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*

How big is the 'next big thing'?

Estimating the burden of non–communicable diseases in low– and middle–income countries

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Non-communicable causes of death and disability will dominate global health agenda for the foreseeable future. The progress in addressing their burden and achieving measurable reduction in low– and middle–income countries (LMICs) will likely require similar steps that were effective in reducing maternal and child mortality globally: (i) defining the size of the burden and the main causes responsible for the majority of the burden; (ii) understanding the most important risk factors and their importance in different contexts; (iii) systematically assessing the effectiveness and cost of the interventions that are feasible and available in LMICs; and (iv) formulating evidence–based health policies that will define appropriate health care and health research priorities to tackle the burden in the most cost–effective way.

Over the past year the pandemic of non–communicable diseases (NCDs) has become a key focus of global political agenda. At the United Nations' high–level meeting on the prevention and control of NCDs in September 2011, a general consensus has been reached that NCDs were already the leading causes of death in all world regions and that their burden is increasing rapidly [1]. The rate of this increase is particularly striking in low– and middle–income countries (LMICs), where life expectancy is increasing as a result of improved socio–economic conditions [2]. It is expected that by the year 2030, NCDs could become responsible for 52 million deaths [3]. In LMICs, health systems will face considerable challenge in adjusting to the rapidly growing demand for services, and this could in turn become an additional significant barrier to achieving the Millennium Development Goals [2]. As a result, many parallel advocacy efforts for tackling NCDs are taking place, with a particular focus on heart disease, cancer, respiratory diseases, diabetes and stroke [4]. A number of interventions have been outlined that could have immediate preventive effect and slow down the pandemic, such as tobacco control, improved diet, exercise and decreased alcohol intake [4].

The release of the new global burden of disease (GBD) estimates for the year 2010, by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington in Seattle, is anticipated with great interest [5]. The new revision is expected to show substantial progress in the reduction of maternal and child mortality in the LMICs over the past two decades. However, many fear that there will be hardly any measurable progress in improving health and survival of adult populations in LMICs. The UN conference in 2011 and the publication of the new GBD estimates could therefore mark the beginning of the era in which non–communicable causes of death and disability will dominate global health agenda for the foreseeable future. The progress in addressing their burden and achieving measurable reduction in LMICs will likely require similar steps that were effective in reducing maternal and child mortality globally: (i) defining the size of the burden and the main causes responsible for the majority of this burden; (ii) understanding the most important risk factors and their importance in different contexts; (iii) systematically assessing the effectiveness and cost of the interventions that are feasible and available within the contexts of different LMICs; and (iv) formulating evidence–based health policies that will define appropriate health care and health research priorities to tackle the burden in the most cost–effective way.

> *Measuring the burden of non–communicable diseases in low–resource settings is a challenging task given the scarcity of available data, inconsistency in case definitions of the measured diseases, differences in reporting of results used by different investigators, lack of funding, research infrastructure and capacity for community–based studies, changing definitions of diseases over time, low transcultural adaptability of screening instruments, and many others.*

The first step in this process is to measure the burden of NCDs in LMICs. This is a challenging task given the scarcity of available data, inconsistency in case definitions of the measured diseases, differences in reporting of results (eg, age groups) used by different investigators, lack of funding, research infrastructure and capacity for community–based studies in LMICs, changing definitions of diseases over time, low transcultural adaptability of screening instruments, and many others [6-8]. Methodological approaches that could take into account the diversity and scarcity in the available information and produce acceptable regional estimates using transparent and sound methodological approaches are urgently needed. Furthermore, the international research community could benefit from clear guidelines on conducting epidemiological studies in LMICs that could inform burden of disease analyses, so that research results are comparable and leading to more reliable estimates.

In the current issue of the *Journal of Global Health*, we are publishing several studies that attempt to summarise information on the burden of non–communicable diseases and provide estimates for a region that has traditionally been considered "information gaps": the African continent. The papers by George-Carey et al. [9], Paul et al. [10], Graham et al. [11] and Dowman et al. [12] provide the first systematic estimates of the burden of dementia, epilepsy and rheumatoid arthritis, respectively. In addition, Reidpath and Allotey provide an authoritative viewpoint on the changing chronic disease management in LMICs [13], Moten et al. discuss the challenge of equitable building of public health infrastructure in low resource settings [14], Kolcic warns of the "double burden of malnutrition" as a silent driver of the NCD pandemic [15], while Maher and Sridhar address the role of political priority in the global fight against NCDs [16]. In the future issues of our journal, we will increasingly welcome similar attempts to quantify disease burden, the role of risk factors and the effectiveness of interventions targeted at reducing NCDs in low resource settings.

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NEWS

▶ Africa

▶▶ Claims that the interventions of the Millennium Villages Project had resulted in a triple reduction in child mortality rates, as declared in a paper published in May, were followed by harsh criticism. Critics, including Michael Clemens from the Center for Global Development in Washington, called the paper's quantitative evidence into question. In a letter to *The Lancet*, Clemens argued that the project needed greater transparency, including independent analysis. The criticism was accepted and the paper was partially retracted in a subsequent edition. Furthermore, the project's founder, economist Jeffrey Sachs, agreed that the project was too autonomous and has now established an external advisory board to oversee the analysis of the project's impact. This move should increase transparency and improve cost–effectiveness analysis of the project, with both factors being essential to development policy. (*Nature*, 12 Jun 2012)

▶▶ A meeting was held in Kampala earlier this year, addressing the so–called 'nodding disease' or 'nodding syndrome'. This illness has affected more than 3000 people in the north of Uganda, with symptoms including involuntary nodding, neurological deterioration and, in many cases, death. Historically, 'nodding syndrome' was already reported in the 1960s in parts of Tanzania and in South Sudan in the 1990s. In this latest outbreak in 2011, hundreds of cases were reported in northern Uganda, a region emerging from a decades–long conflict with the Lord's Resistance Army. (*IRIN*, 2 Aug 2012)

▶▶ Oxfam has warned that the east of the Democratic Republic of Congo faces a catastrophic humanitarian crisis. In this region, millions of people found themselves at the mercy of militias, with a sharp increase in killings, rapes and looting. They also warned of a risk of cholera epidemic, with insecure environment preventing aid delivery. (*BBC*, 7 Aug 2012)

▶▶ A campaign to protect 50 million people against meningitis through vaccination has been launched in seven African countries of the so–called 'Meningitis Belt' – Benin, Cameroon, Chad, Ghana, Nigeria, Senegal and Sudan. Mr Seth Berkley, managing director of GAVI Alliance, is hoping for "a dramatic impact across the continent". (*AFP*, 4 Oct 2012)

▶▶ The US pharmaceutical company Johnson & Johnson has allowed generic manufacturers to produce cheap versions of its HIV/AIDS drug 'Prezista' for sale in Sub–Saharan Africa and least–developed Countries. Prezista, known in its generic form as 'darunavir', is a new antiretroviral drug that is used when patients develop tolerance for and become resistant to existing antiretroviral treatments. The need for such drugs is growing, as increasing numbers of patients become refractory to current treatment, especially in Africa. International pharmaceutical companies are under increasing pressure to make medicines more affordable to poorer nations. (*Reuters*, 29 Nov 2012)

▶ Asia

▶▶ Hand, foot and mouth disease (HFMD) has been identified as the likely cause of death of 54 children in southern Cambodia between April and July 2012. HFMD is caused by enteroviruses, most commonly coxsackievirus A16, which normally results in a mild and self–limiting disease. The Cambodian outbreak was reportedly caused by enterovirus 71 (EV–71) that causes meningitis and encephalitis, resulting in severe neurological, cardiovascular and respiratory problems. (*Reuters*, 8 Jul 2012)

▶▶ The Pakistani government announced plans to introduce a programme of pneumococcal immunisation in the country as part of their expanded programme on immunisation (EPI). The programme will be introduced in Punjab province and will be expanded nationwide within the next eighteen months. Pakistan is the first south Asian country to announce plans to vaccinate against pneumococcus and the project is mainly being funded by the GAVI Alliance. Pakistan is currently paying 20 cents of the full price of US$ 3.50 per dose, and the vaccination will be free to the user. The vaccination used will be GlaxoSmithKline's Synflorix, which has been made available through the GAVI Alliance's Advance Market Commitment (AMC) programme. AMC provides incentives for companies to offer products at reduced prices in exchange for large and long–term contract promises from countries. (*The Guardian*, 9 Oct 2012)

▶▶ More than 500 000 children across Myanmar will be protected against five major childhood diseases in the next six a months. The country's move to introduce the five–in–one pentavalent vaccine is a result of international partnership and support from the GAVI Alliance. (*Health Canal*, 6 Nov 2012)

▶▶ According to the Union of Syrian Medical Relief Organizations (UOSSM), it appears that Syrian troops are seizing foreign aid and reselling it, or otherwise providing it to government loyalists. In a country that is gripped in internal conflicts, this is putting millions of lives at risk. (*Reuters*, 7 Nov 2012)

▶▶ At the conference in Doha, Qatar, UN Climate Change Conference was held in December. One of the main ideas proposed at the conference was to establish the United Nations–led partnership for innovative models for financing climate change adaptation and mitigation activities. The initiative would complement the UN Framework Convention on Climate Change (UNFCCC) and the activities of the World Economic Forum (WEF), aiming to promote successful public–private financing mechanisms. (*UN News*, 27 Nov 2012)

▶ Australia and Western Pacific

▶▶ Collectively, the adult population of the world (18 years and more) weighs about 316 million tons, according to a study published in the journal BMC Public Health to coincide with Rio +20 meeting. As 16.5 million tons of that weight is due to overweight, this amounts to 242 million people of normal weight in addition to the current global population – or roughly, the entire population of Indonesia. The authors of the study suggest that overweight pandemic could endanger both the world's food security and environmental resources. (*Time*, 18 Jun 2012)

▶▶ The controversial Trans–Pacific Partnership Agreement (TPP) has recently come under increased public scrutiny. There are concerns that this effort, proposing to use free trade to impose conditions and override domestic laws, has little to do with trade, because actual trade barriers between the countries in the region are already very low. Some proposed provisions, such as stronger copyright and patent protection, would in fact prevent free trade. (*The Guardian*, 27 Aug 2012)

▶▶ AusAID funds research that should improve the effectiveness of Australian aid in developing countries. Between July 2007 and June 2012, AusAID provided more than 100 million AUD in support of research examining how to improve health systems and improve delivery of health–related aid in low resource settings. AusAID has now developed a longer–term strategy that will support medical research aiming to remove the barriers to achieving priority health outcomes in the Asia Pacific. AusAID's focus is on the diseases and health issues that have the largest impact on the lives of poor people, with the main focus on the Asia–Pacific region. (*AusAID*, 10 Sep 2012)

▶▶ The founding partners of the Measles & Rubella Initiative have recently reported that measles cases are at an historic low in the Western Pacific Region, which is making excellent progress towards eliminating the measles virus. Only two measles deaths were reported this year, representing a 99% decline since 2003. (*UN Foundation*, 13 Sep 2012)

▶▶ World Health Organization hailed several success stories in the Western Pacific region that evolved during the past decade. In 2003, a plan was laid out to eliminate measles and control hepatitis B, and to use those activities to strengthen routine immunization services. Now, hepatitis B infection rates in children are reduced to below 2%, while measles deaths are nearly eliminated. The measles initiative is now also used to improve the prevention of congenital rubella syndrome. (*WHO*, 24 Sept 2012)

▶ China

▶▶ Successful use of compulsory licenses to terminate the monopoly on expensive drugs from some pharmaceutical companies, which began in India, has now prompted changes across Asia. China has amended its patent law to allow issuing of compulsory licenses to the domestic qualified companies to produce and export generic patented drugs under certain conditions. As similar precedents had been made in other countries, China was well prepared on legal grounds for this change. It should allow the government to realize the long–term interest in producing new drugs, particularly those required to address a surging number of HIV cases. (*Reuters*, 8 Jun 2012)

▶▶ Ten years ago, one in twenty pre–school children in China was infected with hepatitis B, which was one of the highest infection rates worldwide. Today, this figure has decreased to less than 1%, in line with most industrial countries, which is a remarkable public health achievement. China's reduction in hepatitis B infection rates will precipitate a marked decline in liver disease in adulthood. Moving forward, the country has set itself another bold task: to reduce the prevalence of hepatitis B amongst the adults to 2%, down from the current 7.2%. (*China Daily*, 13 Jun 2012)

▶▶ Chinese authorities have arrested nearly 2000 people as part of a nationwide crackdown on counterfeit drugs and health care products. There are growing concerns about the true prevalence of both fake drugs and unsafe food supplies in China, with counterfeiting operations becoming increasingly sophisticated. (*New York Times*, 5 Aug 2012)

▶▶ At this summer's fifth Conference of the Forum on Africa–China Cooperation, the Chinese government pledged

US$ 20 billion of new aid to Africa, which signals China's increasingly leading role in international development aid. (*The Washington Times*, 14 Aug 2012)

▶▶ At the first high–level meeting between the Health Minister of China, Professor Chen Zhu, and GAVI Alliance representatives, the Chinese Government expressed willingness to expand its collaboration with the Alliance. (*GAVI Alliance*, 12 Sept 2012)

▶ Europe

▶▶ The World Bank has recently advised developing nations to invest in long–term, sustainable infrastructure programmes that would be relatively independent from the volatility of the global markets. This economic anxiety has been the main reason behind reduced foreign investment into developing nations, and has seen loans from European banks decline by 40% compared with only a year ago. International financing is an essential contributor to growth and development in many of these countries. Governments of developing nations are being urged to adopt policy allowing sufficient flexibility to sustain economic growth even if global markets are to collapse again. (*The Guardian*, 12 Jun 2012)

▶▶ The Anti–Counterfeiting Trade Agreement (ACTA), whose aim was to standardize intellectual property protection, was rejected by the European Parliament earlier this year. This was the first instance that the European Parliament has exercised its powers under the Lisbon Treaty to reject an international trade agreement, with only 39 votes in favour and 478 opposing. The treaty was criticized as being vague, with the potential to jeopardize civil liberties. Before the ruling, European Parliament saw public demonstrations and received a petition from 2.8 million citizens worldwide urging it to reject the ACTA. In a detailed analysis, IP–Watch quoted Aziz–ur–Rehman of MSF saying that "...the way it was written, ACTA would have given an unfair advantage to patented medicines, and restricted access to affordable generic medicines to the detriment of patients and treatment providers alike." (*The Guardian*, 4 Jul 2012)

▶▶ Ministers and State Secretaries of Europe came together for a meeting in Cyprus in late August to discuss the next 7–year budget for the European Union (2014–2020). Up to € 51 billion was proposed for development assistance for the world's poorest, but this proposal is now under threat among many others, as several governments want to reduce the overall EU budget given the economic climate. (*ONE International*, 29 Aug 2012)

▶▶ As a part of its activities to aid Africa, Russia decided to write off US$ 20 billion of debts owed by African countries and to donate further US$ 50 million to the poorest countries. It is also taking part in peacekeeping operations in Africa and expanding programmes to train African peacekeepers and law enforcers, according to Mr Vladimir Sergeyev, director of the Russian Foreign Ministry Department of International Organisations. (*AFP*, 18 Oct 2012)

▶▶ Several campaigns are trying to prevent cuts to EU's proposed aid programmes for some of the world's poorest countries. UK is among the countries calling for cuts in the EU's 2014–2020 € 1 trillion budget, but campaigners fear that the aid budget will take a disproportionate hit of about 11%, which would be the highest cut in the EU budget. The group ONE released a report that suggested that EU aid would more than pay for itself by 2020 and therefore does not deserve to be seen as low priority investment. There are still hopes that a financial transactions tax could be pushed by France and other EU countries, which could increase the aid funding. (*The Guardian*, 20 Nov 2012).

▶ India

▶▶ India will fail to meet Millennium Development Goal targets for both child and maternal health, according to the World Health Organisation's country representative, Dr Nata Menabde. Despite significant improvements, India is predicted to record under–five mortality rate of 52 per 1000 live births in 2015, which would fall short of the 42 per 1000 target. WHO added that achieving universal measles immunisation for infants should be a priority, and India is planning to reach an 89% immunisation rate by 2015. UNICEF also suggested that increased at-

tention should be given to neonatal deaths, where cost–effective interventions are available, such as promotion of exclusive breastfeeding and clean cord care through early postnatal visits. (*Times of India*, 2 Jul 2012)

▶▶ The Indian government has quietly adopted a US$ 5.4 billion policy that will provide free medication to the population. Doctors in India's public health service will soon be allowed to prescribe generic drugs to patients free of charge. This will see a dramatic improvement in the peo-

ple's access to health care, changing the lives of many millions, and helping to overhaul a system that made health care a luxury. The limitation to generic–only drugs should benefit Indian producers of generics, whilst large pharmaceutical companies such as Pfizer, GlaxoSmithKline and Merck will lose out. Following completion of a two–year rollout, the policy is anticipated to provide 52% of the population with free drugs by 2017. Providing free medicine is just one among many current strategies to improve health care in India. (*Reuters*, 5 Jul 2012)

▶▶ The biotech sector in India is becoming a vibrant and booming market. Its vaccines sector witnessed a continued growth in 2011–2012, with Haffkine Biopharmaceutical and Serum Institute recording growth of 100% and 60%, respectively. However, not all stories are of a success, as Bharat Biotech, Panacea Biotec, and Shantha Biotechnics saw some of

their products losing the WHO pre–qualification status. Most of these companies are expected to recover as they apply corrective measures. (*BioSpectrum Asia*, 7 Aug 2012)

▶▶ India plans to ban 91 drugs from over–the–counter sale to prevent their widespread misuse. These include 73 antibiotics, 13 drugs that are potentially addictive, and four anti–tuberculosis treatments. New provisions should ensure that these drugs can only be sold with a prescription from a registered medical practitioner. (*BMJ*, 4 Dec 2012)

▶▶ India's vaccine industry has been cleared by the World Health Organization (WHO) to export vaccines globally. This opens the market from major buyers and international procurement agencies, like the Gates Foundation, Clinton Foundation, UNICEF and GAVI. (*Times of India*, 15 Dec 2012)

▶ The Americas

▶▶ Brazilian foreign aid policy builds on very recent national experience of development based on the agriculture industry. It seeks to export the success that helped Brazil transform from a net importer to exporter of food. Its narrow policy focus on exporting recently successful domestic programmes is rapidly gaining both attention and respect among other aid donor countries. The successes of those targeted aid initiatives usually depend on identification of key elements of the Brazilian experience that can be transferred to recipient nations. (*The Guardian*, 28 Jun 2012)

▶▶ The libel action that a UK physician Andrew Wakefield, whose study on the link between MMR vaccine and autism has been retracted from *The Lancet*, filed in Texas against the *BMJ*, its editor in chief Fiona Godlee, and the investigative journalist Brian Deer following their coverage of this story, has not been upheld in the court of law. The Travis County district judge ruled that the case could not be pursued because the Texas courts had no jurisdiction over the British defendants. (*BMJ*, 6 Aug 2012)

▶▶ Mexico recently achieved a major public health milestone, after managing to enrol nearly 53 million of the previously uninsured Mexican people in public medical insurance programs. Despite periods of economic downturns

that the country went through in recent years, reaching this target ensured universal health coverage in less than a decade. (*Harvard School of Public Health*, 15 Aug 2012)

▶▶ A study by the World Bank suggests that income inequality is decreasing in Latin America, although it has been increasing in the other regions of the world. This is encouraging news for the region, whose governments often pledge to reduce the wealth gap as one of their most important targets. (*The Guardian*, 13 Nov 2012)

▶▶ It appears that Catholic schools attendees in Calgary have managed to overturn the ban on Human Papilloma Virus (HPV) vaccination in late November this year. This outcome was preceded by a four–year controversy after Ottawa and Alberta provided a grant to vaccinate schoolgirls against HPV free of costs. Catholic schools in Calgary refused to implement the policy as a group of bishops viewed the vaccination as incompatible with Catholic teachings, presuming that vaccinating against a sexually transmitted disease would encourage early sex and promiscuity. Local doctors and activists assembled the group "HPV Calgary" and campaigned to make the Calgary Catholic School Board accept HPV vaccination. (*The Globe and Mail*, 29 Nov 2012)

NEWS

▶ The Bill and Melinda Gates Foundation

▶▶ The company Cepheid said that it would be working with the Bill & Melinda Gates Foundation, PEPFAR, USAID and UNITAID to make its diagnostic kit for tuberculosis available at reduced prices in low and middle income settings where the burden of the disease is large. The representatives of Cepheid said that the four organizations committed to funding the purchase of the Xpert MTB/RIF test in 145 countries with largest burden of tuberculosis. (*Reuters*, 7 Aug 2012)

▶▶ The Bill & Melinda Gates Foundation has launched Round 10 of its Grand Challenges Explorations, a funding initiative worth US$ 100 million to encourage innovative research in global health and development. Applications are usually only two pages, with the initial grant budget of US$ 100 000 to demonstrate the potential. Applicants from low– and middle–income countries are particularly encouraged to apply. (*BMGF*, 5 Sep 2012)

▶▶ Following The Giving Pledge call from Mr Bill Gates and Mr Warren Buffet to other billionaires to consider donating half of their wealth to charity, further eleven billionaires added their names to the list – bringing the current total to 92. The new members of this group include Reed Hastings,

the CEO of Netflix; Gordon Moore, co–founder of Intel; and Charles Bronfman, the head of Seagram Co. (*AFP*, 19 Sep 2012)

▶▶ Mr Bill Gates has signed an agreement with the Islamic Development Bank, situated in Jeddah. The agreement is believed to be worth more than US$ 250 million and it should serve the aim to gain Middle East support in the fight to eradicate polio. According to Mr Ahmad Mohamed Ali, who is the chairman and the president of Islamic Development Bank, this five–year programme should cover projects mainly in Pakistan, Afghanistan and Nigeria. (*Arabian Business*, 8 Oct 2012)

▶▶ The Bill and Melinda Gates Foundation joined forces with Mr Aliko Dangote's foundation to fight polio, as the disease resurged in Nigeria. Mr Dangote, a Nigerian businessman considered to be Africa's richest man by the Forbes magazine, announced this alliance in Kano, which is Nigeria's second largest city. Only three countries are considered to still be vulnerable to endemic polio – Nigeria, Pakistan and Afghanistan. The four–year alliance should provide funding, equipment and technical support to strengthen polio immunisation in Kano region. (*AFP*, 27 Nov 2012)

▶ The GAVI Alliance

▶▶ Yemen has announced plans to vaccinate its one million–strong birth cohort against the diarrhoea caused by rotavirus. The campaign will be supported by the Global Alliance for Vaccines and Immunisation (GAVI). Yemen's child mortality is still as high as 77 deaths for every 1000 live births, while more than 46% of the population live with less than US$ 2 a day. (*The Guardian*, 1 Aug 2012)

▶▶ Scientists claim to have developed the first vaccine for hepatitis C, thought to affect up to 200 million people worldwide. Hepatitis C is an infectious disease that most often targets the liver and it is caused by the hepatitis C virus (HCV). According to researchers from the Burnet Institute in Melbourne, a preventative vaccine would have the potential to have a significant global health impact. (*Business Standard*, 16 Aug 2012)

▶▶ In September, European Union health officials suggested that all girls in Europe should be immunized against the human papillomavirus (HPV) that causes cervical cancer, and that the current vaccine coverage rates are far too low. The European Centre for Disease Prevention and Control (ECDC) said that only 19 out of 29 countries in the region

had introduced HPV vaccine, and that vaccination rates were as low as 17% in some of those who started vaccine roll–out. (*Reuters*, 4 Sep 2012)

▶▶ Following the World Health Organization's recommendation to include rotavirus vaccination in their national immunization programme, 41 countries have already introduced rotavirus vaccines. However, Asian countries are still lagging behind and only two countries in Asia – Philippines and Thailand – are currently following this advice. WHO suggested that the price continues to be an important barrier to global scale–up. (*IRIN*, 7 Sep 2012)

▶▶ Dengue fever threatens nearly half of the world's population. The leading candidate vaccine against the disease has shown to be only 30% effective in its first large clinical trial, although clearly representing an important milestone in the 70–year quest to develop such a vaccine. The study's goal of 70% effectiveness hasn't been reached, nor has the statistical significance between the two arms of the trial, but the study still demonstrated that a safe and effective inoculation against dengue is feasible. (*New York Times*, 10 Sep 2012)

The World Bank

▶▶ "The Washington Consensus" has set the fundamental requirements for the World Bank's developmental aid since the late 1980s. It has controversially insisted on deregulation, privatisation and an overall reduced role of the state in industry and domestic market forces. These policies were designed to encourage development of neo–liberal economies suitable for integration into international markets, but have also attracted criticism for driving numerous diverse, multi–cultural societies into a single economic model. Under new leadership from the outspoken Korean–American Jim Yong Kim, the bank aims to adopt evidence–based policy on "real world analysis", and to disband the historical myth that reducing big–government control automatically improves the standard of living and ignites development. Kim is renowned for challenging conservative economic ideas and it is hoped that he could strengthen the role of the World Bank in global development. (*The Guardian*, 14 Jun 2012)

▶▶ For the first time, a physician and development expert has become the President of the World Bank: Jim Yong Kim left his post of the President of Dartmouth College to continue his lifelong work in global poverty reduction and economic development. Mr Kim has wide experience in health care delivery, from co–founding the organisation Partners in Health to spearheading ambitious campaigns at the WHO. He faces significant challenges in his new role, having to balance competing demand for resources to target economic growth with the need to improve health and education programmes. During his future at the World Bank, Kim's vision is to "get better, more focused and effective, and deliver on the Bank's promise: our dream is a world free of poverty." (*The Lancet*, 2 Jul 2012)

▶▶ The new World Development Report from the World Bank suggests that some 600 million new jobs may be needed worldwide in the next 15 years to absorb a growing workforce. The need will be the greatest in Asia and Sub–Saharan Africa. The experts recommended a three–stage approach by governments, urging them to develop and implement policy fundamentals that include macroeconomic stability, a business–friendly environment, investments in human capital and the rule of law. In the second step, they should design labour policies to ensure that growth translates into employment opportunities. Finally, they should identify the jobs that support development, removing the obstacles from creating those jobs in the private sector. (*The Guardian*, 2 Oct 2012)

▶▶ Health campaigners from around the world have been trying to influence the World Bank's president, Jim Yong Kim, urging him to support universal health care coverage in low– and middle–income countries. More than 100 organisations signed an open letter, stating that now is the moment "to play a truly progressive and transformative role in health, by supporting countries to achieve universal health coverage". (*BMJ*, 12 Oct 2012)

▶▶ Details of World Bank–financed contracts will become available online, which is as part of a global initiative to fight corruption. The move should also encourage governments to disclose their deals with private companies. The World Bank Institute, which is the capacity development branch of the World Bank, said the organisation would ensure that its own contracts are disclosed while also helping countries open their books. The move should strengthen the nascent Open Contracting Initiative, which is a global campaign to increase disclosure and participation in public contracting. Governments around the world are estimated to spend around US$ 10 trillion each year contracting private companies, but their deals are rarely transparent although in many poor countries procurement accounts for two thirds of all public spending. (*The Guardian*, 26 Oct 2012)

United Nations (UN)

▶▶ More than 330 000 children are still being born with HIV every year. The UN set a goal to eliminate these infections in babies by 2015, but it appears to be very far from reaching this target. The problem partially lies in targeting mother–to–child transmission only, leaving many HIV–positive women without treatment for themselves. This results in a high mortality rate among these women, leaving many newborns orphaned within two years. Malawi leads the way to address this problem with plan B+, a programme that puts HIV–positive pregnant women onto lifelong treatment. Botswana, Rwanda and many others are expected to follow, although these programmes would come with a massive global price tag that would need to be covered. (*The Guardian*, 25 Jul 2012)

▶▶ UN Secretary–General, Mr Ban Ki–moon, has appointed a high–level panel to develop the post–Millennium Development Goals agenda. The panel will be meeting at the sidelines of the U.N. General Assembly. Mr Jeffrey Sachs, who is a special adviser to Mr Ban on the Millennium Development Goals, suggested creating four big pillars: ending extreme poverty, social inclusion, environmental sustainability and good governance. (*Devex*, 17 Sept 2012)

▶▶ The UN has warned that the world's grain reserves are dangerously low and severe weather in the United States or other food–exporting countries could trigger a major hunger crisis next year. This year the world will consume more food than it produces, largely because of extreme weather in the

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US and other major food–exporting countries. Oxfam announced last week that the price of key staples, which include wheat and rice, may double in the next 20 years. This would have very concerning consequences for people in low–resource settings who spend a large proportion of their income on food. (*The Guardian*, 13 Oct 2012)

▶▶ Two United Nations agencies launched a new initiative in October, called 'm–Health'. They proposed to use mobile technology – particularly text messaging and applications – to help tackle non–communicable diseases. The ITU and the WHO will be expected to provide evidence–based and operational guidance to encourage future users, including national governments, to implement m–Health interventions to address prevention and treatment of non–communicable diseases and their common risk factors. This new initiative is initially expected to run for a four–year period and focus on both prevention and treatment of non–communicable diseases. (*UN News*, 17 Oct 2012)

▶▶ In May this year, Mr Ban Ki–moon, the UN Secretary General, named UK prime minister David Cameron, Liberian president Ellen Johnson Sirleaf, and President Susilo Bambang Yudhoyono, of Indonesia, as co–chairs of a high–level panel to advise him on the global development agenda after 2015. Further 26 members were then appointed on this panel to work on a report, setting out a "bold yet practical vision". The lead author of this report will be Mr Homi Kharas, a former World Bank economist and presently working at the Brookings Institution in Washington, DC. (*The Guardian*, 31 Oct 2012)

▶ UN-AIDS

▶▶ The Programme Coordinating Board of the Joint United Nations Programme on HIV/AIDS (UNAIDS) met for its 30th session in June 2012 to review progress and propose recommendations for the global fight against AIDS. While the Director Michel Sidibe estimated that mother–to–child transmission of HIV/AIDS would be eliminated by 2015, the Board recognised that more efforts were needed in other areas. The Board created a new partnership with UN Women in a bid to improve the HIV/AIDS response towards women. Moreover, it urged member states to adapt their national HIV/AIDS response programmes to the specific needs of the female population. It also called for the implementation of laws enabling the successful delivery of HIV prevention and treatment programmes. (*UNAIDS*, 8 Jun 2012)

▶▶ A mysterious new disease has left scores of people in Asia and several further cases in the United States with AIDS–like symptoms, even though they are not infected with HIV. Acquired immune deficiency in affected patients has not been inherited and occurs in adults, but doesn't spread through a virus, according to Dr Sarah Browne, a scientist at the National Institute of Allergy and Infectious Diseases. She believes that further cases may exist, but that they are likely mistaken for tuberculosis in some countries. (*Associated Press*, 22 Aug 2012)

▶▶ According to the joint report from the UNAIDS, Funders Concerned About AIDS (FCAA) and the European HIV/AIDS Funders Group (EFG), private AIDS–related funding from United States and European philanthropic donors totalled US$ 644 million in 2011. This is a 5% increase from 2010 and it was driven by donations from the Bill & Melinda Gates Foundation. Analysis also revealed that very few new funders seem to be entering the field of AIDS philanthropy. (*UNAIDS*, 8 Nov 2012)

▶▶ The US government spends about US$ 6.4 billion a year on preventing and treating HIV/AIDS in the developing world. It is thought that between 4 and 5 million AIDS patients depend mostly on US–originated aid for the AIDS medicines to keep them alive. Ambassador Eric Goosby, the acting head of the President's Emergency Program on AIDS Relief (PEPFAR), has a unique opportunity to make that money do even more good by releasing the data that PEPFAR and its contractors have already collected. Such move would allow proper evaluation of this program and it "... could improve the efficiency, the quality and the accountability of the US's most frequently praised foreign assistance program". (*Center for Global Development*, 13 Nov 2012)

▶▶ In its 2012 report, UNAIDS praised India for doing "particularly well" in halving the number of newly infected HIV–positive adults between 2000 and 2009. India is presently a home to about 2.4 million people living with HIV, one million of whom are on anti–retroviral treatment. However, the Human Immunodeficiency Virus Type I (HIV–1) has been undergoing a process of fairly rapid viral evolution. The subtype C is responsible for nearly 99% of infections in India, but the scientists working at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) in Bangalore have found a family of five new strains of HIV–1 subtype C. As two of those new strains seem to be outstripping the standard viral strain, this finding is of a special concern for Indian authorities and it may pose a larger challenge in the future. (*IPS*, 29 Nov 2012)

▶ UNICEF

▶▶ A new report from UNICEF, Pneumonia and Diarrhoea: Tackling the Deadly Diseases for the World's Poorest Children, has again highlighted the potential to narrow the survival gap through increased commitment and funding.

