatia

**Realisation:** LASERplus, Zagreb, Croatia, [www.laser-plus.hr](http://www.laser-plus.hr)

## EDITORIAL

Journal of Global Health: The Mission Statement 1

Theresa Diaz, Samira Aboubaker, Mark Young  
 Current scientific evidence for integrated community case  
 management (iCCM) in Africa: Findings from the iCCM Evidence Symposium 2

## NEWS

Regions 6–11

Agencies 12–17

Resources 18–23

Reviewers in 2014 23

## VIEWPOINTS

Tanya Guenther, Yolanda Barberá Láinez, Nicholas P Oliphant, Martin Dale,  
 Serge Raharison, Laura Miller, Geoffrey Namara, Theresa Diaz  
 Routine monitoring systems for integrated community case management  
 programs: lessons from 18 countries in sub-Saharan Africa 24

Samira Aboubaker, Shamim Qazi, Cathy Wolfheim, Adebawale Oyegoke, Rajiv Bahl  
 Community health workers: A crucial role in newborn health care and survival 32

Mark Young, Alyssa Sharkey, Samira Aboubaker, Dyness Kasungami,  
 Eric Swedberg, Kerry Ross  
 The way forward for integrated community case management programmes:  
 A summary of lessons learned to date and future priorities 37

Kumanan Rasanathan, Salina Bakshi, Daniela C. Rodriguez, Nicholas P. Oliphant,  
 Troy Jacobs, Neal Brandes, Mark Young  
 Where to from here?  
 Policy and financing of integrated community case management (iCCM)  
 of childhood illness in sub-Saharan Africa 43

## PAPERS

Kumanan Rasanathan, Maria Muñiz, Salina Bakshi, Meghan Kumar, Agnes Solano,  
 Wanjiku Kariuki, Asha George, Mariame Sylla, Rory Nefdt, Mark Young, Theresa Diaz  
 Community case management of childhood illness in sub-Saharan Africa –  
 findings from a cross-sectional survey on policy and implementation 48

Abigail Pratt, Martin Dale, Elena Olivi, Jane Miller  
 Spatial distribution and deployment of community-based distributors  
 implementing integrated community case management (iCCM):  
 Geographic information system (GIS) mapping study  
 in three South Sudan states 56

Xavier Bosch-Capblanch, Claudine Marceau  
 Training, supervision and quality of care in selected integrated community  
 case management (iCCM) programmes: A scoping review of  
 programmatic evidence 66

Clare Strachan, Alexandra Wharton-Smith, Chomba Sinyangwe, Denis Mubiru,  
 James Ssekitooleko, Joslyn Meier, Miatta Gbanya, James K. Tibenderana, Helen Counihan  
 Integrated community case management of malaria, pneumonia and diarrhoea  
 across three African countries: A qualitative study exploring lessons learnt  
 and implications for further scale up 79

Yasmin Chandani, Sarah Andersson, Alexis Heaton, Megan Noel,  
 Mildred Shieshia, Amanda Mwiroti, Kirstin Krudwig, Humphreys Nsona,  
 Barbara Felling  
 Making products available among community health workers: Evidence  
 for improving community health supply chains from Ethiopia, Malawi,  
 and Rwanda 96

(continued on the inside)