These two diseases account for nearly one–third of deaths among children under five globally, with 90% of these deaths in Sub–Saharan Africa and South Asia. The report, released shortly before the meeting of several world leaders to launch a new initiative for child survival, suggests that simple interventions have the potential to save millions of lives. These include exclusive breast–feeding of babies, access to soap, routine immunisation programmes, and the appropriate use of antibiotics and oral rehydration therapy. (*GAVI Alliance*, 8 Jun 2012)

▶▶ After experiencing a re–emergence of the polio virus seven years ago, Angola has now been polio–free for a full year. United Nations agencies reported that this success is the result of the improvement in the quality of polio campaigns with each round of immunization, moving the world closer to the ultimate target of global eradication of polio. (*UN News*, 10 Aug 2012)

▶▶ According to Dr Mickey Chopra, chief health officer at UNICEF, "an intense focus on countries with the highest levels of child mortality, combined with the availability of cheaper vaccines and medicines, can lead to a development breakthrough". Dr Chopra said that appropriate investments at this point in time could lead to massive gains in reducing maternal and child mortality in the coming years. (*The Guardian*, 28 Aug 2012)

▶▶ GSK's experimental malaria vaccine showed an effectiveness of only 30% among African babies in a crucial clinical trial. The surprisingly poor result left uncertainties over the vaccine's future role in fighting the mosquito–borne disease. (*Reuters*, 9 Nov 2012)

▶▶ This year, an estimate of the burden of tuberculosis in children was included in the Global Tuberculosis Report for the first time. Although this first estimate was very uncertain and likely too low, its inclusion filled an important gap in global paediatric information on tuberculosis. The growing awareness of the burden of this problem among children was reflected at the International Union of Tuberculosis and Lung Health Conference held in Kuala Lumpur in November. (*MSF*, 26 Nov 2012)

▶ World Health Organization (WHO)

▶▶ Several recent articles by senior UK doctors questioned the legitimacy of some post–licensing drug trials, suggesting they were more of a marketing ploy than a scientific exercise. These studies are usually intended to improve understanding of the effects in the 'real world', away from the close monitoring and strict regimens of all previous drug trial phases. Typically, a new therapy is offered to patients as potentially superior to the gold standard treatment, although considerably more expensive. On completing the trial period, funding from the pharmaceutical company can be withdrawn, leaving either a health care system or the patient to cover the cost of new treatment. Worryingly, these tactics are often employed in low– and middle–income countries, where people have to pay for their own health care and where a desire to stay on the new therapy could cause "catastrophic health expenditure" for households. (*The Guardian*, 12 Jun 2012)

▶▶ Advances in medical technology have often bypassed the African continent, being too expensive for its nations. However, a new vaccine against meningitis, MenAfriVac, conjointly developed by the World Health Organisation (WHO) and PATH and priced at less than 50 cents per dose, may become affordable to most African countries. Bill and Melinda Gates Foundation donated US$ 50 million to support the development of this vaccine. It is largely aimed to eradicate the meningitis epidemics in Africa and the coverage recently reached the 100 millionth person, only two years after it was first administered. (*WHO*, 13 Jun 2012)

▶▶ A recent study published in the Lancet Infectious Diseases journal suggested that the estimated mortality from the H1N1 influenza pandemic in 2009 was 15 times greater than previously thought, increasing the WHO's estimate of 18 500 to 579 000. The WHO's estimate was derived solely from laboratory confirmed cases of H1N1 and was known to likely underestimate the true impact of the outbreak. H1N1 virus is a novel combination of human, swine and avian flu and uncertainties about its virulence and pathogenicity were a significant obstacle to the international effort to combat its spread. (*Reuters*, 26 Jun 2012)

▶▶ There is a growing concern that parasites may become more virulent because of climate change. This is a conclusion of a recent study showing that frogs suffer more fungal infections when exposed to unexpected swings in temperatures. It is hypothesized that parasites may be better at adapting to climatic shifts than the animals they live on, while cold–blooded creatures may also be more susceptible to parasites as temperature shifts than warm–blooded ones. How other parasites, such as malaria, might be affected by temperature swings that affect both its hosts, mosquitoes and humans, remains to be explored. (*Reuters*, 12 Aug 2012)

▶▶ The pharmaceutical giant Pfizer announced that the World Health Organization (WHO) has granted an expansion to the prequalification of its pneumococcal conjugate vaccine, Prevenar 13, to include adults 50 years of age and older. The 13–valent vaccine covering 13 different pneumococcal serotypes should demonstrate high effectiveness in protecting the elderly against pneumonia and invasive disease. (*PharmPro*, 11 Sep 2012)

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Demography

In July 2012, the Bill & Melinda Gates Foundation and the UK Government Department for International Development (DFID) hosted an international summit on family planning. About 150 leaders from both low–income and donor countries, NGOs and the private sector committed to spend an additional US$ 4.3 billion on voluntary family planning. More than 20 developing countries pledged to address barriers to accessing family planning services. These actions could result in reduction of maternal deaths globally by 200 000, with a decrease in unintended pregnancies by about 110 million. The impact of those actions could also affect abortions, decreasing their number by about 50 million, and also reduce infant mortality by further 3 million by the year 2020. Accountability and monitoring of the commitments will be arranged to comply with the UN General Secretaries "Every Woman, Every Child" process, while the progress will be reviewed each year by an Independent Expert Review Group. (*BMGF*, 11 Jul 2012)

In a recent five–part series in the *Los Angeles Times*, Ken Weiss explained the adverse effects of population growth, which are both well documented and wide–ranging. However, population reduction through dramatic fertility declines may also have unintended consequences for populations and their well-being, which are complex and require proper anticipating policies to address them. Despite major fertility declines in recent decades in many parts of the world, human population growth is set to continue. (*Center for Global Development*, 17 Aug 2012)

According to the survey of 1000 adults in the United Kingdom, 'middle age' now begins much later than previ-ously thought – at the age of 55. The average age at which the period of life was perceived to start was 54 years and 347 days old. British people do not see themselves as 'elderly' until they approach 70 years of age. Some earlier studies were reporting that the start of middle age may be as early as 36. There are now more adults older than 65 years in the UK than there are children and adolescents under 16 years of age. (*BBC News*, 17 Sept 2012)

Marking Universal Children's Day in November this year, UNICEF released a study forecasting just a 4% increase in the global population of children by 2025. It added that this is expected as a net result of decreases in fertility rates in the North, and further increases in many countries in the South. (*UN News*, 20 Nov 2012)

In a recent study of more than 25 000 French men, both the total sperm count and the percentage of normal sperm per unit of semen fluid have fallen by over 30% between 1989 and 2005. While the average number of spermatozoa remained above the level of infertility, the study demonstrated a significant decline in sperm concentration and viability across the whole country. Researchers argued that a decline in fertility across Europe may be partly due to this unexplained phenomenon, with several other studies suggested that up to 1 in 5 European men may be infertile due to low sperm count. However, researchers continue to debate the evidence for falling fertility and further research is needed to strengthen the observation and identify the causes of this 'sperm decline'. (*BBC*, 5 Dec 2012)

Economy

According to the United Nations Development Programme's (UNDP) in Africa, the continent's growth could rise to 7% by the year 2015. The growth will mainly be fuelled by investors that are building or improving its infrastructure. Although presently the poorest continent, Africa reported strong growth rates of about 5% in recent years, which was second only to Asia and which generated interest from investors. (*Reuters*, 7 Aug 2012)

Mr Rajiv Shah of the US Agency for International Development (USAID) said that an Open Source Development (OSD) model – connecting problem–solvers with local challenges – could be effective in tackling poverty, promoting democracy and reducing child mortality. Mr Shah argued that within a generation preventable child deaths could end, education could improve and extreme poverty could be reduced by nearly two–thirds. (*SciDev. Net*, 14 Aug 2012)

Legatum Institute's 'Prosperity Index' assesses global wealth and well-being for 142 countries around the world. The Institute has been reporting it for 6 years. The index takes into account eight categories: economy, education, entrepreneurship and opportunity, governance, health, personal freedom, safety and security and social capital. In this year's list, the United States has not been ranked in the top ten countries for the first time due to a weakening performance in five of the eight categories. (*The Guardian*, 30 Oct 2012)

The Organisation for Economic Co–operation and Development (OECD) said in Paris earlier this year that China will overtake the United States in the next four years and

become the largest economy in the world. OECD also predicts that China's economy will be larger than the combined economies of the Eurozone countries by the end of 2012 already. (*The Guardian*, 9 Nov 2012)

▶▶ Surprisingly to many observers, France has been given a second downgrade of its sovereign debt rating by Moody's, with the agency removing its 'triple A' ranking in November. This followed a similar move in January by Standard & Poor's agency. The change in rating is explained by concerns that the country's high level of public debt, which has recently risen above 90% of its gross national product, puts the country in danger of becoming yet another victim of the debt crisis in the Eurozone. (*Financial Times*, 19 Nov 2012)

▶ Energy

▶▶ Engineers from Solar Electric Light Company (Selco) have provided solar panels to over 135 000 homes in Karnataka state in India at the price of US$ 125. The panels produce enough power for two light bulbs and a socket and many poor people both them through bank loans. Savings in energy costs due to the panels should allow repayment of those loans. More than 300 million people in India still live without electricity. (*The Guardian*, 3 Jul 2012)

▶▶ In November this year, BP has admitted guilt on 14 criminal charges and agreed to pay US$ 4.5 billion penalty related to the fatal explosion of its rig Deepwater Horizon and the catastrophic oil spill that subsequently polluted the Gulf of Mexico. Mr Eric Holder, the attorney general, said that "... this marks the single largest criminal fine – US$ 1.25 billion – and the single largest total criminal resolution – US$ 4 billion – in the history of the United States". Three BP officials were also charged for manslaughter and negligence in supervising the pressure tests on the well, while a senior official was charged with obstruction of Congress and lying about how much oil was gushing from the well. This criminal settlement is expected to only deal with some of the claims against BP for the oil spill in April 2010, while the penalties for the environmental damage caused to the Gulf of Mexico could amount to as much as US$ 21 billion under the clean water act for restoration costs to waters, coastline and marine life. (*The Guardian*, 15 Nov 2012)

▶▶ United Kingdom may be leading the world in the proportion of energy derived from wind, but the public is deeply divided over their attitude to windfarms: proponents see UK as "the Saudi Arabia of wind", and think of this as a comparative advantage which should be exploited to the full. Those who oppose them say that windfarms destroy the environment and cause more carbon dioxide damage than they relieve with the infrastructure that they demand – such as the extra roads and the turbines themselves, and that the cost of supplementing wind energy with gas–fired generators leads to greater carbon emissions than a gas turbine operating alone. They say windfarms kill birds and interfere with people's hearing and health, while those least convinced believe that wind energy is somewhat pointless because it can't be stored. (*The Guardian*, 30 Nov 2012)

▶▶ Mr Eyal Aronoff, the software entrepreneur, is a co–founder of the Fuel Freedom Foundation. This organisation's aim is cutting America's oil consumption, both foreign and domestic. Their philosophy is that if America cuts its use of oil in half over the next 10 years, prices on the global market would drop below US$ 50 per barrel to reflect this reduced demand, which would reduce the cost of gas to only US$ 2 per gallon. The foundation proposes that the initial reduction in oil dependence would come from widespread adoption of other liquid fuels for fuelling vehicles, such as petrol, ethanol, natural gas or methanol, which are all considerably cheaper. The foundation is against subsidizing cleaner fuels, thus "...turning conventional environmental thinking on its head". (*The Guardian*, 10 Dec 2012)

▶▶ European Commission awarded about US$ 50 million to two renewable energy schemes planned in the west of Scotland. Tidal turbines should be installed between the Isle of Skye and the mainland for about half of that award, while Scottish Power Renewables plan to put another tidal array into the Sound of Islay. A total of 23 grants are being awarded throughout Europe and they are worth nearly US$ 1.5 billion. The projects range from Swedish biomass burning to solar power in Cyprus. The Commission did not fund any bids for carbon capture and storage because the bidders did not manage to secure backing by either industry or the governments. (*BBC News*, 18 Dec 2012)

▶ Environment

▶▶ The talks at the global UN Sustainable Development Summit in Rio were at risk of collapse, with opposing delegations still failing to reach agreement on the goals for our plant's challenges. Tensions have been rising between the developing nations and negotiators from the US, EU, Switzerland and Korea, with provision for "additional financial resources" to sustain a green economy being a key stumbling block that was vetoed by the developed nations. Consequently, speculations have been rising that any policy derived from Brazil's summer summit would be wearingly insubstantial to what many see as the mountainous task of sustainable global development. (*The Guardian*, 8 Jun 2012)

▶▶ Risk analysis firm Maplecroft has recently presented their "Natural Hazards Risk Atlas". The publication shows that the emerging economies in Asia, such as India and the Philippines, are at the greatest financial risk from natural disasters. The firm assessed that the last year was the most costly on record for natural disasters, which caused damages estimated to approach US$ 380 billion. (*BBC* News, 15 Aug 2012)

▶▶ Using an analogy with financial markets, US–based marine researchers have created an index that assesses overall ocean vitality. The index, described in their study published by the Nature journal, comprises ten disparate measures. Those measures are then aggregated into a single score and they assess features such as food provision, carbon storage, tourism value and biodiversity, thus reflecting both the needs of humans and ecosystem sustainability. The index suggests that a global score is 60 out of 100, offering a seemingly gloomy picture. (*Nature*, 15 Aug 2012)

▶▶ In August 2012, the fate of billions of dollars promised by the governments of high–income countries to help the low– and middle–income countries to adapt to climate change was discussed in Geneva, at the first meeting of the UN's Green Climate Fund. It is unclear whether the GCF would have access to much financing in the first years of its existence, although it is envisaged as the world's single largest source of financing for climate change mitigation and adaptation by 2020. (*The Guardian*, 23 Aug 2012)

▶▶ A panel convened by the UN warned in September this year at a meeting in Bangkok that the system known as "the clean development mechanism" (CDM) was in dire need of rescue. CDM is world's only global system of carbon trading. It was designed to give poor countries access to new green technologies, but it has "essentially collapsed", which prevents future flows of finance to the developing world. It is thought that the collapse of CDM would make it harder to raise funds that could help developing countries cut carbon emissions. (*The Guardian*, 10 Sept 2012)

▶ Food, Water and Sanitation

▶▶ Land deals see Africa heading towards "hydrological suicide" according to GRAIN, an organisation that backs small farmers. Pointing to both the Nile and Niger River basins as examples, GRAIN's recent report: 'Squeezing Africa dry: behind every land grab is a water grab', highlights the dangers behind the continent's land deals. Countries along the Nile, including Ethiopia and Egypt, have already leased out land that exceeds the water available in the basin. The report cites Pakistan, India, California, Kazakhstan and Uzbekistan, where water is currently used at a rate far beyond what can be replenished, as proof that such large–scale mega–irrigation schemes are far from sustainable. With one third of Africans already living in water scarce environments, GRAIN asserts the effects of these land deals would amount to an environmental disaster. (*The Guardian*, 12 Jun 2012)

▶▶ Four years ago, a harmful combination of bad harvests, questionable trade policies and inadequate governance created a global food crisis that put millions of lives at risk.

This summer's extreme drought in the Midwest region of the United States is threatening worldwide commodity prices again, which may test the commitments made after the last crisis at a G8 summit in L'Aquila, Italy in 2009. In August this year, FAO reported that global rice paddy production is expected to be lower than expected this year, mainly owing to below–normal monsoon rains in India. (*Financial Times*, 6 Aug 2012)

▶▶ Mr Justin Forsyth, the chief executive of the charity Save the Children, highlighted malnutrition as the "...Achilles heel of development". Mr Forsyth praised UK's Prime Minister, Mr David Cameron, for linking the end of the London Olympic Games and the presence of many world leaders at the event with hosting a "hunger summit" in Downing Street. (*The Guardian*, 12 Aug 2012)

▶▶ UN Environment Programme (UNEP) reported that more than 400 million Africans now live in water–scarce countries, 300 million still lack reasonable access to safe drinking water and up to 230 million defecate in the open.

3

This brings into question the lack of action from African governments to implement integrated water management policies and reach their sanitation targets. A survey of officials in 40 African countries by UNEP suggested that lack of funding is not the main reason behind this situation. Some suggested that water and sanitation would receive greater interest from local politicians if the contribution of safe water to development could be measured and communicated better. (*The Guardian*, 30 Aug 2012)

▶▶ In September, the EU's audit watchdog reported than half of the European Union's projects to provide safe drinking water in Sub–Saharan Africa had failed. The report, conveyed by the European Court of Auditors, had been examining 23 projects that were co–funded by the EU in six African countries between 2001 and 2010. In a statement that followed this report, the European Commission disputed some of the auditor's findings, although acknowledging that the projects could have been run better. (*Reuters*, 28 Sep 2012)

▶ Peace and Human Rights

▶▶ The 2012 Global Peace Index (GPI) found that the world has reversed its three–year worsening trend to become more peaceful for the first time since 2009. All regions apart from the Middle East and North Africa improved their levels of peacefulness. The GPI was developed by the Institute for Economics and Peace to provide a quantitative measure of peace and conflict across the world's nations using 23 indicators, ranging from a nation's military expenditure to their reputation for respecting human rights. Among the reasons for recent changes were austerity–driven defence cuts, which created gains in indicators related to militarisation. Iceland and Somalia were ranked the most and the least peaceful countries, respectively. (*The Guardian*, 12 Jun 2012)

▶▶ In June 2012, Canada was named the best place to live as a woman among 20 of the world's largest economies. The poll was carried out by Trust Law, one of the core humanitarian and journalistic programmes of the Reuters Foundation. It asked 370 experts in gender issues – including aid workers, health professionals and journalists – to consider their decision based on a number of key issues facing women across the globe. The indicators included the percentage of women in education or roles of public responsibility, the rate of domestic violence and maternal health. Canada claimed the top spot partly because of its commitment to policies promoting gender equality, with women currently accounting for two thirds of university graduates and one third of its federally appointed judges. India ranked lowest, with one of the highest early marriage rates in the world (44.5%). (*Reuters*, 13 Jun 2012)

▶▶ It is estimated that about 30% of global aid may be lost to corruption. At the Economic and Social Council's high–level panel on accountability and transparency, held in July this year, UN Secretary–General Ban Ki–moon highlighted the importance of combating corruption. In his words, neither peace and development, nor human rights "...can flourish in an atmosphere of corruption". (*Devex*, 10 Jul 2012)

▶▶ A drive to get more children into school in low– and middle–income countries is losing momentum as aid for education stagnates. The education for all (EFA) global monitoring report, "Putting education to work", said that with continuation of current trends the millennium development goal (MDG) of universal primary education by 2015 will be missed by a very substantial margin. (*The Guardian*, 16 Oct 2012)

▶▶ An international training institute will be teaching human rights campaigners online tactics to increase the impact of their messages and broadcasting. The institute is being set up in the Italian city of Florence. The first students, starting in 2013, will be drawn from human rights activists around the world. The courses are expected to arm them with the latest tools for digital dissent. The recent events in Northern Africa showed that nowadays protests are as likely to be using social networking as public demonstrations, with "street protests becoming Tweet protests". Similarly, repressive regimes are using Facebook for hunting down their opponents. The protesters need to balance their secrecy and safety with their need to achieve the maximum public impact. The training centre is being set up by the European wing of the Robert Kennedy Center for Justice and Human Rights. (*BBC* News, 5 Nov 2012)

▶ Science and Technology

▶▶ During the 1920s it was noted that women who had undergone cauterization of the cervix following childbirth were unlikely to develop cervical cancer. A recent study published in journal PNAS found that a discrete population of cells at the squamocolumnar junction of the cervix are targeted by the human papilloma virus (HPV), which is thought to be responsible for nearly all cases of cervical cancer. Similar cell populations may also be found to be

critical in the development of other HPV associated cancers, such as some anal, vaginal, penile and throat cancers. It may be possible to prevent cervical cancer by ablating the junction cells by a relatively simple cyro–probe procedure, which could be an option in countries where screening is too expensive to implement. (*AFP*, 11 Jun 2012)

▶▶ Presently, are about 2.5 billion people in low– and middle–income countries own a mobile phone, with coverage nearly 100% in large countries such as the Philippines, Mexico and South Africa and 85% in Uganda. People in poorer nations are now well connected and their movements, habits and ideas are more transparent. This change provides unforeseen opportunities to monitor poor societies, particularly those scattered over large regions, and acquire data relevant to improved public policies. (*Financial Times*, 10 Aug 2012)

▶▶ Counterfeit medications are a serious and potentially life–threatening problem in many low– and middle–income countries. Two teams of US–based scientists have developed quick tests can identify such drugs before they cause harm, using chemically treated paper the size of a business card. Rubbing a pill on the paper and dipping it in water indicates suspicious ingredients through colour changes. (*Voice of America*, 21 Aug 2012)

▶▶ A disturbing proportion of high–impact papers whose results could never be replicated prompted scientific publishers to endorse a new initiative: authors of research papers that report major breakthroughs would be encouraged to get their results replicated by independent laboratories. These validation studies would earn authors a certificate and a second publication on replication, protect them from disclosing their results to competitors and save other researchers from pursuing further work on incorrect results. "The Reproducibility Initiative" would work through Science Exchange, based in Palo Alto, California – a commercial online portal that matches scientists with experimental service providers. (*Nature*, 24 Aug 2012)

▶▶ About one–third of the world's population now has access to the internet. In its new report, the International Telecommunications Union said that more remains to be done to achieve internet coverage targets as set out in the Millennium Development Goals. An interesting feature of the report is a notion that a "...strong linguistic shift is now taking place online". With current trends, the number of users accessing the internet in languages other than English, primarily in Chinese, will overtake English language usage by 2015. (*Al Jazeera*, 24 Sep 2012)
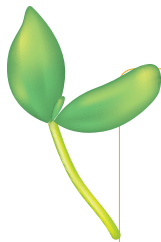
The burden is great and the money little:

Changing chronic disease management in low– and middle–income countries

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Agenda item 117 of the 66th session of the United Nations General Assembly was a watershed for global health. It marked the adoption by the General Assembly on the 16th of September 2011 of the political declaration of the High–level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases [1]. The adoption placed non-communicable diseases (NCDs) center stage for global health. To reach that point required a significant amount of scientific and political effort, first to convene the High–level Meeting on NCDs, and then to have the declaration adopted by the UN General Assembly. The historical time–line leading up to this achievement is punctuated by reflective pieces in a number of journals, but dominated by a series in *The Lancet* [2-8].

One of the interesting features identifiable in the time–line is a shift in vocabulary between late 2010 and early 2011 – a period that is bisected almost exactly by the publication of an article, also in *The Lancet*, identifying "chronicity" as the future issue for health systems [9]. Up until late 2011 the NCDs discussion had more often than not used the vocabulary of chronic diseases rather than NCDs, with reference to a typical set of non-communicable diseases that were chronic in nature, including cardiovascular diseases (mainly heart disease and stroke), some cancers, and type 2 diabetes [2,3]. Occasionally

other conditions such as mental health conditions, respiratory conditions, injury and such like would appear in the narrative. The main conditions, however, were those that might be described using a nomenclature of "diseases of lifestyle", related to choices made about smoking, exercise, and macro– and micro–nutritional content of food [10-13].

The shift in vocabulary may have just been whimsy, but it probably reflected a wish to classify the diseases of interest by their causes rather than by their effects or health systems consequences (long term management) [14]. The global burden of NCDs is significant, and will affect low– and middle–income countries most [15]. As a strategy, there is no doubt that the greatest future health gains in the area of NCDs are going to be made through prevention – which requires an understanding of causation – and might then support the vocabulary shift. Prevention strategies will have to be multifaceted, but may include trying to effect individual behaviour change [16,17], change in industrial behaviour [18] or change in the environment [19]. Making the changes is non-trivial: it will in many cases be harder for lower income countries to implement; it will take time to make the changes; and even when the interventions are successful, there will still be a substantial number of people who will contract non-communicable diseases. The health burden of NCDs will grow for the foreseeable future; it will have a real impact on the

> Many health conditions are chronic, and only some of those chronic health conditions are NCDs. If the interest is on cause and prevention, then NCDs should be treated separately from other chronic diseases. If the interest is on health systems and management, then NCDs should be joined with other chronic diseases.

health and non-health budgets of governments; it will have an impact on the GDP of countries; and it will have to be managed.

Without diminishing the primacy of prevention in global health, in this article we want to focus on the practicalities of the management of chronic diseases. Note again the shift from the NCDs vocabulary back to chronic diseases. This is intentional and pointed. If one is interested in understanding causes and prevention strategies it is important to separate the NCDs from other chronic diseases; however, if one is interested in the effects of the diseases, particularly on the health systems, then it is equally important to join the NCDs with other chronic diseases [9,14]. Many health conditions are chronic, and only some of those chronic health conditions are NCDs. Even after the inclusion – along with the core non-communicable diseases of cardiovascular disease, cancer, and diabetes – the respiratory conditions, mental health conditions, the arthritides, and functional loss and disability, there is a group of other diseases that are all chronic in nature. These are the communicable, infectious diseases that either have no cure, simply ongoing management (HIV/AIDS) or they have a cure, but the cure takes an extended period of 6 months treatment or more (tuberculosis and onchocerciasis – with some hope, following recent trials, that a shortened 2–week course may be feasible for tuberculosis treatment [20]). The commonality is chronicity – the temporal nature of the conditions requires an extended relationship with the health system, including quite probably an extended financial relationship.

Most low– and middle–income health systems have been designed for the management of maternal and neonatal mortality, and acute phases of infectious diseases such as malaria, respiratory tract infections, and diarrhoeal diseases [21]. "Receive them, Revive them, and Return them" could have been the motto emblazoned over the entrance gates to most health services in low and middle income countries. The system – beyond a record of immunisation or antenatal visits – has not traditionally needed to have a memory of the patient. For epidemiological purposes recording health systems interactions is important, but not central to the case management. For the acute diseases the diagnosis drives most of the decision process. In the management of chronic diseases, the diagnosis is known early in the patient–system relationship, and the ongoing strategy revolves around maintenance, monitoring, encouragement, and compliance (with acute services when necessary). This requires that a relationship is built with the client. However, a health system designed to deliver longitudinal management of a chronic health condition is distinctly different from one designed for the management of serial acute episodes.

> The two main issues that arise when contemplating health systems' management of chronic diseases are structure and financing. Our interest is in the observation that the management of any chronic condition entails a commitment to recurrent costs, which reduces the flexibility of health systems to respond to new demands. It also requires that a health system that traditionally has a poor relationship with the population beyond acute management becomes more responsive to changes in the population health profiles. Such a system will be harder for poorer countries to manage than richer ones.

The two main issues that arise when contemplating health systems' management of chronic diseases are structure and financing. Unfortunately, the research base for establishing evidence for action is thin. We return to the lack of research shortly. There is, however, little doubt about the financial impact of an increasing chronic disease burden on the individual, the family, and the health system. Under current health systems arrangements, the financing of chronic disease management in the population is costly, and at a national level costs will increase with rising prevalence [22]. One possibility is that the costs will be carried by individuals through out of pocket payments, which in low– and middle–income countries will often have catastrophic consequences for families [23]. Alternatively, costs could be carried by government, but few low– and middle–income countries could manage the entire financial burden, or some mixture of insurance, out of pocket payments, and government support.

With respect to the individual and family impact, quotes published in a recent article on catastrophic health care spending related to acute coronary syndrome in Kerala provide good examples [23]:

"I am not sure how long I can take my medicines. I have a credit account with the local pharmacy. They also help me out with samples from medical representatives. I cannot be a charity case forever, can I?"

and

"Right now, I am staying with one of my sisters, so that I don't have to pay rent, water or electricity charges. My other sister has cut all ties with me. She fears that I will become a burden on her and her family."

Both these quotes came from the same 50–year–old male patient and highlight individual and family collective finan-

cial burdens. The disease reduced his daily earning from US$ 17 per day to US$ 0.7 per day, and required an increase in expenditure to cover health care (although some was available through charity).

The impact on health systems, particularly health systems already stretched will be marked. In Kenya, the national government believes that the prevalence of type 2 diabetes in the population was around 10% in 2008, although "official statistics note a diabetes prevalence of 3.5%." [24]. Under some fairly loose assumptions, one can imagine that in that 6.5% prevalence gap between what is believed and what is officially acknowledged, there is a fairly large group of people with insidious diabetes that is damaging their eyes, kidneys, and vascular system. For this chronic disease alone, the Kenyan government would be anticipating 10% of their population should be under clinical management (in 2008). Unlike treating a respiratory tract infection, the financing of diabetes management is a recurrent cost because of the chronic nature of the disease. Whence will that money come?

At the moment, 61% of the total health spending in Kenya goes to another chronic disease – HIV [25]. For that level of spending, antiretroviral coverage for 61% of HIV positive people in need of treatment has been achieved; mean-ing that 39% of people in need of treatment are missing out [26]. The commitment to provision of HIV treatment to those in need entails an expansion of services, and an increasing recurrent annual financial commitment that will not reduce in the near future. Indeed, given some of the evidence on antiretroviral resistance, one might imagine the cost will rather increase [27]. Furthermore, the more successful one becomes at management, the greater the number of people under management, the longer they will live, and the greater the recurrent costs.

The purpose here is not to pit one disease against another and argue for the greater worthiness of one group of patients over another. The chronic communicable diseases and the chronic non-communicable diseases often have an interacting pathophysiology – and the management of one supports the management of the other. Both diabetes and HIV increase the likelihood of contracting TB [28]. Having diabetes increases the likelihood of chronic kidney disease, and chronic kidney disease increases the chance of heart failure [29]. Our interest is in the observation that the management of any chronic condition entails a commitment to recurrent costs, which reduces the flexibility of health systems to respond to new demands. It also requires that a health system that traditionally has a poor relationship with

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the population beyond acute management becomes more responsive to changes in the population health profiles. Such a system will be harder for poorer countries to manage that richer ones. The World Health Organization has suggested that [22]:

"In order for low– and middle–income country health systems to expand individual health–care interventions [for chronic diseases], they need to prioritize a set of low–cost treatments that are feasible within their budgets. Many countries could afford a regimen of low–cost individual treatments by addressing inefficiencies in current operations for treating advanced–stage NCDs. Experiences from maternal and child health and infectious disease initiatives show that health priorities can be rearranged and low–cost individual treatments improved with only a modest injection of new resources."

Identifying inefficiencies and cost–effective interventions to improve health systems performance is laudable. Such a strategy will not, however, overcome the fundamental bottleneck. Health systems were never designed to treat 20% or more of a country's population as if they had a disease all the time. Take two middle–income countries as examples. In South Africa, the prevalence of HIV in adults is about 18% [30], diabetes is about 13% [31], and hypertension is 10% [32]. In Malaysia, the prevalence of diabetes in adults is about 15%, and 25% among one of the ethnic groups, the prevalence of hypertension is about 32% [33]. It is not enough to find cost–effective strategies for individual management. A fundamental rethink is required about how population health is managed when a substantial and growing proportion of the population has a chronic disease. We do not have the evidence base for that.

One approach to developing the evidence base is through "community health laboratories". Essentially, within a tractable, geographically defined area, such as a county or district, health systems innovation can be tested and monitored [34]. Assuming that the entire population has been enumerated, and their health status and health systems interaction can be followed over time, it becomes possible to measure the impact of health systems innovations on various dimensions of health systems performance. Using these kinds of community settings, governments can look at im-

plementation within the contexts of real lives and functioning communities. This is particularly important in environments where people employ pluralistic health care engaging multiple belief systems simultaneously, utilising both government and private providers. These community based research environments are particularly well suited to low– and middle–income countries.

In Malaysia, a new health and demographic surveillance site, the South East Asia Community Observatory (SEACO), is being established with the intention of being able to trial health systems innovation relevant to chronic disease management [35]. There are in excess of 40 health and demographic surveillance sites in the world, mainly located in low–income countries in sub–Saharan Africa [34]. They rely on enumerating and then following–up the population over time. The *raison d'être* of HDSS has been in the management and prevention of acute health conditions associated with vaccine trials, maternal and child health, malaria, diarrhoeal diseases, and HIV. Chronic diseases have emerged relatively recently within the scope of HDSS, and no sites had been established with this as a theme of interest. SEACO has been established with chronic diseases prevention and management as a central theme in its development. Unusually, it is also one of only two HDSS in middle–income countries.

The value of settings like SEACO is that they sit between the unrealistically controlled setting of an experimental trial – focused on the individual and uninterested in the contextual effects – and a completely realistic, unmonitored, community setting in which context is everything, but the impact of change cannot be measured or assessed. Low– and middle–income countries, faced with a growing chronic diseases problem will need to rethink how they deliver health care – and even what it may mean to deliver health care – but they also need an evidence base on which to make systems changes. The evidence generated through SEACO–like infrastructure has the potential to provide novel, yet realistic, models of prevention and health care management within the real life context of low– and middle–income countries. With the growing chronic diseases problem this evidence base and new ways of thinking are critical to making long term, sustainable systems change.
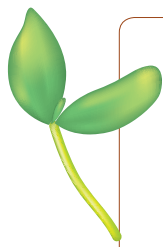
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A prescription for health inequity:
Building public health infrastructure in resource-poor settings

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"My family has already purchased a coffin for me," Naeema explained, enervated though she was. "The medicine we got from the local clinic has not helped. I am getting worse. We have spent almost all of our money going to regional hospitals to get a diagnostic test and request government subsidized medicine. My parents have sold everything we had – our crops, our land, and our livestock – to pay for my medicine. My family does not have any more money or even enough food to eat." Naeema was HIV-positive, and due to a lack of diagnostic capabilities or availability of antiretroviral treatments (ARTs) in her village of Kibosho in Tanzania, she had been bed-bound for more than three months after the onset of her symptoms, when she first arrived at the clinic.

> We live in a fortunate time: we have treatments and other essential tools we need to combat AIDS and other epidemics. Health is a human right. But interventions, either overpriced or merely nonexistent, are usually least available in places they are needed the most. A majority of deaths in these resource-poor settings are avoidable and demonstrate a failure of the health care infrastructure.

We live in a fortunate time: we have treatments and other essential tools we need to combat AIDS and other epidemics. Health is a human right. But interventions, either overpriced or merely nonexistent, are usually least available in places they are needed the most. A majority of deaths in these resource-poor settings are avoidable and demonstrate a failure of the health care infrastructure. In Kibosho, for example, even though the local rural clinician could test for HIV/AIDS antibodies in Naeema's blood, CD4 counts and antiretroviral treatment, which are the best options for improved quality of life and extended life expectancy, were simply not available to those living in the area. The result is non-action. It is not that there are no resources available to actually solve the problem, but rather a host of additional complications that prevent medications from reaching those who need them most, such as adequate roadways to rural communities, refrigeration units to preserve medications, and a host of others. Remedying these problems represent sustainable solutions to building public health infrastructures. In short, distributing medication is trivial if infrastructure to support distribution and administration of those medications is not prioritized. A paradigm shift, therefore, is needed to effectively address these issues. Such a shift would manifest itself in the form of established, local entities playing a central role not only in the distribution of medical aid but in wider systemic support needed to distribute medication and treat patients across resource-poor regions.

Sadly, Naeema's story is not uncommon; tens of millions suffer due to inadequate care and lack of available resources. According to the UN Agency for HIV/AIDS [1] 27 million Africans live with the HIV or are dying of AIDS and some 35 million HIV-infected people live in the developing world, with women and children bearing a significant burden of disease. According to Rodriguez et al. [2], in 2005, when Naeema's condition reached a critical point, only one in ten infected with HIV were tested and knew his or her HIV status. Since that time progress has been made in part due to PEPFAR, PMTCT, Global Fund and other programs, thus resulting in 20% knowing their status at present. Despite these far-reaching improvements, however, there is still much to be done. The fact that more than two decades into the epidemic the World Health Organization (WHO) reports only 80% of infected individuals are aware of their HIV status and 90% are unaware of their partner's status [3], is clear why the disease proliferates as it does and why it will be both exceptionally difficult to eradicate in the long run and challenging to contain the short term. According to the Joint United Nations Program on HIV/AIDS, of the 23 million Africans who are infected, fewer than 150 000 receive antiretroviral treatment [4]. Barring a miracle or a major paradigm shift by the international public health agents in both the public and the private sectors, these people, most of whom live in destitute communities, will die within the next decade. Despite the horrors of the pandemic, the international efforts to diagnose and subsequently deliver antiretroviral treatment to these marginalized populations are limited. It is a situation that we regard as a human rights calamity.

Perhaps the chief culprit for neglect of HIV/AIDS patients in the third world is heavy fragmentation of local health infrastructure in these countries. The term "global health infrastructure" refers to the conglomeration of public, private, and nonprofit efforts, whether unified or not, to address health issues. These entities, while promising to deliver tangible services and innovations, primarily succeed only in providing grandeur spectacles of delusional optimism and impractical idealism. This is exemplified in Naeema's native Tanzania, where agents in both the public and the nonprofit sector have seemingly worked together to obtain ARTs for HIV/AIDS patients, but have largely failed to make them accessible to those who need them the most.

Public and nonprofit agents have also failed to work toward developing a functional public health system in resource poor settings. In his 2009 article in *Philadelphia Social Innovations Journal* [5], David Hunter describes the current state of public health when he explains that

In conjunction with the failure of the public and private sectors to deliver better health outcomes, the epidemic of poverty is exacerbating health catastrophes across the developing world, including Naeema's native Tanzania. Consequently, a considerable portion of international development and humanitarian funding should be directed to building the capacity of the public health, public education and water sectors, all of which are essential to poverty alleviation and economic growth.

"while nonprofits work incredibly hard, with passion and dedication, and often in incredibly difficult circumstances to solve society's most intractable problems, there is virtually no credible evidence that most nonprofit organizations actually produce any social value." He goes on to lament the fact that "Because so few nonprofits are willing to face this fact and ask themselves whether they are doing any good at all, ... we cannot rely on direct service nonprofits to fix themselves." In other words, it can be argued that because nonprofit organizations don't coordinate efforts internally or between other organizations, their work falls far short of its potential in working toward a viable solution.

The public sector is equally ineffective. Non-profit organizations bear the vast majority of the burden in caring for the world's poorest because governments often refuse to take part in efforts to address issues like health infrastructure failure. Conventional wisdom in the global health belt-

Photo: Courtesy of Aliasghar Saajan, Healthnovations International, Tanzania

way is that it is prohibitively expensive and logistically burdensome for governmental organizations to provide health care in resource-poor settings.

Government contribution is necessary in building health capacity in the any developing nation. Such involvement will serve to provide credibility and logistical support that cannot otherwise be orchestrated. Local legislative oversight will additionally ensure sustainability of with widespread disease, and also promote responsibility among those working in their own communities.

In conjunction with the failure of the public and private sectors to deliver better health outcomes, the epidemic of poverty is exacerbating health catastrophes across the developing world, including Naeema's native Tanzania. Consequently, a considerable portion of international development and humanitarian funding should be directed to building the capacity of the public health, public education and water sectors, all of which are essential to poverty alleviation and economic growth. In the case of the HIV/AIDS epidemic, even if ARTs were distributed to infected patients, such treatment would be rendered ineffective for many because they do not function properly for those that are malnourished. The WHO effectively describes the widespread positive impact a functioning public health infrastructure can have on communities in the developing world, while outlining the extensive social investment needed to secure such far-reaching, effective health service [6]:

"Strong, equitable and comprehensive health systems, which are designed to reach even the most marginalized communities, can help to mitigate some of those factors that entwine poverty, death and disease. Nevertheless, only by ensuring that all the functions of health systems (such as: service delivery; the health workforce; information; medical products, vaccines and technologies; financing; and leadership and governance) are driven by the guiding principles of social justice, social participation and intersectoral collaboration, will good quality healthcare that is accessible to all become a reality. "

As the WHO suggests, while health systems have a direct impact on health outcomes, they also work to alleviate economic hardship through job creation in local economies resulting from technology transfer, an emergent service industry based on mobilization and utilization of health care professionals, and a host of other task-based positions that will emerge as a direct result of a functioning infrastructure. Such an infrastructure, therefore, will serve to not only prevent the spread of disease itself, but effectively lessen the poverty-related hardship that can lead to disease faced in particular by rural communities in the third world.

Located in Southeastern Africa on the coast of the Indian Ocean, the per capita income for citizens of The United Republic of Tanzania is estimated to be at about US$ 524 a year, making it one of the poorest countries in the world,

says United Nations Statistics Division [7]. It is also among the most affected countries in the sub Saharan region in terms of HIV/AIDS infection, with an estimated 1.5 million adults and children living with the disease. Because of the widespread and devastating effects of HIV/AIDS in the country, Tanzania serves as a useful model for the problems associated with treating disease and providing a framework for which potential solutions may be overlaid in a health care infrastructure.

Realizing the acute health needs of rural regions of Tanzania where health care infrastructure has been ravaged by rampant poverty and government neglect, it is conceivable that inequalities in access to quality medical care and the consequent health disparities in developing nations are perhaps the biggest challenges in public health today. If mass treatment of HIV/AIDS patients is to take place, ART is the most effective and likely means for it to take place. Circumstances are currently much more favourable in Tanzania than at the turn of the century, as ART has been available there for more than ten years. However, as estimated by the UNAIDS *World AIDS Day Report* [8,9], fewer than 20% of all the infected individuals, most of whom live in rural and hard to reach communities, are currently receiving treatment. This statistic bespeaks the fact that there is a desperate need for effective health infrastructure that can facilitate the delivery of needed care. Ongoing efforts in recent years, predominantly in the non-profit sector, have achieved substantial improvements in health access, prevention, and education [10]. But much more can and must be done. The general state of health systems throughout the developing world still severely limits the diagnosing and subsequent monitoring of HIV/AIDS and other patients in marginalized communities like Naeema's.

Examining the history of both successful and failed attempts to wipe out HIV/AIDS and other infectious diseases provides considerable evidence that these diseases must be targeted jointly by both the public and the private sectors [11]. While public, non-governmental, and international health organizations will naturally focus on varying diseases at different times, eradication efforts have shown to be most effective when a significant number of groups in both private and public sectors coordinate their efforts and holistically

> While public, non-governmental, and international health organizations will naturally focus on varying diseases at different times, eradication efforts have shown to be most effective when a significant number of groups in both private and public sectors coordinate their efforts and holistically tackle a particular disease with pragmatic solidarity.

tackle a particular disease with pragmatic solidarity. The public sector in this model of pragmatic partnership will initiate, fund, and ensure sustainability of equitable health care programs by building effective health systems in resource-poor settings while improving the skills and capacities of non-profit organizations. Additionally, the public sector will work to increase access of core competencies in the private sector to their most marginalized populations. Likewise, the private sector will expand the reach of public sector resources by targeting patients in their milieu. The WHO summarizes this strategy in noting that [6,12]:

"In many countries, the power of health interventions and technologies for curing disease and prolonging life is still not matched by the power of health systems to deliver these to people in need. It is essential to close this gap and the need is now strongly felt by the various actors in global public health. The desire to integrate the two mutually dependent dimensions – new resources for effective and affordable interventions and the broader fabric of health systems – into a more productive whole, that can deliver better health outcomes."

Ultimately, it will be this idealistic yet pragmatic marriage of the public and private sectors, what the WHO calls "mutually dependent actors," that will establish robust and effective health care infrastructures – a socially just paradigm that will deliver equitable health care to those like Naeema who need it the most in order to have a fair shot at a productive, healthy, and fulfilling life.

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Double burden of malnutrition:

A silent driver of double burden of disease in low– and middle–income countries

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Double burden of malnutrition, characterised by undernutrition among poor children and obesity among deprived adults, is a serious global problem and an important promoter of 'double burden of disease' which is currently affecting low– and middle–income countries. Possible ways to reduce this burden is through education on the importance of equilibrium between energy intake and expenditure; ensuring conditions for optimal fetal and early child development; and reducing poverty as one of the main drivers of both undernutrition and obesity, through empowering local communities.

Double burden of diseases in low– and middle–income countries (LMICs) is well recognised. However, proper understanding of the need for a joint intervention against both infectious diseases and non–communicable diseases (NCD) has arisen only recently [1]. In 2008, the proportion of premature deaths due to NCD in population under 60 years of age in low–income countries was 41%, in lower middle-income countries 28%, and in high–income countries only 13% [2]. The most frequent causes of death included cardiovascular diseases, diabetes, cancers and chronic lung disease, and the main underlying risk factors were increased blood pressure (responsible for 13% of deaths globally), tobacco use (9%), elevated blood glucose levels (6%), physical inactivity (6%), and overweight and obesity (5%) [3]. Excessive intake of calories is one of the main common factors behind those conditions and risk factors, along with other lifestyle choices and genetic predisposition.

On the other hand, communicable diseases are still difficult to control, especially in young children, even though most of the necessary tools and knowledge about their prevention, treatment and control are available [4]. Those tools are both effective and affordable, but they do not reach those who need them [5]. Four communicable diseases still account for nearly 50% of global child mortality – acute respiratory diseases, diarrhoea, neonatal sepsis and malaria [6]. An important underlying risk factor for those diseases is undernutrition. It was estimated that as much as 35% of child deaths could be attributed to macro– and micro–nutrient undernutrition [7]. In addition to its effect on mortality, undernutrition also affects human development in many aspects.

Recently, it became increasingly apparent that, in addition to 'double burden of disease' affecting LMIC populations, there is also 'double burden of malnutrition', consisting of undernutrition among children and overnutrition in adults. A driving force behind the shift from undernutrition in childhood to overnutrition in adulthood in LMIC was the rapid increase in economic development, global-

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ization, and urbanization, leading to tremendous changes in lifestyle marked predominantly by changes in diet and physical activity and under– and overnutrition occurring simultaneously among different population groups. This was recognised recently in FAO's document on double burden of malnutrition in six LMIC: China, Egypt, India, Mexico, the Philippines and South Africa [8]. Great disparities were observed: in the Philippines, 27% of children under five years of age were underweight, while 27% percent of women were overweight or obese [8].

Examples of simultaneous occurrence of undernutrition in deprived parts of the population and obesity among more affluent were well recognized in many countries, but these recent changes tend to result in the opposite manifestations of malnutrition even within a single household. For instance, an underweight child and an overweight mother within the same household were observed in 11% of the households in rural areas in Indonesia and 4% in Bangladesh [9]. The figures were even worse in the refugee population living in Western Sahara, in a protracted emergency and dependent on food assistance, where 24.7% of pairs of children aged 6–59 months and mothers aged 15–49 years were affected by this 'double burden of malnutrition'

[10]. Interestingly, in the same study only 2.4% of children were overweight (29.1% were stunted and 18.6% were underweight), while among the women, 53.7% were overweight or obese, and only 14.8% were stunted [10]. Such differences were explained to arise due to the feeding practices and beauty perception of the Sahrawi population, levels of physical (in)activity, conditions within the refugees camps, nutrients available, but also with the emerging evidence of association between childhood undernourishment and the adult obesity [10].

Almost two decades ago Barker proposed his 'fetal origins hypothesis', stating that "fetal undernutrition in middle to late gestation, which leads to disproportionate fetal growth, programmes later coronary heart disease" [11]. His hypothesis was based on ecological studies, but it was soon confirmed in experimental animal models [12,13] and numerous epidemiological studies in different human populations [14-17]. The basic idea underlying this hypothesis was 'developmental plasticity': the phenomenon that enables the development of different end–results within a single organism, given the current environmental conditions; those can range from under–representation of important inputs (such as nutrients), to their over–representation. Sometimes, even the same detrimental effects can arise, but through different adaptation mechanisms, like in the case of obesity and type 2 diabetes [18]. Barker's theory laid the foundations for the developmental model of the origins of the adult diseases, namely for NCD, through programming mechanisms including particular cellular signalling pathways, metabolic and hormonal responses, but also through certain epigenetic modifications [19] which bring permanent changes, leading to disease manifestation in the adulthood. Such 'metabolic programming' has been so far described for obesity [20,21], type 2 diabetes [18], hypertension [22] and other cardiovascular diseases [23], but also for some other diseases, like asthma [24] and lung cancer [25]. There are also some conflicting results, such as the lack of apparent association between low birth weight and adverse effects on health among children and adults. Also, some studies used less reliable study designs, such as ecological, cross–sectional or case–control designs. In order to gain more accurate and credible findings, a life–course approach to the investigation of environmental, metabolic and genetic factors is necessary and warranted [26]. This approach is defined as "the study of long–term effects on chronic disease risk of physical and social exposures during gestation, childhood, adolescence, young adulthood and later adult life" [27].

Fetal origins hypothesis is also known as 'thrifty phenotype' hypothesis, as opposed to 'thrifty genotype' hypothesis, which should also be mentioned here. History of modern humans, dating to the last 120 000 years, was characterised primarily with long periods of food insecurity and scarce re-

sources among hunter–gatherer populations, and only occasional and short–lasting circumstances of abundance. Due to such environmental conditions, early people developed thrifty genotype, enabling them to survive starvation periods and to maximally harness rare opportunities of abundance, storing the energy for upcoming famine. In modern times, dramatic changes resulting in increased food availability led to predisposition to obesity and diabetes type 2 [28].

Today's food abundance in high–income countries is marked with loss of seasonality for almost all foods and many fashionable movements in dietary practices, like the 'Zone diet', the 'raw food diet', the 'Paleo diet', the 'Atkins diet', the 'Cactus diet', the 'blood type diets' and many more. Some of those diets seem to be based on unbalanced nutrients and may even generate opposite effects from those desired. Scientific evidence for the effectiveness and appropriateness of any of those diets is insufficient at best.

Scientific inquiry in food and nutrition practices and their effects is well established, which is perhaps best noted in 63 different journals referenced in the National Center for Biotechnology Information Databases (NCBI) having the word 'food' or 'nutrition' in the journal's name. A review of the research focused on food safety and security during the last decade showed a steadily growing interest and almost 40–fold increase in the number of citations of the published papers between 2000 and 2010 [29].

The analysis of the scientific literature on adult obesity and cardio–metabolic risk revealed a U–shaped correlation between the birth weight and the risk for the disease outcome [17]. This means that both low birth weight (which can be due to maternal undernutrition) and high birth weight (due to maternal obesity and/or gestational diabetes) are associated with greater risk for adverse outcomes in offspring – particularly adult obesity and diabetes. Intrauterine growth restriction (IUGR) permanently alters fetal metabolism to enable survival in restricted environment. When a child with IUGR is born and raised in the environment rich in high–calories diet, which are becoming more frequent in middle–income and even in low–income countries, it will likely become obese. On the other side of the spectrum, energy–rich environment during foetal life, which is due to maternal overnutrition, may drive the development of excess abdominal fat and type 2 diabetes in later life [18]. This problem is concerning on the broader population level, given that obesity pandemic is a relatively recent phenomenon, leading to high (and still rising) prevalence of overweight and obesity in women in reproductive age around the world – in both developed and in developing countries. If epigenetic mechanisms indeed enhance propensity to adiposity through mechanisms proposed above, the human population may have entered a spiral that will make each new generation more obese. For instance, according to the results on national, regional, and global trends in body–mass index (BMI) since 1980, BMI increased by 0.5 kg/m² per decade in women worldwide and by 0.4 kg/m² per decade for men [30]. More than half of the adults in high–income countries and in upper middle–income countries were overweight, but in lower middle– and low–income countries the increase in prevalence of overweight and obesity over the last three decades was greater than in upper middle– and high–income countries [30].

There is ample scientific evidence on the effects of overweight and obesity on health, ranging from local tissue inflammation to atherosclerosis, myocardial infarction, diabetes, hypertension, hyperlipidemia, some forms of cancer, locomotor problems, gout, urinary stones formation, gallbladder disease, sleep disorders, excessive sweating, and others. Obese people also suffer from social stigmatization and isolation, which can easily lead to depression [31] and overall poor quality of life. Furthermore, people with obesity have shorter life span and an increased risk of sudden death [32]. Therefore, obesity is the crucial mediator between the unhealthy lifestyle, marked by the unhealthy dietary patterns, coupled with poor physical activity, and morbidity and mortality from many non–communicable chronic diseases.


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Poverty remains the most important reason for stunting and wasting, which are the most commonly used indicators of malnutrition among children. However, recent findings from the USA described the link between poverty and obesity, mediated through affordability of unhealthy foods. Obesity in North America is significantly more prevalent in poor neighbourhoods and among groups with lower education and income, suggesting inequitable access to healthy foods. This trend is mainly driven by the prevalent consumption of grains, added sugars and fats, which are inexpensive, good–tasting, convenient and low–cost [33]. In the survey among US adults in 12 states during 2009, those who felt insecure about food availability had 32% increased odds of being obese compared to those who felt secure [34]. These findings suggest the presence of the burden of undernutrition within the burden of energy overnutrition. Continuing global recession and economic downfall is likely to further aggravate those negative trends in the future.

The burden of malnutrition is enormous. In 2009, over a billion people were reported as food insecure and 180 million children were reported being undernourished [35]. At the same time, the global estimation from 2008 amounts for 1.4 billion overweight adults and 40 million overweight children, with over 200 million obese men and 300 million obese women [36]. There is no easy solution to overcoming this perplexing problem, but successful strategies will need to incorporate increased reliance on local resources through integrative approaches in all the countries of the world [35].

Described mechanisms and trends highlight a 'double burden of malnutrition' as an important driver of the double burden of disease. On one hand, undernutrition in fetal life and among children predisposes to infectious diseases, but also increases the NCD burden, mainly through overweight and obesity and related co–morbidities. On the other hand, overnutrition in pregnant overweight women closes the circle. Since the abundance of literature is supporting these findings in developed countries, the real question is what the future holds for the developing countries? This problem should be given greater attention, so that a scenario for the future of mankind that was very intelligently portrayed in WALL–E movie is avoided [37].
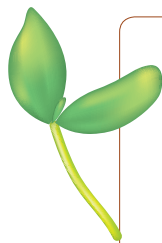
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Floods in Southeast Asia:
A health priority

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Out of all the natural disasters, floods are the most common in both developed and developing countries, accounting for approximately 40% of all natural disasters [1,2]. Flooding has severe implications on human health before, during, and after the onset of a flood. Southeast Asia is a region that is especially prone to frequent and severe natural disasters [3]. The Association of Southeast Asian Nations is comprised of Cambodia, Laos, Thailand, Vietnam, Brunei, Malaysia, Indonesia, the Philippines, Singapore and Myanmar [4]. In this manuscript, I discuss why flooding is a problem is Southeast Asia and why I feel flooding warrants attention compared to other problems in the area due to the serious health impactions that arise as a result of flooding. I also explore why flooding warrants attention compared to other health concerns in the region.

IMPORTANCE OF THE PROBLEM

The frequency and severity of flooding in Southeast Asia has increased over the past several decades. Flooding is a prominent issue that is currently affecting many regions in Southeast Asia, in particular Cambodia, Thailand, Vietnam, Laos, the Philippines, and areas surrounding the Mekong River. According to the United Nations Office for the Co-ordination of Humanitarian Affairs [5] it is estimated that 9.6 million people are currently affected by the flooding in Southeast Asia, with 5.3 million in Thailand alone. According to the National Committee for Disaster Management and the Department of Hydrology, the floods in Thailand are so severe that they have been labeled the worst floods in over 60 years [5]. Flooding in Southeast Asia raises many concerns for the health and well-being of those affected.

MECHANISMS OF THE IMPACT OF FLOODING ON HUMAN HEALTH

The consequences of flooding on human health can occur before, during and after a flooding event. However, not many think about the health risks that can occur before a flood. There is an increased rate of mild injuries before the onset of a flood when people are advised to move their families to a safe location [3]. If left untreated, these injuries can have much larger implications on morbidity and mortality in the event of an actual flood, if an open wound is exposed to a source of contaminated water.

During the actual onset of the flood there is potential for direct causes of injury and death. Most deaths directly related to the onset of a flood are due to drowning, which frequently occurs as individuals attempt to move through high, fast moving water in their vehicles [4] or are swept away into moving waters while trying to help themselves of others [6]. Other deaths are the result of being struck by objects in fast moving water, dying of heart attacks, electrocution or by being buried in mud or collapsed infrastructure [6]. In 2011, an estimated 567 deaths due to floods occurred in Thailand, another 248 deaths in Cambodia, 85 deaths in Vietnam, 30 deaths in Laos, and 102 deaths in the Philippines with a total of 1, 302 deaths in Southeast Asia alone due to direct causes [5].

After the onset of a flood, there is potential for an increase in communicable diseases and further injury. As people start to accumulate back to their homes, the structure and foundation of buildings become damaged and weak, and collapsing can again cause injuries. Electric cables and wires may also be exposed or submerged in water increasing the risk of electrocution and burns [3,4,6]. Increased rates of carbon monoxide poisoning have also been reported as electric generators and pressure washers are used in the cleanup process. Many of these generators are fueled by petroleum and are used indoors or areas of poor ventilation [4]. There are also increased cases of hypothermia as individuals are continually exposed to frigid water, with parts of their body remaining wet for long periods of time [4].

The risk of communicable diseases, particularly fecal oral diseases, also increases in flooded areas. [3,6]. These diseases are spread when fecal matter is passed through the mouth and are more common in areas struck by floods due to declines in sanitation, lack of access to safe drinking water, and the consumption of contaminated foods. Other fe-

I think it is important to recognize the complexity of the causes of flooding in South-East Asia and reflect on the dynamic relationships that come into play when examining climate change and its effects on flood occurrence. I think it is also important to point out that Southeast Asia is more likely to experience the negative impacts of flooding at a much larger scale than higher–income regions of the world. This is largely due to limited resources, a poor economy and poor health infrastructure that characterize low–income countries

cal–oral diseases that are of increased prevalence during a flood include typhoid fever, paratyphoid, poliomyelitis, hepatitis A and hepatitis E [3,4,6].

Vector–borne diseases also increase in prevalence after the onset of a flood, primarily with mosquitoes being attracted to stagnant and slow moving water for breeding purposes. [3,4,6]. Outbreaks of rodent–borne communicable diseases are also reported during floods and are mainly due to increased amounts of rodent excrement in flood water [3,4,7].

Mental health issues have also been known to increase in populations who have experienced flooding, most commonly anxiety, depression and stress [3,6]. I strongly feel that mental health issues are not given as much attention as they deserve. For many, the emotional trauma of experiencing a flood is overwhelming. Thousands of individuals have to relocate, often residing in government shelters [5] leading to a diminished sense of place and attachment, along with a loss of self–identity [4]. Posttraumatic stress disorder, suicide, sleeplessness, irritability, anger and schizophrenia are also common mental health issues that increase in burden during floods [3,6].

Malnutrition is another threat in flooded areas. Food security has become a major issue in Southeast Asia, as it has been difficult to deliver food supplies to flood–affected [8]. Severe damage to agricultural land and livestock affects those who rely on these forms of food production, with rice, maize and coffee beans severely damaged, along with losses in livestock and poultry [9]. This puts many people out of work, placing a financial strain on the economy and on many businesses and families [8]. Severe damage is also suffered by many health care centers, making access to medical care more challenging in the areas that need it the most [6].

CAUSES OF THE PROBLEM

The recent floods in Southeast Asia are a result of a multitude of factors, including typhoons, heavy rains, and tropical storms [5,8]. The combination of four tropical storms and heavy and prolonged monsoon rains caused severe damage in Thailand, Cambodia, the Philippines, Vietnam, Laos, and Burma situated around the Mekong River [10,11]. The Asian monsoon is a wind system that changes directions with the seasons, and carries with it heavy rainfall [12].

Flash floods are a type of flood that occurs suddenly and progress just as quickly as it regresses; they are often short in duration, but their sudden onset makes them extremely difficult to predict and prepare for [13]. Water levels in both the Tonle Sap River and the Mekong River have been rising since August 2011. The overflow of these rivers, along with the combination of monsoon rains and tropical storms caused severe flooding in Southwest and Northern Cambodia, affecting 18 out of the 24 provinces [10].

On a larger scale, these heavy monsoon rains, typhoons and tropical storms are a result of climate change, a very complex system that is characterized by the dynamic relationships between land, bodies of water and living beings [14,15]. Southeast Asia is particularly vulnerable to the impacts of climate change due to its fast growing population, the majority of which are living in poverty, as well as poor food security and dwindling natural resources [14]. Climate change is a result of increasing temperatures which is linked to more intense rains, heat waves, extreme weather events, greater climate variability and rising sea levels, all which contribute to the increased frequency and intensity of flooding [14,16].

Global warming undeniably exacerbates flooding, however the extent of damage done by these floods along with their vast negative health implications are essentially due to particular issues in Southeast Asia. In some parts of South–East Asia there are problems with solid waste management systems. This can contribute to flooding in urbanized areas of Southeast Asia and can contribute to the spread of communicable diseases [17]. Limited resources within low–income countries make it difficult to prepare for flooding, as the resources are often not there to build sea defense, or other counter measures in areas that are at risk of flooding caused by rising sea–levels [18].

Many low–income countries in Southeast Asia are at a greater risk of poor health because a large number of people are living in crowded, highly urbanized areas, where they are more susceptible to contracting and spreading infectious diseases [18]. Disease control programs have improved over the years, however compared to high–income countries there is limited capacity to implement these programs effectively, thereby limiting low–income countries' ability to deal with flood induced increases of these diseases [18].

INTERVENTIONS TO ADDRESS THE PROBLEM

A variety of interventions have been implemented in response to recent flooding in Southeast Asia; some more

successful than others. One of the key elements to flood intervention is prevention. In Bangkok the government had set up a sandbag wall that spanned over six kilometers in order to prevent flooding from high tides in November of 2011 [10].

Detection and early warning system technologies also play an important role in dealing with floods. The Pacific Disaster Center has designed a specialized early warning technology program for Vietnam called VinAWARE [5]. In 2011 alone, VinAWARE was able to detect and track the tropical storms "Nock–Ten" and "Neast" along with several other tropical depressions. It also led to the production of over 950 flood advisories, over 250 storm advisories and over 2200 strong wind advisories, potentially avoiding disastrous results [5].

Detecting and tracking these natural disasters is only the first step. The next important steps involve awareness and community preparedness. Both governmental and nongovernmental organizations in Asia have engaged in small–scale mitigation. However, these efforts are often unsustainable due to a lack of connectedness and engagement with the community [19]. Other challenges to sustaining community preparedness through these organizations include a lack of funding and donor exhaustion. With limited resources, concrete action is often neglected while training and planning takes precedence [19]. There is a strong need to allow communities to take action themselves. For example, the Intermediate Technology Development Group–Bangladesh [ITDG–B] has created an improved housing model and has worked with community members to raise the foundations of homes, treat building materials in order to promote durability and to ensure houses being built have windows for proper ventilation [19,20]. Another community preparedness method is modifying agricultural practices to prepare for floods. Examples include seed preservation and the planting of flood resistant trees in order to protect agricultural production and improve food security during and after the time of a flood [20]. The health and well-being of livestock during a flood is also an important consideration. Southeast Asian communities are designating space for livestock in flood shelters, preparing and storing emergency feed, as well as de–worming and vaccinating farm animals [15,19]. More refugee sites are also being developed along with an evacuation plan, however, negotiations with local union parishad bodies and governmental officials were unsuccessful [20].

Community preparedness plays a strong role in assisting with emergency aid during the onset of a flood. One of the first emergency responses during a flood is evacuation. Evacuation procedures have been set in place, as part of community preparedness, to move people away from flooded, at risk, or dangerous areas. Many roads in Asia are raised to a level that is higher than annual floodwaters allowing people and livestock to travel safely to high grounds or shel-

ters. In fact, in Vietnam, the government has created a successful program known as *flood kindergartens*, which provide parents or guardians with a safe place to leave their children when flood warnings are administered [21]. However, evacuation efforts can be exhausted as many people neglect to evacuate because they fear losing their home and their belongings. Therefore, asset protection is another major feature of emergency response. Many agencies in Asia practice asset protection including such things as storing feed for livestock, replacing lost livestock, rebuilding communities and houses, and distributing tools needed to maintain and reconstruct farms and other businesses [19]. Other solutions include having the police or military secure flooded areas until it is safe for people to return to their homes.

Other forms of emergency response include search and rescue expeditions. These expeditions are extremely complex and need to be carried out in a very efficient and timely manner. The Sphere Project's Humanitarian Charter and Minimum Standards in Disaster Response and the United Nations High Commissioner for Refugees [UNHCR] plays a key role and search and rescue, setting standards for care and operational guidelines for triage units [22].

Other health concerns besides emergency first aid also need to be addressed. These include issues of communicable disease transmission, sanitation, food security and access to safe drinking water. The World Health Organization's Southeast Asia office has reported the need to improve the monitoring and surveillance of disease outbreak during floods [23]. Various initiatives have been set in place to improve sanitation during floods including the provision of safe sites for human excretion, promoting awareness, educating the community on safe sanitation practices and providing soap for hand washing. However, I feel food security in Southeast Asia is still an issue that needs improvement. The Agreement on Disaster and Emergency Response and the Coordinating Centre for Humanitarian Assistance on Disaster Management are two mechanisms set in place to address the need for improved food security [24]. On October 7, 2011 the Association of Southeast Asian Nations collaborated with Northeast Asia to create the ASEAN Plus Three Emergency Rice Reserve, in which 787 000 tons of rice was preserved for emergency use [24]. This collaboration along with the assistance of the UN World Food Program [UNWFP] is likely to have a positive impact on food security in Southeast Asia [23]. Improving sanitation and reducing risk after the onset of a flood are

> Communication, collaboration and knowledge dissemination are essential in improving the health risks associated with floods, not only in Southeast Asia but also around the globe.

also important measures that need to be taken in order to minimize negative health impacts. For example, the government in Thailand is working alongside the Bangkok Metropolitan Administration to drain floodwaters from Bangkok rivers into the Gulf of Thailand [5]. This will decrease water levels, decrease the risk of transmitting communicable diseases, and help to protect assets of livelihoods of the people residing in central Bangkok.

Operational assistance and monetary donations assist in dealing with negative implications of flooding. The Emergency Operations Centre plays a strong role in assisting with emergency response by providing direction and strategic management [21]. The United Nations and government agencies also play their part by providing funding, resources and support for disaster management [21]. In November of 2011 the UNWFP provided funding of over US$ 490 000 to provide operational assistance for emergency response in Southeast Asia [10]. The United Nations allocated US$ 4 million to Cambodia towards the United Nation Central Emergency Response Fund [10]. These projects have been successful in Southeast Asia because of coordination efforts at both the national and local level [19].

Operational or monetary assistance are also being used to examine the existing needs in areas affected by flooding. For example, in Vietnam, the United Nations, governmental and nongovernmental organizations are working together to establish any gaps or remaining needs for recovery [5]. Another example is in Thailand where the United States Agency for International Development along with the Office of Foreign Disaster Assistance are conducting research to examine remaining needs in affected areas [10].

Many interventions have been set in place to address the implications of flooding in Southeast Asia. Some interventions have been highly successful due to collaboration, coordination, and community engagement. However I feel some interventions have failed to address all the needs of this population and require further attention, action and improvement.

POLICY RECOMMENDATIONS

Community preparedness

Community preparedness is an example of an intervention that can be improved in Southeast Asia. Both governmental and nongovernmental operations are often unsustainable due to both lack of funding and community engagement [19]. In order to improve community preparedness relationships between these organizations and the community should be improved and maintained through ongoing support and guidance [19]. There is a strong need for governmental organizations to continue to develop flood preparation strategies beyond mitigation and adaptation to include such measures as monitoring, warning, communication and dissemination, and planned evacuations [25].

Risk assessment

I think improvements also need to be made in the area of risk assessment. The concept of risk assessment needs to be changed to include such measures as adaptation strategies and to recognize not only the role of geography, or location, but to also recognize socially constructed vulnerability [25]. Along with risk assessment there is also the issue of risk reduction, which is often limited in terms of funding and resources, but it is important to achieve it through awareness, education, dissemination, and community preparedness and to keep it in mind during health system planning [6]. Risk reduction issues are often neglected in comparison to emergency response. Health systems need to learn from the hazards involved in past flood experiences in Southeast Asia and adapt to take precautionary measures before the onset of a flood. To date, there is little evidence of this process [6]. Although knowledge translation can be context–specific, there is a need to learn from past experiences around the world and ensure risk response and adaptation strategies are disseminated and communicated about on a global scale [6].

Communication and coordination

Communication and coordination are important factors that need to be considered when addressing floods and other natural disasters. In terms of risk assessment, risk reduction, community preparedness and risk response there is a strong need to improve communication and coordination between policy makers, governmental and nongovernmental agencies, donors, and local communities [6,19]. Information on flood risks needs to be disseminated in a lay and culturally appropriate to reach community members in an effective way. There also needs to be an increase in community input when making decisions and planning emergency response strategies [6]. Governmental and nongovernmental organizations also need to develop stronger coordination and communication when assisting these communities in order to avoid duplication and ensure that the areas that are most affected are receiving the assistance they need [19].

There is also room for improved communication and coordination when assessing the implications of flooding on a population. Organizations tend to have their own research agendas and often neglect to coordinate with other organizations when performing assessments, making it difficult to generalize results. This leads to repetition and replication causing greater post–traumatic stress to flood victims as they are being asked to recall their experience on multiple occasions, which becomes emotionally exhausting [21]. There is also a need to incorporate flooding when formally assessing health implications of climate change.

Global action

Given the extensive damage flooding has caused in Southeast Asia, I think it is imperative to learn from these experiences and promote global action. However, implementing

best practice on a global scale requires extensive political will and monetary resources, which are not always readily available [6]. For example, limited funding is available for research being done by nongovernmental organizations in the Philippines, making capacity building and community preparedness strategies difficult to implement [6]. The majority of resources are put into disaster relief operations while risk reduction and community preparedness are neglected. Nonetheless, it is essential that community preparedness and risk reduction strategies be granted attention, as they are typically low–cost efforts that can be implemented at the local and community level. However, this is a difficult ideological transition for many policy–makers and donors [6].

Other changes required on a global scale involve improving health infrastructure, including the quality and effectiveness of services being offered. In order to reduce health risks from flooding, health systems need to be strengthened, along with other life–supporting services [6]. During a flood, providing effective health care services can be challenging because the flood may also directly affect both staff and facilities. However, there is a need to improve awareness of exacerbated health impacts that arise with flooding and a need to improve continued care, long after a flood has occurred [4]. Improvements also need to be made in infectious disease control, sanitation, and food security to reduce hazardous outcomes during a flood. By improving the general health of a population, people become less vulnerable to health risks during the onset of a flood [6].

Research gaps

There are many gaps in the research that has been conducted on flooding, including gaps in health risk reduction knowledge, as well as the gaps in understanding how we can reduce the implications of climate change, which plays a significant role in the presence of natural disasters, especially floods. In terms of health risk reduction during floods, further research needs to be conducted to determine the mental health implications of flooding. Little research has


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been done to examine long–term health implications, even in high–income countries [3]. This research would be important in order to learn how to provide counseling and continued care long after a flood has occurred. Mortality risks and risks of infectious disease also require research, as there is hardly any quantifiable research in this area [3].

Further research is also needed to determine to what extent climate change adds to flood risks and related health risks in various settings [3,26].

CONCLUSION

Poor support and emergency services, along with a lack of resources in Southeast Asia largely contribute to negative health impacts of flooding in the area. On a larger scale, climate change may be increasing the frequency and severity of floods experienced around the globe. Many interventions have been set in place to prepare communities for floods, reduce and assess risk, and perform emergency services and aid. However, many of these interventions lack sustainability and the resources needed to provide lasting and effective services to those in need. I think the study of health implications of flooding and climate change are a relatively juvenile and there are many knowledge gaps in the literature that need to be addressed through further research and exploration.
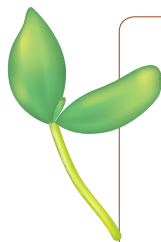
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PAPERS

An estimate of the prevalence of dementia in Africa: A systematic analysis

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Background The burden of non–communicable diseases is growing, particularly in developing countries. The greatest economic burden is due to dementia, the prevalence of which is rising with increasing longevity. In Africa, where the rate of increase of elderly persons is the fastest in the world, dementia is normally dismissed as a part of normal ageing. The lack of awareness means that many patients are suffering undiagnosed. This review aims to assess the information on the prevalence of dementia in Africa in order to estimate the current burden.

Methods A parallel search of Medline, EMBASE and Global Health limited to post–1980 found only 10 relevant studies. Data on prevalence and risk factors were extracted and analysed. We modelled the available information and used the UN population figures for Africa to determine the age-specific and overall burden of dementia.

Results The overall prevalence of dementia in adults older than 50 years in Africa was estimated to be about 2.4%, which translates to 2.76 million people living with a disease in 2010. About 2.10 millions of them live in Sub–Saharan Africa. Prevalence was the highest among females aged 80 and over (19.7%) and there was little variation between regions. Alzheimer disease was the most prevalent cause of dementia (57.1%) followed by vascular dementia (26.9%). The main risk factors were increasing age, female sex and cardiovascular disease.

Conclusions Information on dementia prevalence in Africa is very limited. Further research will not only provide a more reliable estimate of prevalence, and consequently the burden of disease, but will also raise awareness of the problem. This is critical in promoting help-seeking behaviour and generating the political commitment to make dementia a public health priority in Africa.

Non-communicable diseases (NCDs) have become the leading causes of death globally [1]. NCDs kill more people than all other diseases combined, accounting for 63% of deaths in 2008 [2,3]. It is often under-appreciated that nearly 80% of these deaths occur in low– and middle–income countries (LMICs), where ageing is presently occurring at a faster rate [1]. From 1950 to 2009, 68% of the increase in persons aged 60 or over was seen in LMIC [4].

This is true even for African nations, where the average life expectancy is still only 55.2 years, due to high mortality from communicable, maternal,

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perinatal and nutritional causes [5]. The current African context is described in more detail in **Box 1** while **Box 2** briefly describes the characteristics of the disease of interest [5,6].

NCDs are not only a health problem, but also a social problem, significantly contributing to poverty. Most NCDs are chronic and lead to continued expenditures that can trap households in cycles of debt and illness [20]. They tend to disproportionately affect poorer individuals, largely due to inequalities in the distribution of major risk factors [20]. The UN's High-Level Meeting in September 2011 put the global pandemic of NCDs at the top of the global political agenda [9,21]. Gross disparities in resources exist within and between developed and developing countries: new drug treatments are expensive; access to care is often dependent upon sufferers' means to pay; and health care resources are unevenly distributed between rural and urban

Box 1 A summary of the current African context

In Sub–Saharan Africa nearly 6% of adults aged 15–49 are HIV positive, and malaria kills a million children under the age of five each year, with childhood pneumonia, diarrhoea and other infectious diseases still being a major cause of mortality [6]. Nevertheless, non-communicable diseases (NCDs) are expected to exceed them all as the most common cause of death by 2030 [1].

Middle class population of Africa has tripled over the last thirty years to become more than 34% of the continent's population [7]. This growth means more people will seek better health care for themselves and their families and this is likely to contribute to patterns of morbidity and mortality. As its population is ageing faster than that in high-income countries, the necessity of prevalence data from Africa must be emphasised [8]. The health of the elderly is of special importance in this context, as they are filling the roles of the generation decimated by HIV/AIDS, particularly in sub-Saharan Africa [9]. Only a few community-based studies have been carried out in Africa and these have often reported a low prevalence of dementia [10]. Suggested reasons for this include: (i) poor access or reluctance to seek medical care; (ii) the belief that an elderly person has completed their useful life; (iii) differential survival rates; (iv) hiding of cases by relatives concerned about the stigma of mental disease; (v) defective case finding techniques; and (vi) the belief that dementia is a normal part of ageing [11].

Without appropriate and sufficient knowledge on the burden of dementia in Africa, this disease will not be considered a public health priority, making it difficult to secure resources necessary to improve the management of patients [12]. However, the recent report by the World Health Organization stated that "...there is no more powerful tool for obtaining political and financial commitment than locally derived and relevant data" [13]. A reliable estimate of the prevalence could therefore considerably advance further research into the burden, as well as increase understanding of dementia in Africa and low– and middle–income countries (LMICs) in general.

districts [13-17]. Health services in LMICs are ill-equipped to meet the needs of older persons, as health care is primarily clinic-based, with treatments oriented towards acute rather than chronic conditions [2].

One of the NCDs expected to pose the greatest problem to health systems in LMICs in the coming decades is dementia. It has a uniquely profound effect on disability and need for care, being the major cause of dependency among the elderly worldwide [13,18]. Dementia affects not only individuals but also their families on personal, emotional, social and financial levels, driving millions of households below the poverty line and making dementia a global health priority [14-17,19]. It has been estimated 35.6 million people suffer from it worldwide – 0.5% of the world's total population – and this is set to increase to over 115 million by 2050 [13,19]. Slightly more than half of the current sufferers live in LMICs, with a predicted increase of this figure to 71% by 2050 if the present trends continue [22]. The global economic impact of dementia for 2010 was estimated to amount to approximately US$ 600 billion, corresponding to 1.0% of the aggregated worldwide GDP, but per capita costs varied from US$ 868 in low-income countries, US$ 3109 in middle-income countries, to US$ 32685 in high-income countries [1].

As a part of international response to dementia, the WHO launched the Mental Health Gap Action Programme in 2008, with dementia as a priority condition, and it recently published a large report "Dementia: A public health priority" [1,13,15]. The group Alzheimer Disease International keeps publishing the "World Alzheimer's Report" annually, as a laudable attempt to keep track on the burden and impact of the condition [14,16,17]. Finally, in 2011, the High-Level Meeting of the United Nations General Assembly on prevention and control of NCDs acknowledged that "mental and neurological disorders, including Alzheimer's disease, are an important cause of morbidity and contribute to the global non–communicable disease burden" [13]. Despite these, addressing the problem of dementia remains a low priority in most LMICs, which tend to prioritise control and eradication of communicable diseases and reproductive, maternal, and child health. This is not surprising because even in high-income countries the prioritised NCDs are mainly those that cause early death, such as cancer and heart disease, and not those that cause years–lived–with–disability (YLD), such as dementia [7,23].

The objective of this paper is to systematically review publically available epidemiological studies on dementia and its main forms (Alzheimer disease and vascular dementia) in Africa and to estimate the burden of dementia in Africa in 2010. It also investigates differences in prevalence by age and gender, to highlight the segments of the population requiring the most urgent attention. The paper also aims to suggest policy implications and to contribute to an improvement in evidence and information on dementia in LMICs.

Box 2 A summary of background information on dementia

Dementia is a syndrome, usually of a chronic or progressive nature, in which there is deterioration in cognitive function. This deterioration can be caused by a number of brain disorders or injuries that primarily or secondarily affect the brain, such as Alzheimer disease or stroke. Dementia affects higher cortical functions such as memory, thinking, comprehension and judgment. This impairment is commonly accompanied by a decline in emotional control, social behaviour, or motivation [13]. Diagnosis is conventionally made when cognitive decline affects a person's ability to carry out daily routine activities [14]. Many different forms or causes of dementia exist. Alzheimer disease is the most common, contributing to 60–70% of cases. It is characterised by cortical amyloid plaques and neurofibrillary tangles, and symptoms include a gradual onset of impaired memory, apathy and depression [14]. Early-onset Alzheimer disease can present before the age of 65 and normally has a genetic cause [15]. Vascular dementia accounts for 20–30% of dementia [14]. It is diagnosed when the brain's oxygen supply is compromised by repeated strokes or other blood vessel pathology, leading to accumulated damage to brain tissue and function [15]. Symptoms are similar to those of Alzheimer disease although memory is less affected and mood fluctuations are more [14]. Other common subtypes are frontotemporal dementia (5–10%) and Lewy body dementia (<5%). Post-mortem studies have suggested that boundaries between different forms are indistinct and subtypes often co–exist [14]. Dementia is largely under-diagnosed and often by the time of diagnosis patients are at a late stage in the disease process [16]. This is a particular issue in low and middle income countries (LMICs), as families may not understand their relative's behaviour [14]. Early diagnosis is helpful so that everyone involved can be better equipped to deal with the disease and know what to expect [15].

Risk factors

The main risk factor for dementia is advancing age, and after the age of 65 the prevalence doubles every five years [17]. The environment is thought to influence the development of the disease, although little is understood about the underlying mechanisms [15]. Other suspected risk factors include: (i) cardiovascular problems; (ii) excessive alcohol consumption; (iii) social isolation; (iv) head injury; and (v) having one or two copies of the APOEε4 genetic variant. However, moderate alcohol consumption and oestrogen have been reported to reduce the risk of developing dementia [18].

Course and outcome

Dementia is usually progressive and irreversible unless a cause is identified and treated effectively. Each person is affected in a different way, with varying speed of deterioration. Generally, the lifespan of the affected person is reduced [15]. Disease course is normally characterised into three stages: early, middle and late. The early stage is often overlooked as 'old age'. However, as the disease progresses into the middle stage limitations become clearer and more restricting. By the late stage, the person affected becomes nearly entirely dependent, with severe memory disturbances and physical symptoms [14].

Management

Currently, no treatments to cure or alter the progression of dementia exist. Patients can be treated symptomatically with pharmacological or psychosocial interventions. The latter are often highly effective and should be the first choice when managing behavioural problems [15]. Moreover, the provision of information and support has been shown to reduce the psychological distress often experienced by carers [15].

Resources and prevention

Primary preventive intervention is a highly cost-effective, yet neglected area. Effective interventions could significantly reduce dementia prevalence and incidence, improve the quality of life of patients and carers, and reduce the resources needed to provide adequate institutional and home health care [19].

METHODS

Definitions and study design considerations

The chronic nature of dementia makes an estimate of prevalence more suitable than one of incidence [17]. Prevalence here refers to people aged 50 years and over with dementia in 2010. This age cut–off value (50+) was introduced because 50 years was the lowest age of participants included in the studies in this review.

Search strategy

After initial scoping exercises to identify key words and Medical Subject Headings (MeSH) and input from a librarian to choose the final search terms (**Table 1**), a system-atic review of published literature was undertaken across the following databases via OVID:

    1) Medline (1980–Current) on 22 January 2012;
    2) EMBASE (1980–Current) on 9 February 2012;
    3) Global Health (1980–Current) on 9 February 2012.

An additional search of Google Scholar and the hand-searching of the selected studies' reference lists produced no additional results. Specific countries were those identified by the World Bank list of economies (January 2012) as being LMICs in Africa. Limitations were placed to studies concerning humans and those published after 1980.

Study selection

The inclusion criteria used to screen the useful papers were: (i) community-based studies; (ii) conducted in LMICs in

Table 1 Search terms

1	Prevalence/ or incidence/ or morbidity/ or mortality/
2	(prevalen* or inciden*).mp.
3	(disease adj3 burden*).mp.
4	1 or 2 or 3
5	Dementia.tw.
6	Alzheimer*.tw.
7	5 or 6
8	Exp Africa/ or exp africa, northern/ or exp algeria/ or exp egypt/ or exp libya/ or exp morocco/ or exp tunisia/ or "africa south of the sahara"/ or africa, central/ or exp cameroon/ or exp central african republic/ or exp chad/ or exp congo/ or exp "democratic republic of the congo"/ or equatorial guinea/ or exp gabon/ or exp africa, eastern/ or exp burundi/ or exp djibouti/ or exp eritrea/ or exp ethiopia/ or exp kenya/ or exp rwanda/ or exp somalia/ or exp sudan/ or exp tanzania/ or exp uganda/ or exp africa, south-ern/ or exp angola/ or exp botswana/ or exp lesotho/ or exp ma-lawi/ or exp mozambique/ or exp namibia/ or exp south africa/ or exp swaziland/ or exp zambia/ or exp zimbabwe/ or exp africa, western/ or exp benin/ or exp burkina faso/ or exp cape verde/ or exp cote d'ivoire/ or exp gambia/ or exp ghana/ or exp guinea/ or exp guinea-bissau/ or exp liberia/ or exp mali/ or exp mauritania/ or exp niger/ or exp nigeria/ or exp senegal/ or exp sierra leone/ or exp togo/
9	4 and 7 and 8
10	Limit 9 to (humans and yr = "1980-Current")

Africa, any age-group or sex; (iii) reporting prevalence of dementia. We excluded all studies that were either hospital-based, published before 1980, studies without a numerical estimate for prevalence, studies with subjects not human, or review articles (see **Figure 1**). We then evaluated the re-tained studies for quality of their design and methods. We required a clear case definition of dementia, with a defined nominator, denominator and time frame of the study, ap-propriate study design for a prevalence study, and adequate explanation of processes undertaken, including recruit-ment of subjects (see **Figure 2** and **Table 2**). Case defini-tions were mostly similar, with considerable overlap be-tween studies, and they should not have had a significant influence on the analyses (**Table 3**). Hospital–based stud-ies were excluded; it cannot be presumed that everyone in LMIC has access to medical facilities and dementia may be secondary to another condition, for which the patient has been hospitalised.

Data extraction

Study characteristics and other relevant data were extracted from each retained article and entered into Microsoft Excel spreadsheet. Noted study characteristics include: country, region, period of study, setting, sample, age of participants, population characteristics, study size and type of assessor (see Online Supplementary Document). Wherever more than one article referred to the same study site / cohort, the first chronologically published paper was entered into the database and all additional data from other papers were added to the initial study (see Online Supplementary Doc-ument for further details). All data on dementia prevalence and the prevalence of its two most important subtypes (Al-zheimer disease and vascular dementia) were extracted: the
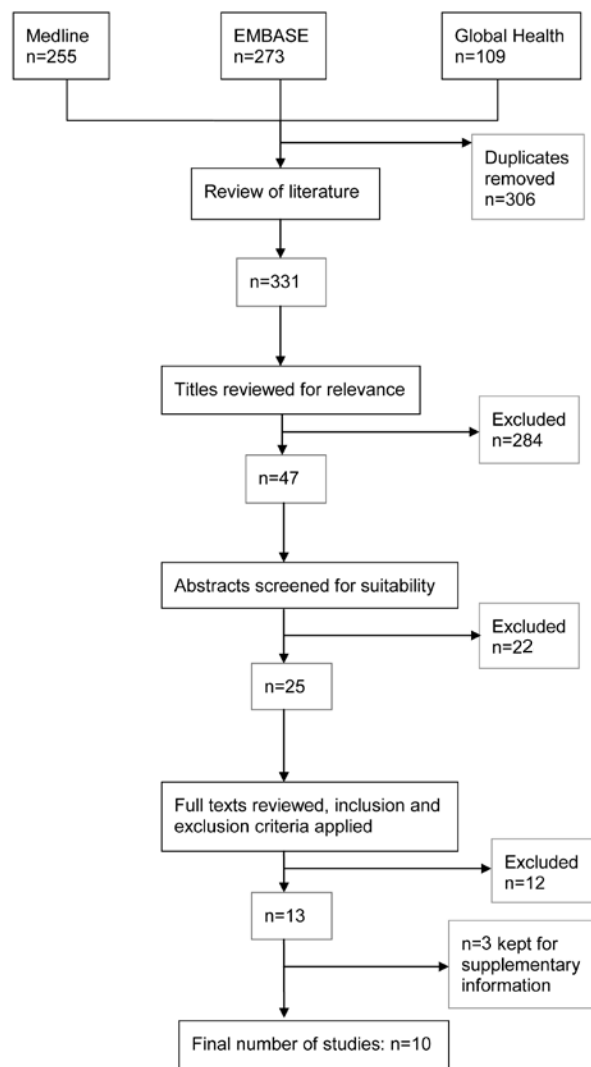
Figure 1 A summary of search strategy used to identify the studies relevant to estimating the prevalence of dementia in Africa.

Table 2 Characteristics of studies included in the review

CHARACTERISTIC:	No. OF STUDIES
Country:	
All	10
Nigeria	4
Egypt	2
Benin	2
South Africa	1
Central African Republic	1
Democratic Republic of the Congo	1
Duration of study:	
<1 years	5
1–2 years	4
3–4 years	1
Sample size:	
0–1000	4
1001–2000	3
2001–3000	2
>3000	1
Setting:	
Urban	6
Rural	2
Urban and Rural	2

Figure 2 Geographic locations of retained studies with overall prevalence estimates; most studies were active in the period 2002–2009.

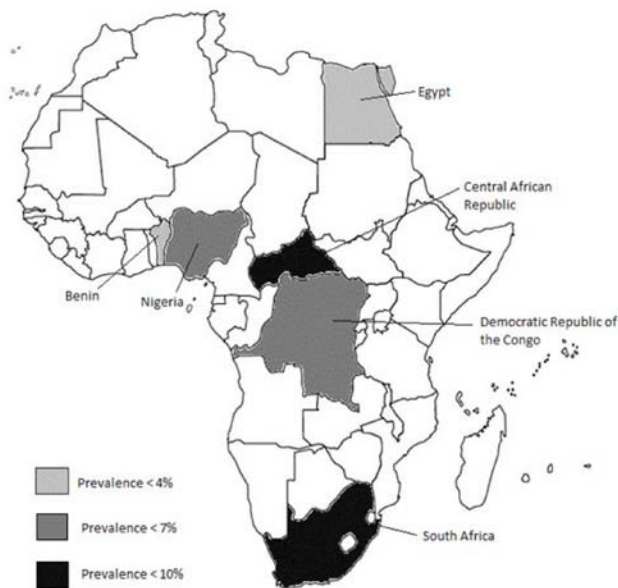total sample size for each study, number of cases with disease, and the prevalence in the overall sample. In addition, we extracted each prevalence which was reported within a specific age–group, whether it was disaggregated by gender or not (see Online Supplementary Document).

Data analysis

Our aim was to establish the pattern of relationship between person's age and likelihood to suffer from dementia (or its two subtypes) across the age range starting from 50 years of age until death, where the overwhelming majority of cases (>99%) are expected to occur in the population. This relationship was modelled based on the available information from all retained studies. All the extracted information from individual studies was plotted in a graph defined by age (x–axis) and prevalence of dementia (or its 2 subtypes; y–axis). The coordinate on x–axis was defined as the mean age of the persons included in each (sub)sample, while the coordinate on y–axis was defined by the reported prevalence in that (sub)sample. The size of the "bubble" plotted in the graph was proportional to sample size relevant to each individual

Table 3 Case definitions and screening measures of dementia in retained studies

Author	Country	Case definition	Screening measures	Complications
Ben-Arie (1983) [24]	South Africa	n/a	MMSE, PSE, FCA	Life Satisfaction Index Social Performance Schedule
El Tallawy (2010) [25]	Egypt	n/a	SSQ, FCA	Other neurological conditions
Farrag (1998) [26]	Egypt	DSM–III–R NINCDS–ADRDA Hachinski Ischaemic Score	SSQ, MMSE, FCA, laboratory diagnosis	IADL Geriatric Depression Scale Revised Weschler Adult Intelligence Scale
Guerchet (2009) [27]	Benin	DSM–IV NINCDS–ADRDA	SSQ, CSI–D, FCA	Goldberg's Anxiety and Depression Scale Jacoby's Stigma Scale Psychosocial factors according to Persson and Skoog Medical examination
Guerchet (2010) [28]	Central Republic of Africa Democratic Republic of the Congo	DSM–IV NINCDS–ADRDA Hachinski Ischaemic Scale	SSQ, CSI–D, 5WT, FCA	Medical history Psychosocial factors according to Persson and Skoog Goldberg's Anxiety and Depression Scale
Gureje (2006) [29]	Nigeria	DSM–IV	10WDRT	World Mental Health Survey version of WHO Composite International Diagnostic Interview Katz Index of Independence of Daily Living Nagi Physical Performance Scale and Health Assessment Questionnaire WHO-QOL-BREF
Hendrie (1995) [30]	Nigeria	DSM–III–R ICD–10	SSQ, CSI–D, CERAD	n/a
Ochayi (2006) [11]	Nigeria	DSM–IV ICD–10	CSI–D	Medical examination
Paraiso (2011) [12]	Benin	DSM–IV NINCDS–ADRDA NINDS–AIREN	SSQ, CSI–D, FCA	Medical examination Goldberg's Anxiety and Depression Scale Psychosocial factors according to Persson and Skoog
Yusuf (2011) [31]	Egypt	DSM–IV ICD–10	SSQ, CSI–D, CERAD, SDT, BDS	n/a

DSM – Diagnostic and Statistical Manual of Mental Disorders, NINCDS–ADRDA – National Institute of Neurological and Communicative Disorders and Stroke – Alzheimer Disease and Related Disorders Association, ICD–10 – International Classification of Diseases – 10, NINDS–AIREN – National Institute of Neurological Disorders and Stroke – Association Internationale pour la Recherché et l'Enseignement en Neurosciences, MMSE – Mini Mental State Examination, PSE – portal–systemic shunt encephalopahty, FCA – Family Caregiver Alliance, SSQ – Speech, Spatial and Qualities of Hearing Scale, CSI-D – CommunityScreening Interview for Dementia, 5WT – Five Word Test, 10WDRT – 10–Word Delay Recall Test, CERAD – Consortium to Establish a Registry for Alzheimer Disease, SDT – sibship disequilibrium test, BDS – Blessed Dementia Scale, IADL – Instrumental Activities of Daily Living

source of information. For all age groups that were not fully defined, such as eg, "60+ years", mean age was determined as the age that comprised 50% of the population in this age group in the country where the study was undertaken, according to the UN Population Division's estimates for the year of study. Graphs were then plotted with mean age on x-axis and dementia prevalence on y-axis, taking into account sample sizes which were represented by circle size (see eg, **Figure 3**). Graphs were drawn for both dementia and its two most common forms – Alzheimer disease and vascular dementia; for dementia, two additional analysis were possible – for men and women.

Given that the lowest mean age for any (sub)sample defined in the retained studies was 54.5, we defined the age group of 0–54 years as the one where no data were available, and assumed that the prevalence of dementia in that age group was close to zero. Thereafter, the information on the prevalence was organised by 5–year age groups (from 55–59 years; 65–74 years; 75–84 years; and 85 years and
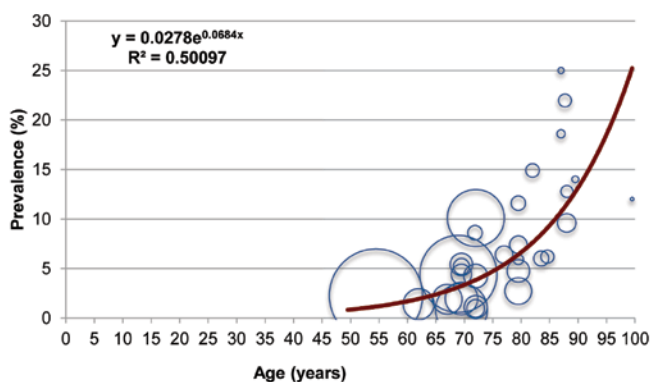

Figure 3 Age–specific prevalence of dementia in Africa based on the information from 10 studies, with sample size underlying each data point presented by the size of each bubble.

over). The weighted mean prevalence and standard deviation were then calculated for each of those four age-groups for dementia (**Table 4**), Alzheimer disease (**Table 5**) and vascular dementia (**Table 6**). Weighted mean prevalence was calculated as an average of the prevalence multiplied by sample size, while 95% confidence intervals were calculated from the standard errors of prevalence values.

To compute the overall burden of dementia, Alzheimer disease and vascular dementia in Africa, an epidemiological model was developed using meta–regression–like approach. A fundamental difference in this study was that the goal of this regression analysis was not to investigate the association between age and prevalence, but rather to use available data to predict the most likely prevalence at any given age after 50 years. The model with best "fit" (largest proportion of variance explained) was used for each disease (**Figures 3**, **4** and **5**). The equation of the trendline was then used to compute the predicted prevalence at the ages of 52, 57, 62, 67, 72, 77 and 87 years, which are mid–points of the UN Population Division's 5–year age group population estimates for Africa in 2010. We multiplied the predicted prevalence at each age with total population in the corresponding age groups to compute the total number of people living with dementia and its two main forms in Africa.

RESULTS

Systematic review

An initial screen of three databases returned 255 results from Medline, 273 results from EMBASE and 109 results from Global Health. After excluding duplicates, 331 titles were reviewed for relevance and only 47 studies were selected for review of abstract. Wherever the abstracts lacked a numerical estimate for prevalence, full texts were sourced.

Table 4 Age–specific weighted mean prevalence (%) of dementia in Africa

Age group (years)	55–64	65–74	75–84	85+
No. of data points	2	12	8	8
Mean age (years)	58.25	70.12	80.00	88.92
Weighted mean prevalence and standard error (in %)	2.17 (0.84)	5.66 (1.69)	6.14 (2.72)	12.94 (3.71)

Table 5 Age–specific weighted mean prevalence (%) of Alzheimer disease in Africa

Age group (years)	55–64	65–74	75–84	85+
No. of data points	1	6	7	4
Mean age (years)	62	70.15	78.45	87.42
Weighted mean prevalence and standard error (in %)	0.8 (–)	2.11 (1.05)	3.27 (3.23)	10.99 (7.81)

Table 6 Age–specific weighted mean prevalence (%) of vascular dementia in Africa

Age group (years)	55–64	65–74	75–84	85+
No. of data points	1	5	7	3
Mean age (years)	62	70.28	78.42	87.23
Weighted mean prevalence and standard error (in %)	0.3 (–)	0.94 (0.47)	0.63 (0.86)	2.88 (2.14)

Eventually, only 10 studies were retained for the final review and data extraction [8,10-12,24,27,29-32]. The literature search process is outlined in **Figure 1**.

Study characteristics

The majority of studies took place in Western Africa, with no studies conducted in Eastern Africa. The EDAC Survey found the prevalence of dementia in two Central African countries, the Central African Republic and the Democratic Republic of the Congo [8]. The clustering of studies in Nigeria could be attributed to the longitudinal study on the prevalence and incidence of dementia and Alzheimer disease in Yoruba people [30]. Half of the studies were conducted within less than one year. The mean sample size was 7263, but this is mainly a result of significant skewing due to one large study with 62 583 participants; the mean sample size of the other 9 studies was 1004. Studies were largely conducted in urban areas, with two of them conducted in both urban and rural settings. The majority of studies focused on prevalence in adults aged 65 years or more (**Table 2**).

Case definitions

Table 3 shows the case definitions and screening and complication measures used in each study. DSM and NINCDS–ADRDA were the most common criteria for Alzheimer disease diagnosis. ICD–10 and Hachinski Ishaemic Scale were used to diagnose vascular dementia. Modified versions of CSI-D and questionnaires were the most commonly used screening instruments. Diagnosis criteria for dementia are relatively adaptable to the community setting. However, most of the studies modified the screening instruments for the low literacy levels and local languages of the communities being examined, often involving the exclusion of sections of tests and adapting the diagnosis score. Many used an informant, often a family member, to gather a reliable history. Teams consisting of psychiatrists, clinical psychologists, neuropsychiatrists, neurologists, physicians or trained interviewers screened all of the populations.

Determination of participants' age

As a rule, the age of each participant was verified in an official document, which in many cases involved birth certificates. However, in six of the studies there were substantial problems with age estimates in a considerable proportion of the participants, when official birth records were unavailable. In such cases, local historical landmark events were used to estimate the age of participants. This has been shown to be an accurate method of age estimation [12].

Prevalence estimates

All 10 retained studies reported numerical estimates for dementia prevalence, with age breakdown of prevalence available from all studies but one [24]. No prevalence was recorded until the age of at least 50. Age groups 65–74 and 75–84 typically provided the most data points. **Figures 3**, **4** and **5** and **Tables 4**, **5** and **6** show that the prevalence of dementia grows from about 2% at the age of 60 to nearly 13% at the age of 90, with a trend to reach more than 25% at the age of 100. In comparison, Alzheimer disease has a prevalence of about 1% at 60 years, 2% at 70 years and slightly above 3% at 80 years, but then accelerates rapidly to more than 11% at the age of 90. In comparison, vascular dementia seems to reach about 1% of prevalence after the age of 60, but then the prevalence remains relatively stable and only begins to increase after the age of 85, to about 3%.

Although meta-analysis of the 10 retained studies in Africa would suggest that about 73% of the cases of dementia were Alzheimer disease and about 15% vascular dementia, those studies had a predominance of elderly people, and were therefore not representative of the current African popula
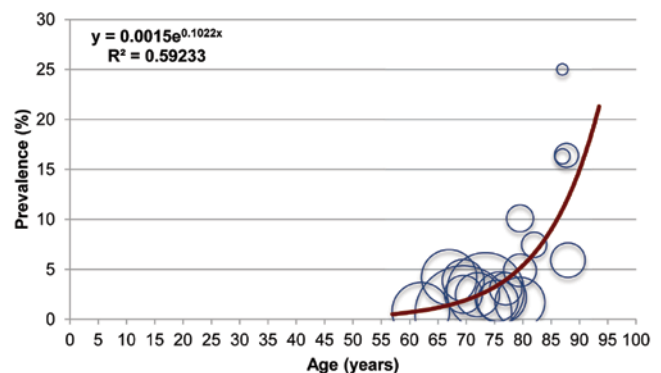
$$y = 0.0015e^{0.1022x}$$
$$R^2 = 0.59233$$

Figure 4 Age–specific prevalence of Alzheimer disease in Africa, with sample size underlying each data point presented by the size of each bubble.

$$y = 0.0019x^2 - 0.2245x + 7.1276$$
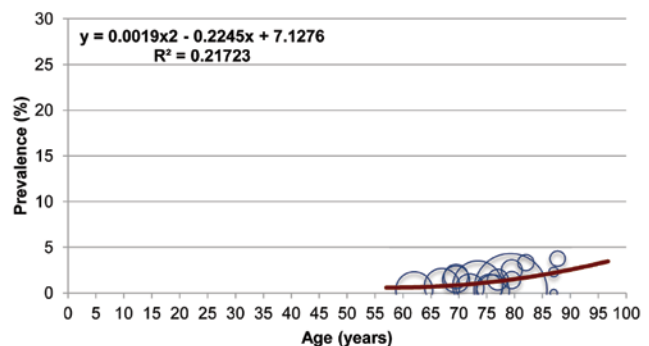$$R^2 = 0.21723$$

Figure 5 Age–specific prevalence of vascular dementia in Africa, with sample size underlying each data point presented by the size of each bubble.

tion. The extrapolation of our findings to the current African population suggests that Alzheimer disease is currently responsible for 57.2% of all dementia cases in Africa, and vascular dementia for 26.9%, but with the former having a an increasing trend in relative importance (**Figure 6**).

We were also interested in investigating any differences in sex-specific prevalence of dementia. The only disease with sufficient evidence on gender breakdown was dementia, where 7 studies could be used. **Table 7** shows that females seem to have higher overall prevalence, particularly in very old age groups, although these data are based on relatively little information and surrounded with large uncertainty.

Finally, the overall prevalence of dementia in adults older than 50 years in Africa was estimated to be about 2.4%, which translates to 2.76 million people living with a disease in 2010, and about 2.10 millions of them live in sub-Saharan Africa. Further details are provided in **Table 8**.
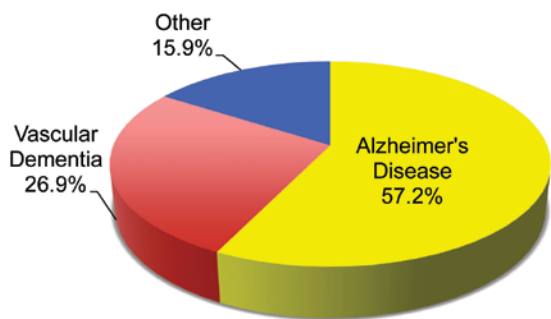

Figure 6 Proportional contribution of different types of dementia to the overall burden in Africa.

Risk factors for dementia

Eight papers reported on risk factors for dementia, in addition to prevalence estimates. The main findings are reported below and tabulated in Online Supplementary Document. All studies established increasing age as the strongest risk factor for the prevalence of dementia, with four studies also showing higher prevalence among females. Education is thought to be protective against dementia [31], so higher prevalence in women in Africa may reflect lower educational attainment and poorer socioeconomic status, another recognised risk factor for dementia [32]. The only study that carried out APOE genotyping reported higher prevalence of dementia in people with APOEε4 [27]. Poor nutritional status may also exacerbate the risk of developing dementia [18], and one study found a BMI<18.5 to be associated with dementia prevalence [11]. Another study found a lifetime of excessive alcohol consumption to double the risk dementia compared to those who were abstinent for life [29]. Hypertension and diabetes are emerging as significant endemic threats in Africa [8], which is notable as two of the studies reported cardiovascular problems as risk factors for vascular dementia: one study reported higher prevalence in urban areas [12], while another one reported higher prevalence in rural areas [29]. Other studies did not find study setting to represent a significant risk factor.

DISCUSSION

This paper identified and analysed 10 studies reporting prevalence of dementia in African countries in order to provide an estimate for the overall prevalence of dementia in persons aged 50 years or more in Africa. It was conducted with an aim to provide recommendations for future policies and research.

Table 7 A comparison of age–specific weighted mean prevalence of dementia in African men and women

Age group (years)	60–69	70–79	80+
Men:			
No. of data points	2	7	2
Mean age (years)	64.50	72.83	84.87
Weighted mean prevalence and standard error (in %)	1.93 (0.88)	2.60 (2.17)	16.83 (3.58)
Women:			
No. of data points	2	7	2
Mean age (years)	64.5	74.5	84.5
Weighted mean prevalence and standard error (in %)	1.35 (0.10)	5.22 (2.62)	19.68 (10.00)

Table 8 The estimates of the total number of cases of dementia, Alzheimer disease, vascular dementia and other forms of dementia in Africa in the year 2010 (figures in brackets: Sub–Saharan Africa only)

Age group (years)	All dementia	Alzheimer disease	Vascular dementia	Other forms
0–54	308 513 (235 380)	96 608 (73 707)	185 615 (141 615)	26 290 (20 058)
55–59	352 334 (270 845)	130 713 (100 481)	128 145 (98 507)	93 476 (71 857)
60–64	388 370 (300 607)	170 352 (131 856)	101 769 (78 771)	116 250 (89 980)
65–69	401 815 (317 297)	208 666 (164 775)	89 998 (71 068)	103 151 (81 454)
70–74	399 054 (303 042)	245 459 (186 402)	84 044 (63 823)	69 550 (52 817)
75–79	342 986 (254 173)	249 838 (185 145)	69 972 (51 854)	23 176 (17 174)
80+	571 692 (413 919)	479 437 (347 124)	86 583 (62 688)	5673 (4107)
Total	2 764 764 (2 095 263)	1 581 073 (1 189 491)	746 126 (568 326)	437 565 (337 447)

Findings

The overall prevalence of dementia in Africa in person aged 50 years or older, as modelled from 10 studies of sufficient quality and using UN's population estimates, was about 2.4%, which translates to 2.76 million people living with a disease in 2010. About 2.10 millions of them live in Sub–Saharan Africa. The highest reported prevalence was 10.1% across eight contiguous states in Nigeria and the lowest was 1.12% in Ibadan, Nigeria. The former value was from a study carried out in 2006, while the latter was in 1995, which may explain the large discrepancy between the two results from the same country. Age–specific analysis showed a general trend of an exponential increase in prevalence with age. The rough doubling of dementia prevalence every five years after the age of 65 is well documented in developed countries. The protective effect of oestrogen against dementia may account for lower prevalence of females in the 55–64 age group [18]. Alzheimer disease was found to be the most prevalent cause of dementia, followed by vascular dementia, and these findings match those of developed countries.

Previous estimates of dementia prevalence in Africa have been provided by the Alzheimer Disease International using a Delphi consensus study (for the years 2001 and 2020), and by the WHO (for the year 2010) [13,33]. The former predicted about 0.5 million affected persons in 2001 and 0.9 in 2020, although this estimate was restricted to Sub–Saharan Africa. It is apparent that the estimate based on expert opinion has already grossly underestimated the burden of this problem [33], which in our study already reached 2.1 million of sufferers in Sub–Saharan Africa in 2010. The WHO's estimate for 2010, of 1.9 million affected people in the population aged over-60, is much closer to our estimate which quotes the corresponding figure of about 2.1 million in persons over 60 years old. Our review estimates that at least 2.7 million people aged 50 years or more are living with dementia in Africa in 2010.

Limitations

While this review aimed to provide the best possible estimate for the prevalence of dementia in Africa, there are features that may have limited the results. The overall data on dementia in Africa is insufficient, with only ten studies suitable for inclusion, and with the gender-aggregated and dementia subtypes prevalence available from only seven and six of the studies, respectively. All of the studies included data from >139 subjects, and one sample size was particularly large [25]. The similarity of prevalence values suggests that the range of sample sizes did not substantially skew the results. Methodologies did not vary too widely among studies, allowing for direct comparisons. The search was limited to 1980 – present time, although most of the stud-

ies were active between 2002 and 2009. Considering the life expectancy at birth for Africans in 1980 was 48.5 years, it is unlikely that many, if any, prevalence studies for dementia were conducted before 1980 [34].

Case definitions of dementia, Alzheimer disease and vascular dementia were similar enough, with considerable overlap between them, for the results to be comparable. Misclassification bias may have occurred due to communication difficulties during assessment, especially as there is no definitive clinical diagnosis for dementia. It has been suggested that DSM–IV dementia criteria might underestimate dementia prevalence, especially in areas with low awareness of the emerging problem [8,35,36]. Another cause of underestimation is informant participation in the use of CSI–D, because of the cultural specific differences that prevent informants from disclosing information that could compromise their parents' integrity [12], so that informants may give answers they think are acceptable rather than accurate [10]. Other notable aspects of the CSI–D instrument are that it should be independent of educational and cultural background of the subject, making it suitable where literacy level is low, and that it may have difficulty distinguishing depression from dementia [11].

All included studies were community-based, in order to avoid many biases present in facility-based studies or in other studies relevant only to specific population subgroups. Still, the quality of data is heavily reliant on the sensitivity and specificity of the screening methods and diagnostic criteria. Only three of the retained studies reported sensitivity and specificity of methods [11,12,29]. Standardisation of these tools is important to limit observational bias. Results may have depended on who the assessor was, with some assessors likely having more experience in dementia diagnosis than others, such as neurologists. Another concern is the focus of studies on certain regions in Africa. No studies were conducted in Eastern Africa, while six took place in Western Africa. Moreover, the general tendency of higher rates of illiteracy in rural areas, where many students leave school to work in the fields, may also potentially cause comparability issues.

Awareness and diagnosis of dementia in developing countries

An ongoing debate on the lower prevalence of dementia in developing countries centres around the fact that the elderly in these regions are not expected to involve themselves in the instrumental activities of daily living (IADL) [31]. The living environment is often without sophisticated utilities, and therefore poses little cognitive challenge. Additionally, the social environment is one that protects the elderly rather than imposing tasks on them. This social environment which is relatively undemanding may mean that only those

with severe dementia are likely to match social impairment criteria and receive diagnosis, thus under-estimating the true size of the problem [29]. Research and media attention in Africa is also mainly given to the diseases with higher case fatality, such as HIV and malaria. In comparison, dementia has a low mortality but high morbidity and disability. The general lack of awareness of the disease has important consequences: (i) help from medical services is not sought; (ii) no structured training exists on the recognition and management of dementia at any level of the health service; (iii) there is no constituency to place pressure on the government or policy makers to provide more responsive dementia care services; and (iv) families are the primary caregivers with little support from other individuals or agencies [15]. These features create a multi–faceted burden to the individual, their family and society, which has personal, emotional, financial and social aspects [17].

The affected person may experience ill health, disability, impaired quality of life and reduced life expectancy [14]. One study showed elevated odds for persons with dementia to be disabled in all areas of activities of daily living (ADL) and also having lower quality of life [29]. These findings correlate with the GBD reports, which indicate that dementia is one of the main causes of disability in later life [2]. Dementia can adversely affect communication, memory and mobility, creating dependence. It can affect sleep and mood, which can become a source of distress for caregivers, while creating feelings of loneliness and social isolation for the sufferers [15,37]. Due to the dependent nature of dementia, family and friends become a vital support network, but the reliability and universality of family care systems in LMIC are often overestimated [15,37]. Although there are many potential caregivers, this may not always translate into adequate care [31]. With the growing middle class, this situation is likely to change as family structures evolve toward western models and family support becomes less available [12]. Carers within family will find themselves in a difficult position, where they can either stop working in order to care for the affected person, thus losing the opportunity to earn income, or continuing with their work in parallel but reducing the outcomes for the affected. Caregiving is associated with high levels of psychological strain, and family caregivers have been shown to have increased levels of affective disorders such as depression and anxiety [13]. In addition, some studies reported a common misconception in many African settings that there is no treatment for dementia, and that it is a normal part of ageing [25]. This poses a problem, as dementia recognition would improve disease outcomes [15]. Diagnosis is crucial in that it provides access to treatment, care and support across the disease course. Earlier diagnosis is important for the affected person, as it allows people to plan ahead while they still have the capacity to do so; it also

enables their caregivers to become better equipped and prepared [15]. Another consequence of the growing middle class is that a larger proportion of the population will be educated and have a higher awareness of the disease and possible treatments [7]. They are therefore more likely to seek better health care for themselves and their families. Combined with the substantial increases in dementia prevalence, these factors will place a considerable strain on already resource-scarce health services. Considering both this strain and the disintegration of multigenerational family structures, a purely health services response would be insufficient, and societal action is also needed.

Research evidence should inform the actions that are most needed, and each country should develop a priority research agenda. The course of dementia epidemics needs to be monitored nationally, focusing on changes in prevalence and incidence that might indicate success or failure of efforts to control it. Significantly more research is required to understand the causes of dementia, and how do lifestyle factors influence the risk [13]. Lack of consistency in the methodologies and case definitions of dementia between studies may hinder the comparability of the data. In this study, inconsistencies in reporting on the reviewed examinees were an important issue when standardising data. Standards to ensure synchronisation of methods would be helpful, such as types of assessor and screening measures. Suggestions of criteria for future studies are shown in Table 9. Diagnosis of dementia according to DSM criteria requires: (i) impairment in short- and long-term memory; (ii) impairment in abstract thinking or judgement, or impairment of higher cortical functions or personality changes; and (iii) evidence that the cognitive disturbances resulting from (i) and (ii) significantly interfere with work, usual social activities or relationships with others [38]. DSM criteria were chosen over ICD criteria because (i) they are defined more precisely; and (ii) ICD criteria are more dependent on informants, making them harder to apply to a community setting [39].

Although two-phase diagnosis studies are thought to increase the rates of attrition before clinical assessment, some authors found them to be feasible in African countries due to high participation rates [8]. Trained investigators should be used, so that any additional burden on practicing physicians is avoided. All adults in the population aged 50 or older should be screened, to prevent missing a diagnosis of early–onset Alzheimer disease.

There are considerable further obstacles that should be addressed by policies to control dementia in Africa: (i) generally low priority of mental and neurological disorders; (ii) poor awareness and understanding of those diseases; and (iii) lack of infrastructure and resources [13]. Evidence from this review has shown that dementia prevalence in

Table 9 Recommended criteria for future studies of dementia in the community

Criteria	Minimum required standard
Case definition	DSM criteria. Screening measures: SSQ, CSI–D & FCA. Complication screening measures: Goldberg's Anxiety and Depression Scale, psychosocial factors according to Persson and Skoog, WHO–QOL–BREF.
Methodology	Two–phase dementia diagnosis study. Door-to-door survey of all households. Interview prior to start of study should obtain demographic and risk factors.
Assessor	Specially trained investigator; training includes symptom recognition, physical examination and patient communication skills.
Population	All adults included, representative of community population. Replacement subjects matched to drop–outs. Prevalence and incidence data grouped by age (18–49 y, by 10 y thereafter), sex (M/F) and subtype (Alzheimer disease, vascular dementia, Lewy body dementia, frontotemporal dementia and others).
Sample size	>500 subjects
Duration	>1 year

FCA – Family Caregiver Alliance, SSQ – Speech, Spatial and Qualities of Hearing Scale, CSI-D – Community Screening Interview for Dementia, WHO-QOL-BREF – WHO Quality of Life-BREF
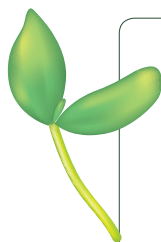
Africa is increasing towards the levels that are present in developed countries, and this trend will continue to increase at a faster rate than anywhere else in the world. Resources need to be set aside to tackle this growing problem at national, local, family and personal levels. Attention must be given to reducing the burden of disease through timely and appropriate diagnosis and treatment, symptom management and reduction in exposure to risk factors. Public campaigns will need to be launched to fight common misconceptions regarding dementia, such as that: (i) it is not very common; (ii) it is a normal part of ageing; (iii) there is nothing that can be done to help; (iv) it is better not to know about it; and that (v) it is the responsibility of the family to provide care. The varying presentation and impact of dementia make it challenging to alter the social and cultural determinants of care–seeking behaviour. Many of the risk factors identified in this review, such as age and sex, require a grass–roots approach in order to raise awareness of and educate the general public about dementia. It is important that people's cultures and beliefs are considered when developing awareness–raising campaigns. Other risk factors are linked to the structural determinants of disease and require multi–sectoral action. It is important that health care workers are well trained in case management of dementia, with the ability to efficiently assess, diagnose, treat or refer and educate patients and their caregivers. This approach should limit distress in the affected person, reduce strain and build the confidence of carers, and reduce unnecessary consultations.

Strategies to raise awareness of dementia and improve the chance of early diagnosis include: (i) practice–based educational programmes in primary care; (ii) the introduction of accessible diagnostic and early stage dementia care services (eg, memory clinics); and (iii) promoting effective interaction between different components of the health system [16]. With the growing middle class in Africa, established cultural norms of care and social protection through extended family networks are no longer sustainable. A key policy priority therefore is to plan for the long-term care of people with dementia. In addition, more research needs to be commissioned and funded in order to improve understanding of the different social and environmental risk factors.

Conclusion

The number of elderly people in Africa is increasing rapidly, with an accelerating number of the persons affected by dementia. Although the epidemiological literature on dementia in Africa is very limited, our estimates of the number of cases living with dementia in Africa suggest that this condition should already be considered a public health priority. The analysis of the study design of the available research indicated that the prevalence is likely to be underestimated, and that the true figures are likely to be considerably higher. The evidence base of epidemiological data of dementia must be improved to fully understand the burden and its impacts on individuals, families and societies. More research is needed in the entire Africa, but particularly in the southern and eastern regions. Consistency in case definition and methodologies are vital in creating a reliable estimate. There is also a need for age– and sex–specific information in order to refine the existing burden estimates and provide specific targets for health programmes. Other research priorities include multiple collaborative community–based studies in the adult population and investigations of lifestyle factors that influence development of the disease. Policy recommendations include raising awareness of the disease through educational programmes in primary care, the introduction of diagnostic and early stage dementia care services in the community, and collaboration between different components of the health system. Planning for the long–term care of sufferers and their families is encouraged in light of the growing middle class in Africa.

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PAPERS

Optimizing community case management strategies to achieve equitable reduction of childhood pneumonia mortality: An application of Equitable Impact Sensitive Tool (EQUIST) in five low– and middle–income countries

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Background The aim of this study was to populate the Equitable Impact Sensitive Tool (EQUIST) framework with all necessary data and conduct the first implementation of EQUIST in studying cost–effectiveness of community case management of childhood pneumonia in 5 low– and middle–income countries with relation to equity impact.

Methods Wealth quintile–specific data were gathered or modelled for all contributory determinants of the EQUIST framework, namely: under–five mortality rate, cost of intervention, intervention effectiveness, current coverage of intervention and relative disease distribution. These were then combined statistically to calculate the final outcome of the EQUIST model for community case management of childhood pneumonia: US$ per life saved, in several different approaches to scaling–up.

Results The current 'mainstream' approach to scaling–up of interventions is never the most cost–effective. Community–case management appears to strongly support an 'equity–promoting' approach to scaling–up, displaying the highest levels of cost–effectiveness in interventions targeted at the poorest quintile of each study country, although absolute cost differences vary by context.

Conclusions The relationship between cost–effectiveness and equity impact is complex, with many determinants to consider. One important way to increase intervention cost–effectiveness in poorer quintiles is to improve the efficiency and quality of delivery. More data are needed in all areas to increase the accuracy of EQUIST–based estimates.

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Three years are left until the 2015 deadline to achieve the Millennium Development Goals (MDGs) and much progress has been achieved. A recent Inter–Agency Group for Child Mortality Estimation (IGME) meeting reported a child mortality decrease of over one third from 1990 to 2010 [1].

However, an unforeseen issue is that in many low– and middle–income countries (LMICs) a decrease in under–five mortality rate (U5MR) has been accompanied by increased inequity in health outcomes between the poor and those better off [2]. This important consideration has been discussed extensively in a recent United Nations Children's Fund (UNICEF) report which argues for abandoning the 'mainstream approach' where scaling–up of child health interventions is first provided to more readily accessible (and typically wealthier) groups in society. Instead, an 'equity–focused' approach is suggested, contending that it is more cost–effective to target interventions at the poorest in society, resulting in a greater U5MR decrease while also positively impacting upon equity.

To test this hypothesis, a tool is required that can address the many determinants in the multifaceted relationship between cost–effectiveness and equitable impact in child mortality reduction. Although a number of tools have been developed to assist intervention prioritization at local and national levels – such as Marginal Budgeting for Bottlenecks (MBB, supported by UNICEF) [3],Choice of Interventions that are Cost–Effective (CHOICE, promoted by the World Health Organization – WHO) [4], and the Lives Saved Tool (LiST, developed by Johns Hopkins University and Futures Institute) [5], none of these tools can fully address equitable impact considerations as they make no allowance for income–related inequalities in countries.

We recently described a conceptual framework that helps understanding the complex interplay between determinants of cost–effectiveness and equitable impact in child mortality reduction (see **Figure 1** for visual representation of the framework), also exposing the importance of several critical determinants for which information is typically lacking [6]. The tool based on this framework has been named EQUIST – **EQU**itable **I**mpact **S**ensitive **T**ool [7]. This study presents the first implementation of EQUIST to test the hypothesis that, against conventional wisdom and prevailing practices, significantly higher gains in child mortality reduction can be achieved through an equity–focused approach to scaling–up of child health interventions without compromising cost–effectiveness.

METHODS

To test EQUIST, five exemplar countries representative of larger WHO regions were used: Nigeria (Sub–Saharan Africa), Egypt (Eastern Mediterranean), Bangladesh (South–East Asia), Cambodia (Western Pacific) and Peru (Americas) (**Figure 2**). These were selected because of their large size and relatively adequate information reported by equity strata. It was also decided to focus on a single disease – pneumonia, which is still the leading cause of child deaths globally [8]. To allow appropriate close scrutiny, a single intervention was studied, namely community case
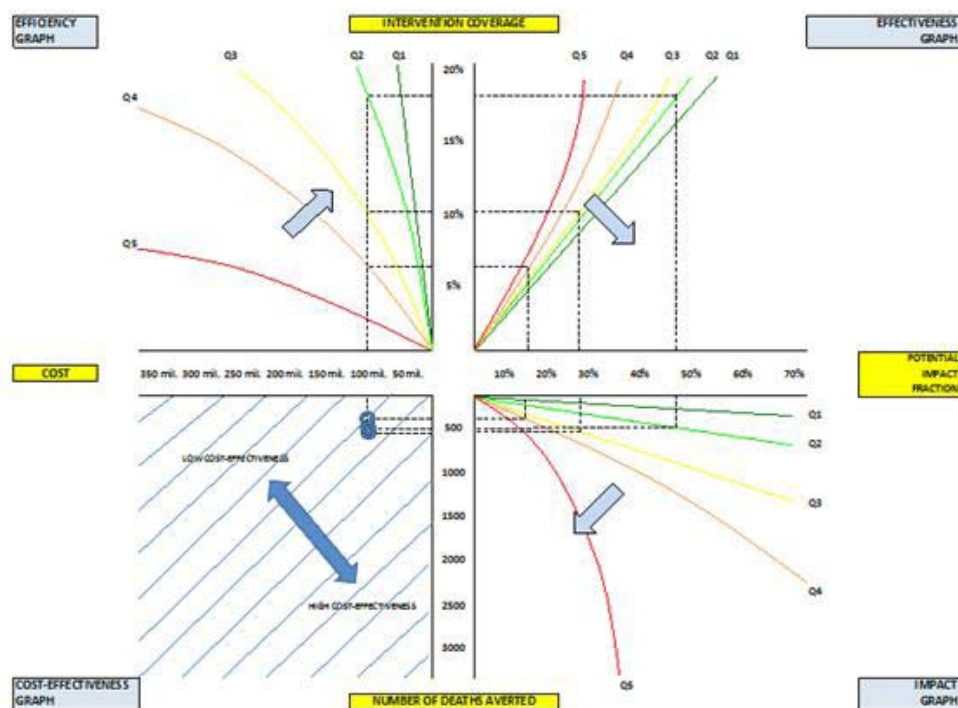

Figure 1 Conceptual framework for EQUIST [6], demonstrating a hypothetical planning exercise assessing the cost–effectiveness of delivery of a new intervention to different equity strata in the population (quintile Q2 vs Q3 vs Q4) with a fixed budget.

Figure 2 Exemplar countries used in the study.

management with antibiotics (CCM), which has proven efficacy in reducing child pneumonia mortality [9,10]. The Child Health Epidemiology Reference Group (CHERG) estimates of worldwide child mortality for 2008 [11] were used, as these data are complete, high–quality, and coincide closely with the most recent Demographic and Health Survey (DHS) data in the five chosen countries [12-16].

Estimates of U5MR

The first step in populating this model was to establish U5MR distribution by wealth quintiles in the five countries, along with the quintile ratio (QR), a commonly used measure of equity (the closer QR is to 1, the closer the country is to health outcomes equity [17]). For all of the countries, data were available from DHS reports 2007, 2008 or 2010 [12-16], therefore correlating strongly with the most recent CHERG data.

Cost estimates

The second step was to estimate the cost of scaling–up CCM in each quintile from its existing level of coverage. For more accurate estimation, cost was split for CCM into antibiotic costs and non–antibiotic costs. It was assumed that the direct costs of antibiotics (ie, the medicines themselves) would be constant across countries and quintiles, while the non–antibiotic costs were likely to be different due to factors including geography, infrastructure and human resources [18].

Direct antibiotic costs for CCM were taken as US$ 0.27 for all quintiles in all areas [8]. Non–antibiotic costs were modelled based on an unpublished report from Pakistan [19], which was the only available source, highlighting the general scarcity of information on this important variable. Direct CCM cost was added to non–CCM costs calculated from the quintile's U5MR to obtain an estimate of the cost for each intervention per child treated in any individual

quintile. In the next step, to gain a more accurate measure of the cost of treatment per quintile, the cost per child treated was multiplied by the total number of under–five episodes of pneumonia in each quintile. The number of episodes was estimated by combining a modelled case fatality rate (CFR) for each quintile with the estimated number of under–five pneumonia deaths.

Estimates of current intervention coverage

The third step was to determine coverage levels of the chosen intervention in the five countries in 2008. Coverage with CCM was assumed to be the same as the indicator "% under–fives with suspected pneumonia receiving antibiotics" used in UNICEF 's "The State of the World's Children" (SOWC) reports.

Effectiveness estimates

The fourth step was to estimate how CCM's effectiveness varied according to the quintile in which it was implemented and therefore calculate the quintile–specific potential impact fraction (PIF). Effectiveness was modelled by graphing effectiveness reported in each study used in a review of CCM [9], against the U5MR for the specific country at the year of study publication (taken from Child Mortality Estimates database [20]). The estimate for each quintile given using the equation of this graph was then adjusted upwards by 50% of the remaining effectiveness gap as suggested in the methods used by Theodoratou et al [9] and the LiST [5].

Disease proportion estimates

Finally, it was necessary to populate the model with disease burden estimates for each disease in each quintile. This was initially attempted through systematic literature review; however an attempt (using MEDLINE, EMBASE and Global Health databases) yielded insufficient data therefore it was decided to model them instead. Data on distributions of under–five mortality deaths by cause for all countries (from the CHERG report [11]) were combined with U5MR data for each country (from SOWC 2009 [21]) in a model, resulting in estimates of cause–specific mortality in each quintile for each global region, and subsequently for the exemplar countries.

Final model

Once the model was fully populated with data necessary to evaluate cost–effectiveness and impact on mortality and equity of community case management for under–five

pneumonia mortality, it was decided to compare the cost per number of lives saved for scaling–up the intervention in the next wealthiest 10% of the uncovered population ('inequity promoting' approach [6]), in the middle 10% of the uncovered population ('equity neutral' [6]), in the poorest 10% of the population ('equity–promoting' [6]), and finally a 10% scale–up in the 'mainstream approach' (coverage scale–up continuing to follow current quintile–specific relative distribution [22]).

Further detailed information on the methods described above in each section is presented in Online Supplementary Document (table w1).

RESULTS

Table 1 and **Figure 3** show the estimates of U5MR (as deaths per 1000 live births) by quintile for the exemplar countries. Quintile ratios for each country are shown in **Figure 4**. Data for each country exhibit expected trends of U5MR decreasing with wealth [11]; however, not all to similar degrees. Nigeria is shown to have a noticeably higher U5MR than the other 5 countries and this is supported by the 2008 CHERG report, which found the significant majority of under–5 mortality to occur in Africa [11]. Peru has the greatest QR ratio, suggesting it has the highest inequity. Bangladesh exhibits a higher U5MR in each quintile than Peru but a much less significant U5MR variation between quintiles (especially quintile Q3–Q5), and the lowest QR of the five countries, suggesting it is the most equitable studied.

Figure 4 shows estimates of coverage by wealth quintile for community case management (CCM). Although the estimates of coverage by quintile for community case man-
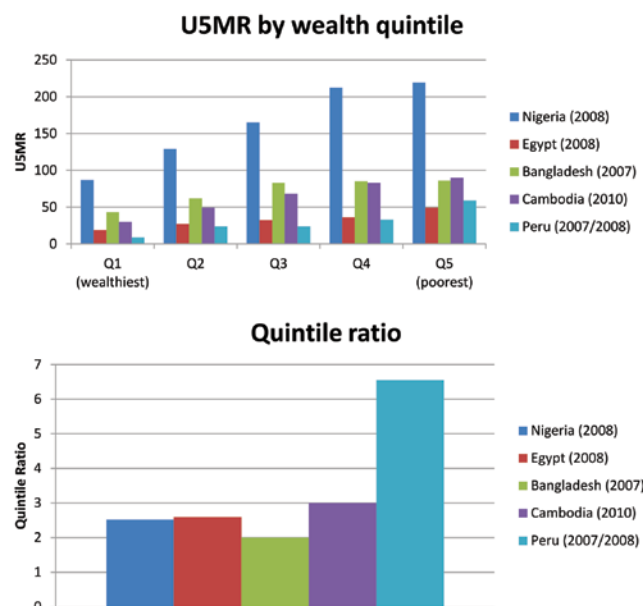

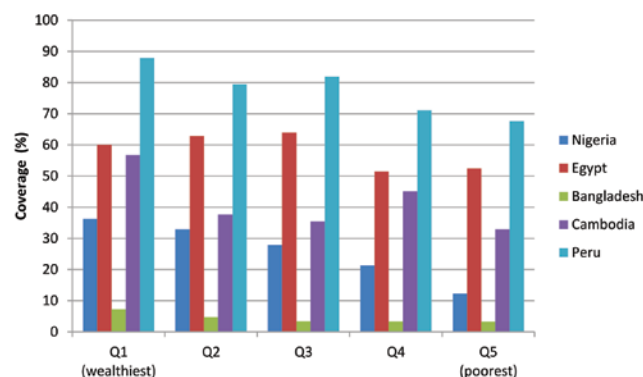**Figure 3** U5MR and inequity by wealth quintiles in exemplar countries.

Figure 4 Community case management (CCM) coverage estimates by wealth quintiles in exemplar countries.

Table 1 Cost of community case management (CCM) per child treated in each country by wealth quintile (Q)

	Overall	Q1 (wealthiest)	Q2	Q3	Q4	Q5 (poorest)
Nigeria:						
U5MR	189.00	87.00	129.00	165.00	212.00	219.00
Cost of antibiotic (US$)	0.27	0.27	0.27	0.27	0.27	0.27
Non–antibiotic cost (US$)	2.52	1.43	1.87	2.26	2.76	2.84
Total cost of CCM per child treated	2.79	1.70	2.14	2.53	3.03	3.11
Egypt:						
U5MR	36.00	18.90	27.20	32.20	36.10	49.00
Cost of antibiotic (US$)	0.27	0.27	0.27	0.27	0.27	0.27
Non–antibiotic cost (US$)	0.88	0.70	0.79	0.84	0.88	1.02
Total cost of CCM per child treated	1.15	0.97	1.06	1.11	1.15	1.29
Bangladesh:						
U5MR	61.00	43.00	62.00	83.00	85.00	86.00
Cost of antibiotic (US$)	0.27	0.27	0.27	0.27	0.27	0.27
Non–antibiotic cost (US$)	1.15	0.95	1.16	1.38	1.40	1.41
Total cost of CCM per child treated	1.42	1.22	1.43	1.65	1.67	1.68
Cambodia:						
U5MR	54.00	30.00	49.00	68.00	83.00	90.00
Cost of antibiotic (US$)	0.27	0.27	0.27	0.27	0.27	0.27
Non–antibiotic cost (US$)	1.07	0.82	1.02	1.22	1.38	1.46
Total cost of CCM per child treated	1.34	1.09	1.29	1.49	1.65	1.73
Peru:						
U5MR	27.00	9.00	24.00	24.00	33.00	59.00
Cost of antibiotic (US$)	0.27	0.27	0.27	0.27	0.27	0.27
Non–antibiotic cost (US$)	0.78	0.59	0.75	0.75	0.85	1.13
Total cost of CCM per child treated	1.05	0.86	1.02	1.02	1.12	1.40

U5MR – under–five mortality rate

agement generally follow expected trends of decreasing coverage with increasing poverty (the greatest differences by quintile being found in Nigeria and Cambodia), Egypt exhibits a slightly unexpected pattern with increased CCM of suspected pneumonia in Q2 and Q3 as compared with Q1. This is thought to be due to the fact that in rich urban communities (ie, Q1), medical professionals are trying to avoid over–treating (and therefore promoting antibiotic re-sistance), but in poorer quintiles this is not the case and more cases are treated aggressively with antibiotics, ex-plaining the higher coverage levels. There is then a dip again in coverage observed in Q4 and Q5 in Egypt, likely to be explained by poor access to health care in the poor-est part of the population.

Figure 5 illustrates the model for non–antibiotic cost for CCM and **Table 1** shows the final 'cost per child treated' calculated for CCM in each quintile of the exemplar coun-tries. A consistent trend is observed of increasing interven-tion cost from Q1–Q5 with Cambodia showing the biggest cost differences between Q1–Q2 and Q2–Q3 and Nigeria between Q3 and Q4. These countries also show the high-est overall cost difference.

Figure 6 illustrates the case fatality rates modelled for each quintile (region–specific graphic models are displayed in the Online Supplementary Document, table w2) and **Fig-ure 7** shows the resulting adjusted cost per quintile treated. Again the trend almost uniformly shows an increasing cost from Q1–Q5, with one noticeable difference – the finding of Q5 in Nigeria being marginally less costly than Q4, sug-gesting that the case fatality in Q5 is so high that scaling–up in this quintile will save more money than in Q4 for the same investment.

Table 2 shows data used to model CCM effectiveness/PIF and **Figure 8** illustrates the model. Importantly, **Table 2** highlights scarcity in CCM effectiveness data, as although these papers were carefully screened in a recent review and found to be high–quality [9], none of them were published after 1998. **Figure 9** illustrates the upwards–adjusted ef-fectiveness data for each quintile in each country, showing a continual trend of decreasing effectiveness from Q1 to Q5 but with the biggest decrease being seen in Nigeria, where the poorer quintiles have a significantly higher U5MR.

Figure 10 shows quintile–specific disease proportion esti-mates for each of the exemplar countries, expressed as the percentage of the total under–five mortality burden. Sig-nificant differences across wealth quintiles in causes of death in those aged under–five can be seen in each of the five exemplar countries with all studied countries showing increasing proportions of deaths due to malaria, pneumo-nia and diarrhoea in poorer quintiles while proportions of deaths due to congenital abnormalities, preterm birth com-plications and injury decrease as poverty increases. This is
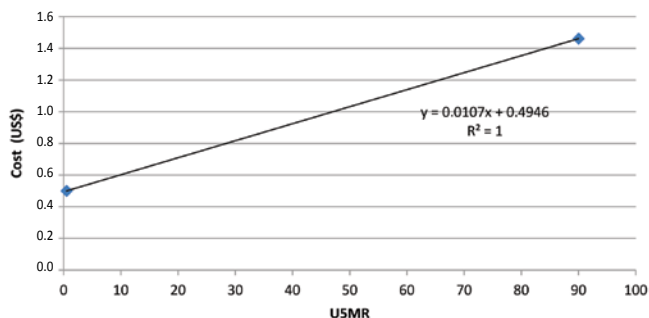

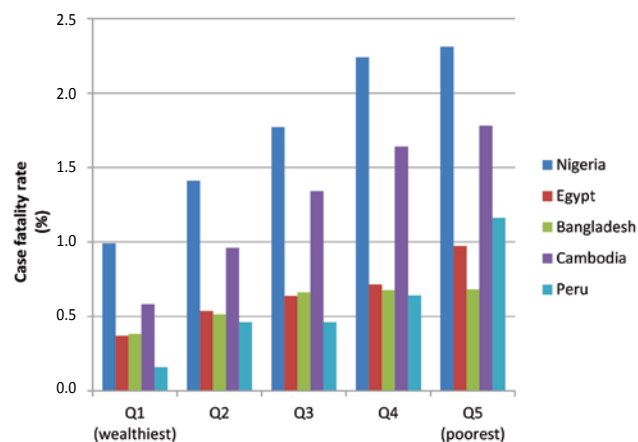**Figure 5** Non–antibiotic cost estimate model.

Figure 6 Case fatality rates by wealth quintiles in exemplar countries.
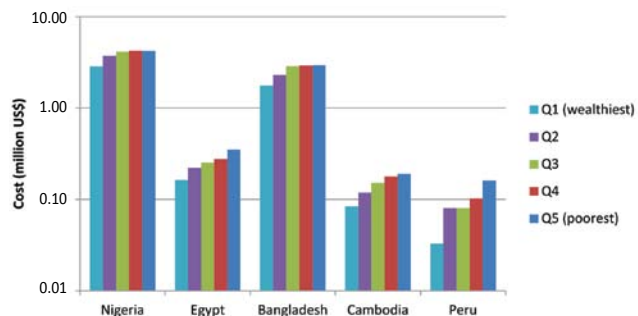

Figure 7 Cost of community case management (CCM) treatment by wealth quintile in exemplar countries.

Table 2 Data for CCM effectiveness/Potential Impact Fraction (PIF) modelling

Study	Location	Year	U5MR	Effectiveness
Mtango et al [23]	Tanzania	1986	161.40	30.10
Pandey et al [24]	Nepal	1989	126.30	84.00
Bang et al [25]	India	1990	114.80	49.10
Khan et al [26]	Pakistan	1990	123.60	55.00
Reddaiah et al [27]	India	1991	111.90	26.00
Pandey et al [28]	Nepal	1991	122.00	30.00
Fauveau et al [29]	Bangladesh	1992	132.10	50.00
Agarwal et al [30]	India	1993	105.60	27.80
WHO [31]	Philippines	1998	43.10	35.00
Our suggestion [6]	Global	2012	0.00	100.00

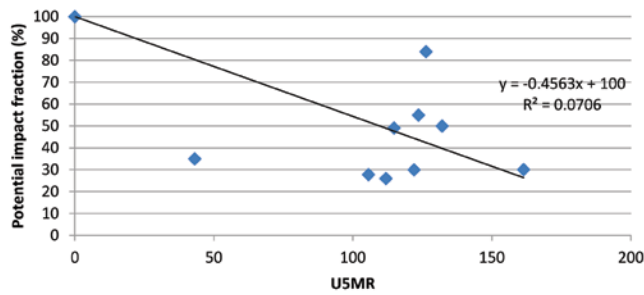U5MR – under–five mortality rate, WHO – World Health Organization

Figure 8 Effectiveness/Potential Impact Fraction (PIF) model for community case management (CCM).
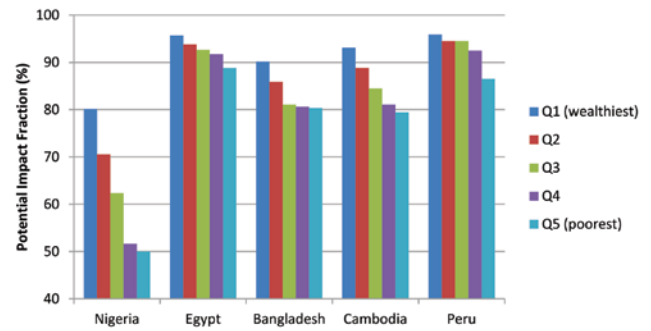

Figure 9 Effectiveness/Potential Impact Fraction (PIF) model for community case management (CCM) in each country by wealth quintile**s** in exemplar countries.

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thought to be due to the fact that infectious diseases such as malaria and pneumonia are treated more effectively in richer populations resulting in a diminished proportion of deaths due to these causes but an increased proportion of deaths due to causes that even well–funded health systems struggle to deal with such as congenital abnormalities or injury.

Bangladesh shows an interesting pattern of birth asphyxia, which takes up highest proportion of mortality in Q2 and Q3, potentially suggesting that in these quintiles although the infectious diseases which are prevalent in poorer quintiles are still well treated, the health care facilities in these quintiles are not as good as in Q1 and so more babies die of birth asphyxia.

WHO region–specific disease proportion estimates and models for disease proportion against U5MR and quintile–specific numbers of deaths in 2008 from each of these causes of death in each of the five exemplar countries are presented in the Online Supplementary Document (tables w3 and w4).

Figure 11 illustrates the final results: cost per life saved (in US$) for each quintile in each country by scaling–up CCM in the different studied strategies.

Strikingly, the 'mainstream' approach for CCM in all countries is not the most cost–effective, instead an equity–promoting approach always delivers the greatest cost–effectiveness in terms of US$ per life saved. The absolute cost differences between this and the next most costly approach differ with context, varying from US$ 59.92 per life saved in Peru to US$ 1.10 in Bangladesh, where an equity–promoting approach is of almost the same cost–effectiveness as an equity–neutral approach of scaling up in the
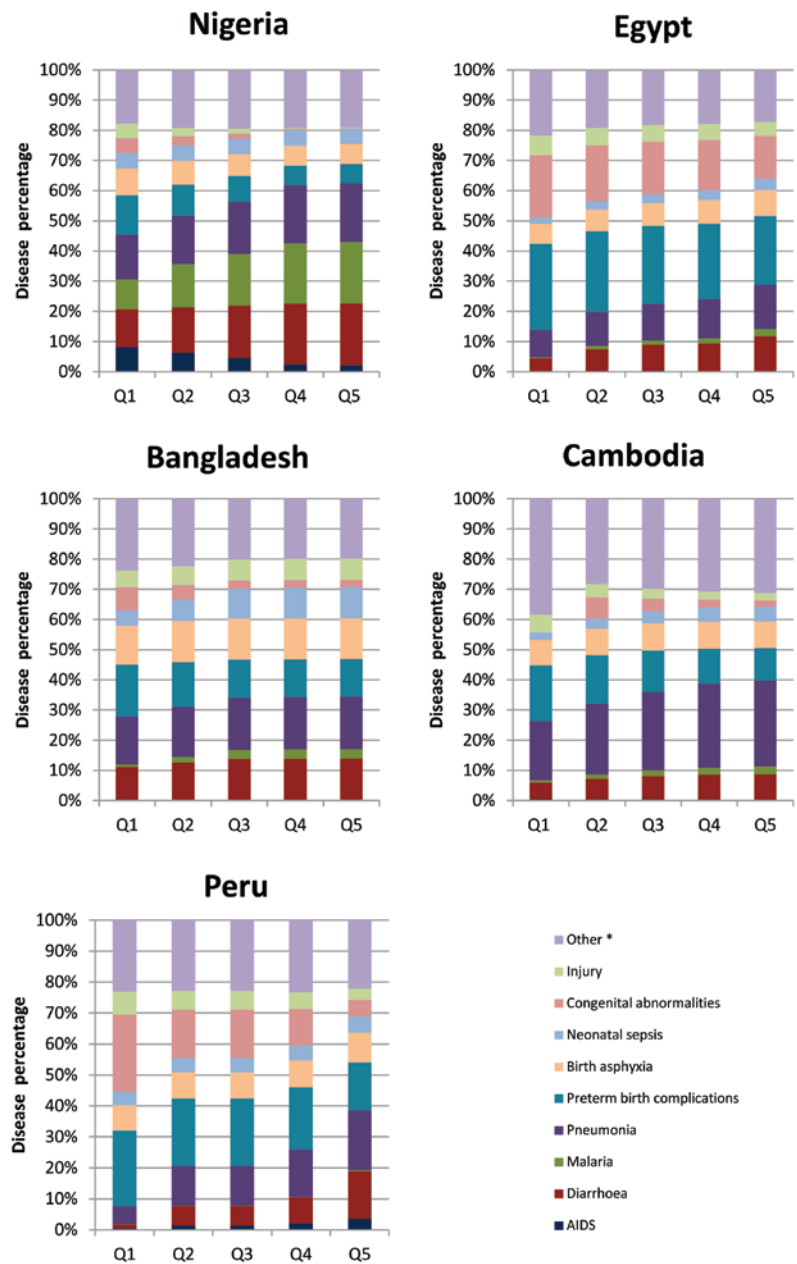

Figure 10 Modelled cause–specific child mortality by wealth quintiles in exemplar countries.
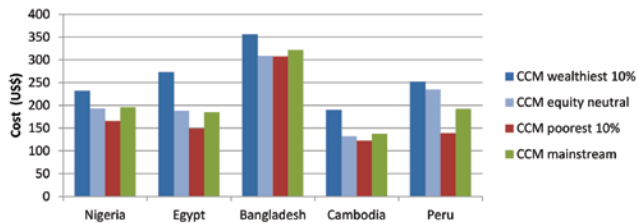
Figure 11 Estimated cost per life saved in exemplar countries.

Figure 12 Estimated number of lives saved in Mainstream vs Equity–promoting models for the same investment.

middle uncovered 10%. It is thought this is due to the differences in U5MR from Q3 to Q5 being relatively small in Bangladesh, resulting in the differences in disease burden, coverage, effectiveness and cost also not being large. This can be contrasted with Peru where the greatest difference in cost–effectiveness is between equity–promoting and equity–neutral and the greatest difference in U5MR is between Q5–Q3. This potentially suggests that in more inequitable contexts such as Peru (which has the highest QR of the countries studied), an equity–promoting approach will have a greater impact when compared with more equitable contexts. Egypt is the only modelled country where the next most cost–effective scale–up option is the 'mainstream' approach, possibly due to an already relatively equitable coverage of CCM across quintiles (a difference of only 7.6% coverage from Q1 to Q5).

Nigeria is an interesting context to study as due to its exceedingly high U5MR in poorer quintiles, the effectiveness modelled for Q5 is 50.4%. It was thought that this might result in an equity–promoting scale–up delivering poor results however what is observed in actuality is that scale–up in Q5 is still the most cost–effective. This highlights that the childhood pneumonia burden in this stratum is so great that even treating 50% will result in a huge improvement, but also that any intervention which could improve effectiveness of CCM could further enhance this and result in extremely significant reductions in Nigeria's overall childhood pneumonia burden.

Table 3 shows the exact numbers of lives saved from the same investment of US$ 1 000 000 either in the 'mainstream' approach or an equity–promoting approach with targeted CCM scaling up in Q5. This is illustrated in **Fig-**

ure 12. Although it can be seen that an equity–promoting approach to investment in CCM always results in a greater saving of life than the 'mainstream' approach, the gradient of the difference varies significantly between countries with the greatest contrast found in Peru, the country with the highest QR and therefore greatest inequity, again suggesting that an equity–promoting approach is potentially most valuable in countries with the highest inequity.

The results for all aspects of this study are further explained the Online Supplementary Document (table w1).

DISCUSSION

This study aimed to populate EQUIST [6] with real data from five exemplar LMICs and thereby investigate cost–effectiveness of different strategies to scaling–up childhood pneumonia interventions. Apart from noting the scarcity of high–quality information in this area, this paper has delivered three major outcomes. Firstly, the information generated through modelling to populate EQUIST represents a novel contribution to understanding equity and child health in LMICs. Secondly, this paper has shown that EQUIST is potentially a valuable tool for evaluating cost–effectiveness of different approaches to scaling–up health interventions. Finally, this first implementation of EQUIST has highlighted the complexity of relations between the multiple determinants of cost–effectiveness and equitable impact in LMIC child mortality reduction. Unexpected patterns are seen both in each variable's distributions and in the final outcome results, further compounded by the difficulty in determining which of the multiple contributory variables is influencing the results most. This emphasizes that data on equity and cost–effectiveness for intervention planning in LMICs can be far from intuitive.

An extensive review of the literature found only one paper that attempted to model any child health data split by wealth quintile. Amouzou et al used the LiST to model child mortality data for richest and poorest quintiles in Bangladesh and found this to be within a 95% confidence interval of current DHS data [32]. This is an impressive result, suggesting that LiST could play a role in expanding knowledge on wealth–related child health outcomes. The paper how-

Table 3 Number of lives saved for US$ 1 million investment according to Mainstream vs Equity–promoting model

Country	Mainstream model	Equity–promoting (Poorest 10%) model	Mainstream vs Equity–promoting (Poorest 10%) model
Nigeria	5108	6037	929
Egypt	5411	6698	1287
Bangladesh	3110	3254	144
Cambodia	7262	8188	925
Peru	5209	7191	1982

ever does not go further to investigate policy implications and extensive literature searching found no published attempt to adjust any of the major tools (ie, LiST, MBB or CHOICE) for calculating scaling–up costs by wealth quintiles and thereby explore equity considerations. EQUIST appears to be the only published framework which adequately addresses these considerations, making it an important development for future public health policy.

Limitations

In absence of information, it was necessary to model much of the data needed to populate EQUIST including data for non–antibiotic costs, as although there are several studies estimating overall cost of global scale–up of health systems [18,33] and some discussing the cost of more specific scale–up of individual countries and/or interventions [34,35], no studies were found which reported data on the differential cost of scale–up across wealth quintiles although the importance of this difference was highlighted by Johns and Torres [18].

Estimates of relative disease proportions split by wealth quintile were the most extensive modelling exercise undertaken and are therefore central to consider when assessing this EQUIST implementation's robustness. The modelling was based on data from the highly–cited CHERG report on child mortality [11] and the UNICEF SOWC 2009 report [36] and is therefore thought to robustly estimate differential disease proportions. That the model used U5MR instead of GDP to split disease distribution is justifiable as the U5MR for Q1–Q5 in each country was known, so this could be used as a common denominator to determine quintile–specific disease distribution.

Limitations of the data in this study are further explained in the Online Supplementary Document (table w1).

Future research/policy implications

The results of this first implementation of EQUIST provide important conclusions. Firstly, one of the main findings of this study was the lack of good data in this important area. The need for extensive future research to fill gaps should be emphasized, especially into variables such as effectiveness and cost of interventions across population wealth strata. One potential way of doing this would be to further expand the DHS or MICS (Multiple Indicator Cluster Surveys [37]) to collect information on more diverse health indicators, including those related to the EQUIST framework variables. This paper also adds to the calls from others for future intervention scale–ups to be monitored with relation to their differential costs, effectiveness and impacts across equity strata so as to widen the knowledge base [38], a process which is starting to happen through the UNICEF initiative "Monitoring Results for Equity System" (MoRES)

[39]. The trends observed here for CCM for pneumonia may be similar or completely different for other pneumonia interventions or other major causes of childhood mortality and so if further research was conducted to populate EQUIST with data for other interventions/diseases, these could be investigated and greater understanding could be developed regarding equitable impact of childhood mortality interventions more broadly. For example vaccines have been shown previously to have a positive impact on equity while also reducing childhood mortality significantly, such as in the case of measles vaccination in Bangladesh [40]. Therefore, as vaccines against pneumonia such as Pneumococcal Conjugate (PC) and *Haemophilus influenzae* (Hib) are rolled out across an increasing number of countries through the GAVI Alliance [41,42], using EQUIST it could be possible to target scale–up in a more informed manner, directing vaccines with increased cost–effectiveness while also promoting equity. Further research/modelling however will be necessary to determine the necessary components of the EQUIST model for analysing these interventions before any policy recommendations can be made.

Another potential facet for future research is the inclusion within EQUIST of other indicators of inequity apart from wealth. Policy makers are likely to find targeting interventions strictly by wealth quintiles difficult, therefore decomposing the components of the EQUIST for other sub–population group measures may be of more use. One potential way to do this is to consider using geographical areas to split populations as significant variances in U5MR are typically seen [12-16] and geographical areas are easier for policy makers to target. Further research/modelling however would have to be undertaken to define these groups and their values for each component variable of the EQUIST. Another potential discriminatory variable which could be explored is gender, as U5MR is known to be higher in boys than girls in most LMICs (apart from India and China where the opposite is true) [43], however there is little known with relation to the other variables of EQUIST such as gender differences in disease distribution within specific wealth quintiles. If these data were to be attained either through survey or modelling, it would be possible to apply EQUIST to gender as well as wealth/geography and further address equity considerations.

One of the most important findings in this first implementation of EQUIST is that the current, "mainstream", approach never showed the highest cost–effectiveness in studied examples. Therefore for CCM scale–up, the current approach is unjustifiable. If countries are already not delivering interventions maximally cost–effectively, and many are increasing inequity, could an equity–focus lead to improvement in both areas? The CCM cost–effectiveness data generated in this paper suggest that indeed the most cost–
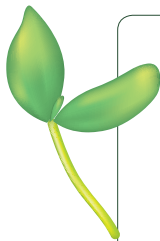
effective approach is in actuality scale–up in the poorest, as although poorer quintiles display a decrease in effectiveness and an increase in cost of scale–up, the higher burden of disease and case fatality observed in these strata is great enough to offset this. This potentially lends increased weight to policy makers and academics increasingly calling for exactly this kind of equity–focus in scale–up of interventions [2,22,37,43-46]and can be seen as a major development in the evidence supporting this call. Although this implementation is only the first of EQUIST and therefore needs refinement and improvement of data, it is hoped that eventually this tool could be used at a national and sub–national level to aid policy makers to more efficiently target intervention scale–up so as to both save a maximal number of lives and also impact positively on equity.

This implementation of EQUIST and the conceptual process involved behind thinking about intervention scale–up in this manner also suggests possible means of further enhancing cost–effectiveness, resulting in more lives saved for a given investment. The limiting factor in CCM in poorer quintiles such as Nigeria seems to be the very low effectiveness of the intervention and so it is implied that enhancement of the efficiency or quality of provision will also significantly decrease cost and therefore increase cost–effectiveness [6].This devel-

opment should therefore be a focus for future research so that cost concerns do not force resource–limited policy makers to further perpetuate the observed trends of increasing inequity in many countries worldwide [2]. A recent review highlights a number of current limiting factors in the effectiveness of community case management including incomplete compliance with guidelines, inappropriate choice of antibiotics and poor management of treatment failure and co–morbidities [47]. These must be overcome if an equitable approach to scaling–up CCM is to become practicable in some of the world's poorest countries.

CONCLUSION

Child health information split by wealth strata in LMICs is severely lacking. This first implementation of the EQUIST framework has expanded knowledge and delivered important analyses on cost–effectiveness of different strategies in scaling up of community case management to tackle pneumonia in five LMICs, demonstrating EQUIST's potential future value. It has highlighted the complexity of interactions between equity, cost–effectiveness and their determinants, also reinforcing important suggestions for future policy such as the significant effect on cost–effectiveness of increasing efficiency and quality of interventions in poorer quintiles.

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Political priority in the global fight against non–communicable diseases

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Background The prevalence of non–communicable diseases (NCDs) – such as cancer, diabetes, cardiovascular disease, and chronic respiratory diseases – is surging globally. Yet despite the availability of cost–effective interventions, NCDs receive less than 3% of annual development assistance for health to low and middle income countries. The top donors in global health – including the Bill and Melinda Gates Foundation, the US Government, and the World Bank – together commit less than 2% of their budgets to the prevention and control of NCDs. Why is there such meagre funding on the table for the prevention and control of NCDs? Why has a global plan of action aimed at halting the spread of NCDs been so difficult to achieve?

Methods This paper aims to tackle these two interrelated questions by analysing NCDs through the lens of Jeremy Shiffman's 2009 political priority framework. We define global political priority as 'the degree to which international and national political leaders actively give attention to an issue, and back up that attention with the provision of financial, technical, and human resources that are commensurate with the severity of the issue'. Grounded in social constructionism, this framework critically examines the relationship between agenda setting and 'objective' factors in global health, such as the existence of cost–effective interventions and a high mortality burden. From a methodological perspective, this paper fits within the category of discipline configurative case study.

Results We support Shiffman's claim that strategic communication – or ideas in the form of issue portrayals – ought to be a core activity of global health policy communities. But issue portrayals must be the products of a robust and inclusive debate. To this end, we also consider it essential to recognise that issue portrayals reach political leaders through a vast array of channels. Raising the political priority of NCDs means engaging with the diverse ways in which actors express concern for the global proliferation of these diseases.

Conclusion Ultimately, our political interactions amount to struggles for influence, and determining which issues to champion in the midst of these struggles – and which to disregard – is informed by subjectively held notions of the right, the good, and the just. Indeed, the very act of choosing which issues to prioritise in our daily lives forces us to evaluate our values and aspirations as individual agents against the shared values that structure the societies in which we live.

The prevalence of non–communicable diseases – such as cancer, diabetes, cardiovascular disease, and chronic respiratory diseases – is surging globally. In 2004 deaths due to NCDs accounted for three out of five deaths worldwide, with 80% of these deaths occurring in low– and middle–income countries [1]. What is more, deaths due to NCDs are predicted to increase by 15% worldwide between 2010 and 2020 [2].

NCDs are no longer just the scourge of the rich. As the World Health Organization (WHO) recently observed: "*NCDs and poverty create a vicious cycle whereby poverty exposes people to behavioural risk factors for NCDs and, in turn, the resulting NCDs may become an important driver to the downward spiral that leads families towards poverty*" [3]. A recent World Bank study in India found that treatment costs for an individual with diabetes typically consume between 15 to 25% of household earnings [4]. Where families lack access to affordable health care – a reality that is especially commonplace in low– and middle–income countries – they tend to forego care or fall into financial hardship; in both cases, the poor end up suffering the worst [5].

Moreover, the main risk factors for NCDs are perpetuated through social norms and practices. According to the WHO, these risk factors include tobacco use and exposure to second–hand smoke, unhealthy diet, physical inactivity, and harmful use of alcohol [2]. The impacts of these factors are not immediately detectable (as in the case of an infectious virus), but evolve over the course of one's lifetime. NCDs can thus be described as 'invisible' diseases: their long–term nature makes it such that sufferers often go unnoticed.

NCDs are thus rooted in the social determinants of health and cannot be stopped through individual action alone. By way of example, current global marketing activities are driving the transition towards diets that are high in sugar and saturated fat, thus increasing the risk of developing one or more NCDs [6]. Research has also demonstrated strong links between increased tobacco consumption, free trade, and foreign direct investment. For instance, in the 1980s bilateral trade agreements signed between the US and several countries in Asia resulted in a spike in demand for tobacco products, especially in the poorest Asian countries [7].

Recognising the need for a collective response, the WHO has responded with a shortlist of 'best buy' policy interventions to prevent and treat NCDs. These policies include tax increases to curb tobacco use; restrictions on the marketing of alcohol; replacement of trans fats to promote healthier diets; hepatitis B immunisation to prevent liver cancer; and multi–drug therapy to prevent heart attacks and strokes [8]. Most significantly, these 'best buys' can be implemented at relatively low cost, ranging from US$ 1.50–

2.00 per head in low–middle income countries to US$ 3 per head in upper–middle income countries [8]. The costs of inaction are much greater: the WHO estimates that each 10% rise in NCDs is associated with 0.5% lower rates of annual economic growth [3]. Thus, in 2011 the World Economic Forum ranked NCDs among the major global threats to economic development [9].

Yet despite the availability of cost–effective interventions, NCDs receive less than 3% of annual development assistance for health to low and middle income countries [10]. The top donors in global health – including the Bill and Melinda Gates Foundation, the US Government, and the World Bank – commit less than 2% of their budgets to the prevention and control of NCDs [11]. NCDs cause the highest burden of disease across the world, and yet the global response to this reality has been woefully inadequate.

Why is there such meagre funding on the table for the prevention and control of NCDs? Why has a global plan of action aimed at halting the spread of NCDs been so difficult to achieve? This paper aims to tackle these two interrelated questions by analysing NCDs through the lens of Jeremy Shiffman's (2009) political priority framework [12]. We define global political priority as "*the degree to which international and national political leaders actively give attention to an issue, and back up that attention with the provision of financial, technical, and human resources that are commensurate with the severity of the issue*" [13]. Grounded in social constructionism, this framework critically examines the relationship between agenda setting and technical factors in global health, such as the existence of cost–effective interventions and a high mortality burden. Shiffman calls into question the tendency on the part of many global health advocates to treat indicators of the burden of disease as self–evident. To this end, Shiffman argues that strategic communication surrounding the causes, effects, and implications of disease ought to be a central task of health advocates. Following this logic, we explore the ways in which the policy community surrounding NCDs – or the network of individuals and organisations concerned with the issue – have come to understand and portray the issue's importance. In this manner, we explain the neglect of NCDs on the global stage in terms of a lack of strategic communication.

We begin by outlining the theoretical approach and methodology to be followed throughout the paper. Next, we explore the various ideas and framing mechanisms that have been used to portray NCDs. Finally, we seek to address two weaknesses in the Shiffman framework. We conclude by reconciling the Shiffman framework's focus on strategic communication with the claim, advanced by several global health experts, that well–financed corporate and private agendas currently act to undermine the pursuit of health for all.

SOCIAL CONSTRUCTIONISM

This paper follows in the social constructionist tradition, whose most basic tenet holds that '[our] socially shared interpretations mediate and form our perceptions of reality' [12]. While the social construction of reality is well established in social scientific research [14-16], this approach has been applied in only a handful of instances in the field of public health [17,18]. This paper thus aims to show the rich insights to be gained from applying a social constructionist approach to the study of human disease.

In order to attract attention for an issue, we argue that actors must engage in 'strategic social construction'. This is defined as the process whereby actors conduct means–ends calculations with a view to changing other actors' utility function in ways that reflect new normative commitments [19]. Moreover,we operate from the assumption that a desire on the part of a group of actors to transform ideas into norms can be meaningfully translated into an effective plan of action; in other words, that 'we can think about the strategic activity of actors in an intersubjectively structured political universe' [20].

Consequently, we use Shiffman's (2009) political priority framework as a tool for understanding the process of translating grievances into norms that demand action. Shiffman identifies three variables that are fundamental to raising the priority of a given issue area: (1) ideas, (2) institutions, and (3) policy communities. The framework to form the basis of the present analysis is a condensed version of an earlier framework proposed by Shiffman and Smith (2007). We use the 2009 version of the framework as it makes explicit its critique of materialist approaches that explain health priority–setting in terms of 'objective' indicators.

From a methodological perspective, this paper fits within the category of discipline configurative case study [21]. This type of study uses established theories to explain a case, whether for the purpose of highlighting important historical developments, improving pedagogy, or drawing attention to the need for new theory in neglected areas. One limitation of this approach is the temptation to make predictions about future events on the basis of theories that 'lack clarity and internal consistency' [21]. To date, the Shiffman framework has been applied to a limited number of cases, including maternal and child health, neonatal health, and oral health [13,22-24]. Beyond these cases, the framework's theoretical implications remain unspecified. We endeavour to surmount this limitation by clarifying and refining the framework. A second limitation of this paper is its lack of interview data. However, wherever possible we incorporate primary source material, including direct statements from actors in the public sector, private industry, and civil society. Third, this paper does not focus on the insti-

tutional factors that have impeded the generation of priority for NCDs. While we acknowledge that well–financed institutions are crucial in terms of giving 'teeth' to an issue, this paper aims to refine the framework's theoretical assumptions. If incorporated into future analyses, these refinements can be used to situate the role of institutions in the priority generation process.

THE USE OF IDEAS IN NCD ADVOCACY

What ideas have been used to portray NCDs? What ideas have been ignored? This will be accomplished by analysing these ideas from three vantage points: issue framing, issue characteristics, and implementation. Framing refers to 'conscious strategic efforts by groups of people to fashion shared understandings of the world and of themselves that legitimate and motivate collective action' [25]. It follows from this definition that issues in global health do not automatically designate themselves as priority issues, but rather, that issues are selectively and consciously advanced by organised groups of people. Crucially, however, the frames that condition these strategic decisions often go unnoticed. As such, '[we] do not see the frame directly, but infer its presence by its characteristic expressions and language. Each frame gives the advantage to certain ways of talking and thinking, while placing "other out of the picture"' [26].

Why, then, do certain frames resonate with political leaders and the public at large and subsequently compel action, while others do not? Two characteristics that can be used to explain this variance in the efficacy of frames are 'credibility' and 'salience' [27]. Credibility refers to 'how truthful people perceive the frame to be', whereas salience refers to 'how central [the frame] is to their lives' [12]. To zero in on how credibility and salience are portrayed, Shiffman (2009) identifies two types of claims generally used by activists in global health: problem claims, surrounding severity and neglect of their issue; and solution claims, surrounding a given problem's tractability and the benefits that would ensue from addressing it. An example of a problem claim from the literature on NCDs is as follows: 'An urgent and collective response is required because no country alone can address a threat of this magnitude' [5]. Conversely, in the aim of drawing attention to the need for concerted action on NCDs, other advocates have put forth the following solutions claim: 'The evidence is unequivocal: major and rapid health and economic gains are possible with only modest investments in prevention and control of chronic diseases' [28].

The purpose of these claims is to convince others to 'buy into' the interpretations that they advance. For instance, the notion of 'magnitude' in the aforementioned problem

claim is invoked in order to make a normative judgment. In this particular claim, magnitude is linked with the notion of a 'collective response', or the capacity of human beings to affect meaningful change. As such, the intended effect of this claim is to exclude interpretations that reduce the proliferation of NCDs to individual responsibility by framing the issue in terms of unrealised potential for collective action.

Credible claims, therefore, are ones that align with previously held frames. But what role has framing played in contributing to the lack of priority for NCDs? What frames have been used to portray this issue, and how can we assess the effectiveness of these frames?

First, the issue of credibility has been dominated by calls to improve surveillance of these diseases, particularly in the developing world. The WHO's 2008–2013 Global Strategy for the Prevention and Control of Noncommunicable Diseases repeatedly identifies the elaboration of 'reliable population–based mortality statistics and standardized data' as a key strategic objective [29]. Indeed, for one well–versed in quantitative methods, the availability of credible facts demonstrating the effects of NCDs may be enough to motivate action. In response to enduring confusion about the causes of NCDs such as lack of personal control, the lead author of one of the papers in the first *Lancet* series on chronic diseases thus remarked: 'I thought we got rid of these myths. But they keep coming back' [30].

However, for others in government and in industry, mere reliance on statistics may prove unconvincing. Indeed, a wide range of factors has served to reinforce the perception that NCDs are unworthy of attention. For instance, the very label of these diseases is a case study in poor branding: "anything that begins with 'non' may be considered a 'non–issue' or a 'non–starter'" [31]. Moreover, it fails to convey the crucial point that NCDs are indeed communicable: not just through infectious modes of transmission, but also through social norms and practices. In China, for instance, 59% of Chinese men smoke, compared to only 4% of women [32]. In the Chinese context, smoking – a key risk factor for NCDs – is therefore interwoven with gender roles and perceptions of social status. A label that at first glance excludes social processes as forms of disease communication thus represents a major impediment to the generation of priority.

The lack of a 'human face' to portrayals of NCDs represents a second problem. In contrast to a disease such as polio, where the victim is immediately recognisable by virtue or his or her physical appearance, sufferers of diseases such as diabetes often go unnoticed. To suggest that evidence alone can compel action is to ignore the role of emotion and affect in shaping human reactions to external events [33]. Yet NCDs have not been portrayed through the use

of images and media clips that depict actual human sufferers [34]. This serves to dehumanise the issue, limiting its emotional appeal, and ultimately, its salience.

These examples suggest that credibility, understood in terms of technical evidence, has dominated the debate surrounding NCDs. Crucially, this has happened at the expense of salience. The role of framing in conveying the implications of mortality statistics is often misunderstood (as evidenced by *The Lancet* lead author's above comment), or ignored entirely. The myths that, for some, evidently contradict convincing scientific evidence can seem irrelevant for others whose frames of reference do not consider such myths to be worthy of attention. As a result, intentionally shaping social norms and practices involves much more than outwardly projecting facts and figures and hoping that they 'stick'. In the absence of context–sensitive communication strategies, claims surrounding the severity or tractability of NCDs may never make it off the page.

How, then, do certain the technical aspects of NCDs interact with ideas in the priority generation process? We focus on three variables that mediate this relationship: (1) 'causes [that] can be assigned to the deliberate actions of identifiable individuals'; (2) 'issues involving bodily harm to vulnerable individuals, especially when there is a short and clear causal chain assigning responsibility'; and (3) 'issues involving legal equality of opportunity' [35].

In terms of the first and second factors, the fact that NCDs are caused by several risk factors and over the course of a long period of time makes it difficult to attribute their causes to the deliberate actions of identifiable individuals. Ultimately, the perceived uncertainty about NCDs, and about many public health problems in general, is a function of causality [17]. As a result, the lack of attention for NCDs is at least partly attributable to a failure to engage with ideas of causality.

Similarly, the third factor identified above – legal equality of opportunity – represents another obstacle to the generation of priority for NCDs. To date, the WHO has not used its treaty–making power in order to articulate and enforce legally binding regulations surrounding NCDs. However, the WHO did exercise this power in 2005 in order to establish the Framework Convention on Tobacco Control (FCTC). The fact that cigarettes contain carcinogenic tar and other harmful agents – a material component of tobacco – provided sufficient rationale for the establishment of a legally binding treaty designed to curb tobacco use. The FCTC demonstrates that certain interpretations of the causes of disease are so widely shared that it is feasible to control them through the use of legal instruments. However, there has been little headway made towards a Framework Convention on Alcohol Control [36]. From a legal standpoint, the lack of a short causal chain for the full range

of risk factors for NCDs thus represents a core challenge for global health advocates.

Another example of the interplay between technical factors and ideas is captured by the role of consumer insights in food and beverage production. Private industry has actively called for further research 'to gain a better understanding of the biology of sweeteners in human sensory systems' [37]. This argument holds that in order to meaningfully halt the spread of NCDs, consumer taste preferences must be taken into account. PepsiCo has thus committed to remove 10 210 tonnes of salt from its products sold in the US by 2015 – and this, without compromising flavour [37].

However, it remains the case that these taste preferences are always mediated. For example, PepsiCo's commitment to maintaining a wide range of product offerings reproduces ideas about the nature of consumption in a global marketplace. The very suggestion of responding implies that humans will continue to demand as many food and beverage options as possible in accordance with a free market mentality. Yet food is not seen as a symbol of free–market choice in all social contexts. Simply labelling certain foods 'bad' in excess quantities assumes a common interpretation of the role these foods play in the lives of those who consume them. In developing world contexts, for instance, access to a variety of food options may be much more limited than in Western societies. In these contexts, acommoditised understanding of food may play little to no role in shaping local dynamics. A major gap thus lies in understanding the ways in which social meanings interact with potentially harmful foodstuffs, particularly in the informal sector and in home food preparation [37,38]. In accordance with the Shiffman framework, disaggregating the different views attached to technical factors such as food, and examining the ideas and value systems upon which they are based, is crucial to devising effective strategies to elevate the importance of NCD prevention and control.

One could therefore ask: Is it necessary to have an elaborate base of evidence justifying a proposed intervention in order to generate support for that intervention? As previously mentioned, such a focus on expanding the evidence base is frequently invoked by public health experts. As a further example, one of the key problems identified at the United Nations High–Level Meeting on the Prevention and Control of Non–communicable Diseases held in September 2011 was the lack of 'a proper evaluation on the differences between community and targeted initiatives' with respect to minimum age regulations for youth [34].

Of course, we do not dispute that the availability of rigorous evidence is crucial to achieving better health outcomes. At the same time, the availability of evidence is merely one component that political leaders consider when deciding which issues to prioritise. Bull and Bauman (2011) echo this argument in reference to one of the key risk factors for NCDs, physical activity, calling 'inaccurate' the perception that we do not have sufficient evidence to act. Instead, these authors assert that '[much] better use of well–planned, coherent communication strategies are needed' [39].

In this vein, we argue that a useful way of understanding the generation of political priority for a given issue is to reflect on the ideas attached to proposed interventions related to that issue. If one accepts that the availability of evidence is one among many factors that motivate policy–making, understanding the underlying reasons that inspire the actions of policy–makers is crucial. In the case of NCDs, this would suggest that the availability of cost–effective interventions ought not to be ignored in the process of devising effective issue portrayals.

As an example in this regard, one can consider the many connotations of the term 'epidemic'. One of the most salient debates in the lead–up to the UN High–Level Meeting on NCDs centred on the implications of labelling the spread of NCDs an 'epidemic'. Applying this label to NCDs could allow countries to invoke flexibilities in World Trade Organization rules that allow drug manufacturers to make generic versions of patented drugs [40]. These flexibilities find their origin in a provision in the Doha Declaration on the TRIPS Agreement and Public Health, which holds that 'public health crises, including those relating to HIV/AIDS, tuberculosis, malaria and other epidemics, can represent a national emergency or other circumstances of extreme urgency' [41]. In the end, the draft political declaration agreed by World Health Organization Member States referred to NCDs as a 'challenge of epidemic proportions' [42].

For many in public health, calling the global spread of NCDs an epidemic reflects the very real need for urgent action. This interpretation appeals to language traditionally used to refer to other diseases such as HIV/AIDS, on the basis that framing NCDs in a similar way will attract high levels of support. From this perspective, one could argue that to water down the impacts of NCDs by referring to them in any other way would be the equivalent of willfully ignoring sound evidence.

However, for others in government and in the business community, the term 'epidemic' conjures up scenarios of stifled innovation and, its corollary, ineffective pharmaceutical products. For example, the director of the Office of Global Affairs at the US Department of Health and Human Services justified US opposition to eliminating all patent protections on drugs that treat NCDs as follows: "[Doing away with patent protections], *to our minds, was not the way you get a stream of ongoing research and development and the new and improved drugs that we continue to need*" [40].

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In terms of reconciling these conflicting positions, the Shiffman framework offers the following insight: Policies that may seem entirely rational in one social context may seem irrational in another. Just because an intervention *can* be understood by an audience does not mean that it *will* be understood in the way in which one intends. Thus, a strictly public health perspective on NCDs that ignores the broader economic implications of proposed interventions spread will have little appeal amongst these actors.

What is more, this particular understanding of the relationship between health and the economy is informed by socially constructed – or, in this case, free–market capitalist – ideas about the global economic order. This demonstrates that decisions on the part of political leaders regarding whether or not to implement policies aimed at the prevention of disease are inseparable from broader questions of ideology. Policies related to health are much more than just instrumental means of achieving a result of maximum 'utility', but are inspired by value systems that cannot be explained by rational calculations alone [19]. As a consequence, raising the political priority of a given issue is contingent upon engagement with the underlying rationales of policy proposals related to that issue. The full range of interpretations associated with proposed interventions must therefore be taken into account in the process of devising effective portrayals of NCDs and their effects.

DEFINING THE NCD POLICY COMMUNITY

In this final section we reflect on what constitutes the policy community surrounding NCDs. We address this question by proposing two specific refinements to the Shiffman framework: first, to broaden the definition of policy community to include private industry; and second, to reconceptualise the structural determinants of NCDs in terms of ideas.

Shiffman defines policy communities as 'networks of individuals (including researchers, advocates, policy–makers and technical officials) and organizations (including governments, non–governmental organizations, United Nations agencies, foundations and donor agencies) that share a concern for a particular issue' [12]. However, Shiffman does not specify what he means by 'sharing concern' for an issue. From an analytical point of view, this generates significant uncertainty. The lack of clarity surrounding the notion of concern can lead one to focus too narrowly on the community of actors who actively proclaim to be in support of an issue, while failing to incorporate the influence of those 'outside' this community. To this end, "[an] *analytic approach that offers policy community actors as the central creators and disseminators of ideational messages misses other*

possible sources of ideas that may prove persuasive in motivating action" [24].

The desire on the part of many actors in the private sector to align profit objectives with broader social goals also represents a way of expressing concern, and one that has proven highly influential. As such, we seek to amend Shiffman's definition of policy community by explicitly including the private sector. We argue that an issue is concerning to an individual or set of actors when it is of interest, or of importance, to that individual or set of actors. This definition allows for concern to be expressed in many different ways, and not just through traditional methods, such as protest or lobbying. Under this definition, strategic communication is still essential to raising the priority of a given issue area, but the source of such communication is expanded to include a wider range of actors. In this manner, actors that have traditionally been excluded from the policy community and portrayed as forces to be resisted – such as multinational corporations in global health – are redefined as agents of change.

The funding trends are clear: private donors are increasingly driving the global health agenda. Furthermore, the role of private corporations in shaping public perceptions about the risk factors for disease extends well beyond the realm of aid for health. In the domain of advertising, for instance, 11 multinational companies – including such well–known companies as General Mills, Nestlé, Mars, and PepsiCo – account for approximately 80% of global advertising spending in the food and beverage industry [37].

Much less clear, however, is the question of how to respond to these trends. One notable response is the adapted political process model [30]. Among other factors, this model identifies vested corporate interests as a key obstacle to meaningful action on NCDs, claiming that such interests are often subversive, or, to use their words, 'diabolical' in nature [30]. These authors are also critical of the Shiffman framework. They argue that it "[views] *politics as a market, where the ultimate political outcomes are determined by a collision of forces involving people, interests groups, and ideas*". To those who would seek to advance the Shiffman framework, they present the following challenge: "[does] *it help to tell someone that their ideas about how to control diseases have not been influential, so they should come up with better ones*?" [30].

In our view this challenge is misguided in several respects. First, the act of strategic communication cannot be reduced to 'good' vs 'bad' ideas. This misses the crucial point that our frames paint certain ideas as unworthy of attention from our very first encounter with them. This does not mean that such ideas are intrinsically 'bad', but that they may not resonate with our target audience. In order to get past frames – the 'gatekeepers' of ideas – the ideas that we

employ must be salient in the lives of those whom we intend to influence.

Second, this challenge overlooks the constructed nature of interests. The authors of the political process model do indeed acknowledge the need to identify corporate interests, concluding with the following recommendation: "*A challenge for global health is to identify these interests and bring them to the light of day, holding them to standards of transparency and public accountability*" [11]. But this argument fails to recognise that 'they' are also 'us'. 'They' – in this case, private corporations – respond to, influence, and are legitimated by, the ideas that 'we' hold. Their very existence is contingent upon consent. To suggest that corporate interests must be resisted due to their 'diabolical' nature is to depict these interests as irreconcilable with the interests of other (implicitly more benevolent) actors who operate within a given issue area. In short, it is to take the intentions, interests, and attitudes of these actors as granted. But more than that, it is to incite feelings of animosity towards private corporations whose interests may be much more complex than such feelings may lead one to believe. As a result, the adapted political process model may lead to oversimplifications that focus on dominant interpretations at the expense of alternative ones, and taken to the extreme, portray certain issues as polarised to the point of being beyond the reach of mutual dialogue.

This is not to suggest that corporations always act in the best interests of human health; indeed, history is replete with examples of corporate entities using ethically questionable marketing tactics and failing to internalise the environmental and social costs of their operations. In this regard, one can consider the 'Keep America Beautiful' campaign in the United States that was aimed at reducing street litter and promoting environmental awareness. Funded by the tobacco conglomerate Philip Morris, this campaign targeted every kind of trash except tobacco waste, despite the fact that tobacco is estimated to make up 25% of all litter on US streets [30]. This case clearly contradicts well–established evidence about the negative health effects of smoking.

Nevertheless, rather than categorically excluding corporations from the policy community, we contend that a more valuable approach is to focus on the contested ideas emerging within the modern–day economic system – even if these ideas are more incremental than alarmist in their assessment of the system's shortcomings. The concept of corporate social responsibility is most illustrative of this point. This concept holds that 'business models should marry performance and profitability with the deliberate purpose or goal of contributing to the solution of relevant social and environmental challenges' [37]. Under the leadership of CEO Indra Nooyi, PepsiCo has thus adopted the phrase

'Performance with Purpose' to guide its operations. Similarly, the US Secretary of Health Kathleen Sibelius recently remarked: "*Healthy offering and healthy profits are not mutually exclusive*" [34].

In this regard, the success of the business community in attracting the support of US government and other high–level officials is due in no small part to the appeal of its overarching ethos: to "[provide] *consumers with the tools they need to maintain a healthy lifestyle*" [37]. This consumer–centric focus is influential in two key respects. First of all, many Western states have reduced their foreign aid budgets in the wake of the 2008–2009 global financial crisis, thus limiting the funds available for global health initiatives. Second, governments must invariably confront other social and economic problems, including financial instability, terrorism, and climate change. While many of these problems can be addressed synergistically, the fact remains that global health advocates often compete with these issues for attention. As a result, strategies for improving health outcomes that are consumer–focused and that take the bulk of responsibility off the shoulders of government are, in many cases, more likely to gain traction.

To be clear, we do not intend to argue in favour of greater private sector involvement in halting the spread of NCDs. We simply mean to highlight the power of the ideas employed by the private sector, and to suggest that any supposedly balanced analysis of NCDs must take them into account.

Finally, it is worthwhile to address relationship of social constructionism to notions of power. One major criticism of this approach holds that that simply identifying ideational constructs fails to address the powerful inequalities that restrict the ability of individuals to communicate ideas in the first place [43]. It follows that "[too] *much emphasis on the message can draw our attention away from the carriers of frames and the complicated and uneven playing fields on which they compete*" [26]. Similarly, engaging with power relations addresses the criticism that constructivists shy away from seemingly 'evil' norms and ideas [44]. Indeed, the dominant economic paradigm at present is one of free markets, trade liberalisation, and consumer choice. Particularly within the alternative globalisation movement, these free market forces are often considered predatory to the point of being evil – and it is clear that the private sector is a key driver of these forces [45].

A concrete example of an attempt to reorient the perception of the private sector as a structural force to be resisted is the Pan American Health Organization Forum for Action on Chronic Disease, also known as the Partners Forum. It has engaged the private sector by including business representatives in a reworked version of the CARMEN network, which is comprised of 32 countries in the region of

the Americas that are committed to the prevention and control of NCDs and their risk factors. A key element of this Forum is the establishment of a 'clear definition on who the members should be, criteria for inclusion, admission, and rules for removal' [46]. In short, the Partners Forum represents a significant step forward in terms of reconciling the many ways in which that global health advocates – including private companies – express concern, but for reasons of fear, pride, or otherwise, fail to operationalise in the form of partnerships.

Moreover, it is clear from this example that the act of strategically communicating ideas about the social determinants of health is much more than just a one–way transfer of information. That some in global health see the private sector as a structural force to be resisted is the result of blaming a subset of actors that is not solely responsible for producing the current situation. Power is not something that actors automatically possess, the crucial point being that movements develop *within* communities, and not from the exploits of individual actors working in isolation [26]. In this regard, social structures ought not be understood not as monolithic forces to be resisted [47]. On the contrary, the process of advancing new normative commitments ought to be understood as a process of socialisation, through which boundaries between contested and shared ideas are debated, articulated, and redefined.

CONCLUSION

In conclusion, through the lens of Shiffman's political priority framework, we have sought to shed light on the factors that have relegated NCDs to the bottom of the agendas of governments and donors in global health. Our objective has not been to dictate what global health advocates should do in order to raise the priority of NCDs. Instead, we have attempted to elucidate the perceptions that have led to NCDs being ignored in the corridors of power. By deconstructing the attitudes, interests, and motivations of relevant national, international, and transnational actors in global health, we have sought to identify the ways in which these perceptions have been reproduced. This, in turn, enables advocates to communicate the causes and potential impacts of NCDs in a way that is sensitive to existing points of view.
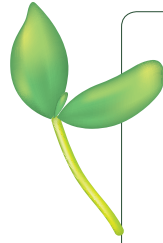
We support Shiffman's claim that strategic communication – or ideas in the form of issue portrayals – ought to be a core activity of global health policy communities. But issue portrayals must be the products of a robust and inclusive

debate. To this end, we also consider it essential to recognise that issue portrayals reach political leaders through a vast array of channels. This means acknowledging the role of actors, such as private entities whose intentions may not at first glance appear to be shared with the traditional members of a policy community, such as researchers, physicians, and NGOs. Raising the political priority of NCDs means engaging with the diverse ways in which actors express concern for the global proliferation of these diseases. In the case of the private sector, this means recognising that companies often choose to pursue both economic and social goals in an integrated manner. As we have argued, portrayals of NCDs have been hampered by dissonance between the ideas espoused by actors in the public, private, and civil society sectors; a prominent example of this being the polarisation of the debate over whether to label the global spread of NCDs an epidemic. Promoting dialogue between these actors is a crucial first step in terms of devising communication strategies that are likely to resonate and compel action.

More broadly, we have endeavoured to show the value of social constructionism as an approach to the study of social and political change. The following insight is most instructive: "*Persuasion is the process by which agent action becomes social structure, ideas become norms, and the subjective becomes the intersubjective*" [19]. Strategic portrayals of ideas thus constitute the practical equivalent of translating agent action into structure.

Indeed, this analysis opens up several avenues for further research. First, how have the frames used to portray NCDs varied over time? What criteria can we use to study the long–term success of issue portrayals, and how can we measure salience in the long–term? Second, this analysis also demonstrates the importance of studying unsuccessful attempts at attracting high–level attention for a given cause. In what ways have other neglected health problems been understood and portrayed? What commonalities do these portrayals share with those used by advocates for NCDs?

Ultimately, our political interactions amount to struggles for influence, and determining which issues to champion in the midst of these struggles – and which to disregard – is informed by subjectively held notions of the right, the good, and the just. Indeed, the very act of choosing which issues to prioritise in our daily lives forces us to evaluate our values and aspirations as individual agents against the shared values that structure the societies in which we live.

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Estimating the incidence of colorectal cancer in Sub–Saharan Africa: A systematic analysis

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Background Nearly two–thirds of annual mortality worldwide is attributable to non–communicable diseases (NCDs), with 70% estimated to occur in low– and middle–income countries (LMIC). Colorectal cancer (CRC) accounts for over 600 000 deaths annually, but data concerning cancer rates in LMIC is very poor. This study analyses the data available to produce an estimate of the incidence of colorectal cancer in Sub–Saharan Africa (SSA).

Methods Data for this analysis came from two main sources: a systematic search of Medline, EMBASE and Global Health which found 15 published data sets, and an additional 42 unpublished data sets which were sourced from the IARC and individual cancer registries. Data for case rates by age and sex, as well as population denominators were extracted and analysed to produce an estimate of incidence.

Results: The crude incidence of CRC in SSA for both sexes was found to be 4.04 per 100 000 population (4.38 for men and 3.69 for women). Incidence increased with age with the highest rates in Southern Africa, particularly in South Africa. The rates of CRC in SSA were much lower than those reported for high–income countries.

Conclusion Few health services in SSA are equipped to provide timely diagnosis and treatment of cancer in SSA. In addition, data collection systems are weak, meaning that the available statistics may underestimate the burden of disease. In order to improve health care services it is vital that accurate measurements of disease burden are available to policy makers.

In 2008 cancer was the leading cause of mortality worldwide, responsible for the deaths of an estimated 7.6 million people [1]. Colorectal cancer (CRC) accounted for over 600 000 of those deaths, with 70% occurring in low– and middle–income countries [1,2]. With the emergence of non–communicable diseases (NCD) in countries where traditionally the biggest problem were infections, it is estimated that, by 2030, cancer will become the cause of over 13 million deaths a year [3]. While rates of infectious diseases typically decrease with the economic growth of a country, rates of NCD do not appear to decrease until high levels of education and lit-

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eracy are reached [2]. The increasing prevalence of NCD is also having serious economic impact on health systems around the world, with the cost of long–term treatment for chronic conditions unsustainable in many health systems [3]. NCDs are heavily involved in the vicious cycle of health and poverty, where poor health results in loss of income, which in turn results in inability to pay for health care or maintain a healthy lifestyle [4]. Many NCDs result in chronic conditions requiring long–term medical expenditures and ongoing loss of income owing to ill health [5].

Low– and middle–income countries (LMICs) carry the majority of the burden of NCDs both in terms of incidence and mortality [6]. The rates of cancer are dramatically increasing partly because of the ageing population, and partly due to the rapid 'globalisation' and the adoption of the associated risk factors within these populations [7]. These risk factors include physical inactivity, smoking and alcohol consumption and poor nutrition [8]. A recent study found that over half of people aged 50 or over in SSA possessed at least 2 of the risk factors associated with NCDs [7].

Cancer registries cover less than 25% of the world's population. It is estimated that this proportion would reduce to 11% if only data of good quality is included [8]. The WHO collects data on cancer deaths from cancer registries around the world (**Box 1**) and produces estimates of the global and regional burden of cancer [14]. The International Agency for Research on Cancer (IARC) also publishes sets of estimates of global incidence and mortality through the GLOBOCAN project, the most recent from 2008 [15]. This data indicates that colorectal cancer (CRC) is the 5th most common cancer in SSA [15].

Although the reliability of the information provided in cancer registries, especially in SSA, is open to question, the registries remain one of the very few sources of data on cancer and therefore are the closest we can get to an estimate of the burden [8]. The size of the population denominator and the accuracy of the data can vary greatly between these sources, with only 23 of the 47 SSA countries having a formal registration system for cancer [16]. Many of these registries only cover small regions, often cities, within a country. Typically, the few rural registries indicate a much lower incidence of cancer than urban registries. Given that the majority of accessible data comes from urban registries, where only 40% of the population live and with higher risk factors, the estimates may be exaggerated [17] or gravely under–representative of rural areas.

Although the number of cases of CRC in SSA is thought to be very low in comparison to those diagnosed in the Western world (**Box 2**), it constitutes a significant proportion of the cancers in this region [24]. The aims of this study were to contribute to improving the evidence on the burden or NCDs in LMICs, by reviewing the evidence from

Box 1 Non–communicable diseases and the global health agenda

> In recent decades the focus of international health organisations for the developing world has been communicable diseases. As a result huge sums of money and political attention have been dedicated specifically to HIV/AIDS, malaria and tuberculosis. However, NCD are now a significant barrier to reaching some of the Millennium Development Goals (MDGs), which focus primarily on reducing infectious diseases [5].
>
> In 2000, the resolution "Prevention and Control on Non–Communicable Diseases" was adopted by WHO member states at the World Health Assembly [9]. This resolution had three main aims:
>
> 1. Examine the major risk factors associated with NCDs
> 2. Introduce health promotion programs aiming to minimise the risk factors
> 3. Improve access to health care
>
> Since this initial commitment to reducing the burden of disease caused by NCDs the World Health Assembly has also endorsed the Global Strategy on Diet and Physical Activity and Health [10,11], and the Framework Convention for Tobacco Control [12].
>
> The UN high–level meeting on non–communicable diseases in 2011 recognised four major conditions that had previously been neglected by the international health community; cardiovascular disease, chronic respiratory diseases, diabetes and cancer [4,13].

the published literature (found through systematic review) and unpublished data on cancer registries to assess the burden of CRC in SSA. We also aimed to explore the quality and availability of data and to make suggestions for research and public health policy priorities to improve control of CRC in SSA.

METHODS

The data in this review came from cancer registries, and were identified through two main sources – a systematic review of the published literature and an analysis of the unpublished cancer registry data, as shown in **Figure 1**.

Search strategy for systematic analysis and data extraction

A systematic analysis of published literature on public domain was carried out using the databases Medline, Embase and Global Health. The search used both Medical Subject Headings (MeSH) and keywords as well as the individual countries in Sub–Saharan Africa. Search terms for Medline are outlined in **Table 1** and were modified where necessary for the other databases. Final searches were completed on 13 January 2012. All references found in the initial searches were exported to Refworks.

Box 2 Colorectal cancer and public health

Commonly CRC develops from adenomatous, colonic polyps with 65% in the rectosigmoid and 15% in the ascending colon or caecum [18]. Spread of the cancer is typically through the bowel wall and, in cases of rectal carcinoma, may invade the abdominal walls or pelvic viscera. Lymphatic invasion through the systemic or portal circulation is common with the liver and lungs as secondary sites [19]. The progression from adenoma to carcinoma is a well–documented process involving mutations in a number of genes such as APC (adenomatous polyposis coli), DCC, k–ras and p53 [18,20].

Approximately 80% of CRC is caused by environmental factors such as physical inactivity, smoking, alcohol and poor diet [21]. Nutrition is thought to be a major contributing factor to the differences in incidence of CRC between developing and developed countries. Western diets, typically high in fibre, increase faecal bulk, reducing transit time and resulting in a higher risk of developing malignancy [21]. The other 10% of CRC is caused by genetic mutations in two major pathways resulting in familial adenomatous polyposis (FAP) or hereditary non–polyposis colon cancer (HNPCC). Individuals with these diseases have a lifetime risk of CRC of up to 80% [21].

Screening for CRC is known to not only help detect the cancer in its early stages, and therefore improve chances of a curative treatment, but also to detect pre–cancerous lesions which, if removed successfully, can avoid more expensive and radical treatments [22]. Colorectal adenomas/polyps are extremely common in the Western world, occurring in approximately 20% of people over the age of 60 [21]. In the UK a national screening programmes for CRC have been launched, targeting those in the 50–74 age group. It is estimated that these interventions have resulted in a 16% reduction of mortality caused by CRC [23].
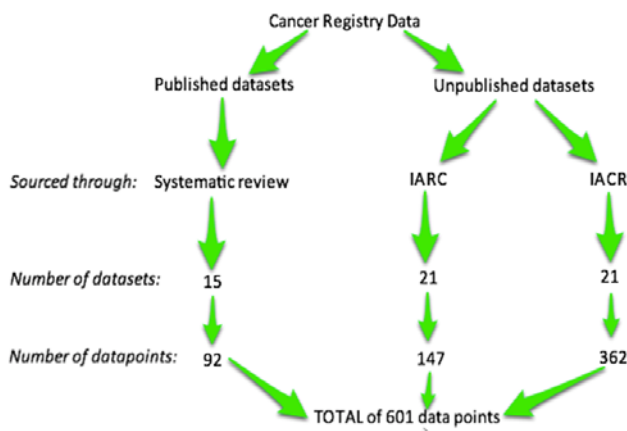

Figure 1 Sources of data.

Table 1 Search terms

1	prevalence/ or prevalen*.tw
2	mortality/ or mortal*.tw
3	global burden of disease/ or (disease adj3 burden*).tw
4	incidence/ or inciden*.tw
5	1 or 2 or 3 or 4
6	colorectal adenoma/ or CRC/ or colon cancer/ or rectum cancer/ or colorectal carcinoma/ or colorectal disease/
7	(bowel* or large intestine* or large bowel* or gut* or colorect* or colo* or rect*) adj3 maligna* or carcinoma* or neoplas* or cancer* or tumo* or polyp*).tw
8	6 or 7
9	SSA/ or (Africa* adj3 Sub–Sahara*).tw or (Africa* adj3 south* adj3 Sahara*).tw
10	exp Africa or central/ or exp Cameroon/ or exp Central African Republic/ or exp Chad/ or exp Congo/ or exp "Democratic Republic of the Congo"/ or exp Equatorial Guinea/ or exp Gabon/ or exp Africa, Eastern/ or exp Burundi/ or exp Djibouti/ or exp Eritrea/ or exp Ethiopia/ or exp Kenya/ or exp Rwanda/ or exp Somalia/ or exp Sudan/ or exp Tanzania/ or exp Uganda/ or exp Africa, Southern/ or exp Angola/ or exp Botswana/ or exp Lesotho/ or exp Malawi/ or exp Mozambique/ or exp Namibia/ or exp South Africa/ or exp Swaziland/ or exp Zambia/ or exp Zimbabwe/ or exp Africa, Western/ or exp Benin/ or exp Burkina Faso/ or exp Cape Verde/ or exp Cote D'Ivoire/ or exp Gambia/ or exp Ghana/ or exp Guinea/ or exp Guinea-Bissau/ or exp Liberia/ or exp Mali/ or exp Mauritania/ or exp Niger/ or exp Nigeria/ or exp Senegal/ or exp Sierra Leone/ or exp Togo/ or exp Comoros/ or exp Madagascar/ or exp Mauritius/ or exp Seychelles
11	9 or 10
12	5 and 8 and 11
13	Limit 13 to yr = 1980-current

The selection criteria used in screening relevant studies were: original studies, limited to post–1980, conducted in Sub–Saharan Africa as defined by the World Bank [25], involving any age–group or sex, with no restrictions on the language of publication. The retained studies were further evaluated for quality of design and methods; studies with clear case definition of CRC, a population denominator of more than 10 000, and numerical measure of disease frequency were included.

Given that the systematic review produced a limited number of relevant papers, we decided to search for other potential sources of information on CRC in SSA. It was predicted that many of the cancer registries in SSA might hold unpublished or more recent data that could be obtained through methods other than systematic review. The IARC Web site provided access to an unpublished document pre-

senting the data from cancer registries across SSA. Further review of this paper showed that some of the data had already been used in published articles found through the systematic search. However, there were an additional 21 data sets that met the criteria for this review. Permission to use this further data for analysis in this review was sought from the IARC through the World Health Organization (WHO). This was granted and is presented in Online Sup-

plementary Document, where a sample of the data extracted from this IARC paper is also shown.

Contact details for the directors of cancer registries in SSA were provided on the IACR Web site [16]; they were contacted to investigate whether they had any unpublished data that could be included with permission. Of the 23 directors contacted, 11 replied. Two replies directed attention to the IARC document, mentioned above, that had the most recent data for their registries. Seven of the replies, although positive and encouraging, provided no additional data. The reply from Botswana contained data for CRC from 1998 to 2011. The reply from the South African national cancer registry provided details of their Web site which had extensive information on cases of CRC between 2000 and 2004 and population data for 2000–2002. Population estimates for 2003 and 2004 were obtained through the South African government statistics Web site [26]. This second additional source provided the current review with a further 21 datasets. Examples of the data received directly from cancer registries are presented in the Online Supplementary Document. Owing to the extensive data available for South Africa a separate analysis was carried out investigating incidence trends over a 5–year period for different racial groups [27-31]. All the unpublished cancer registry data, both from the IARC and the IACR, was screened using the same selection criteria employed in the systematic literature search to ensure that the data was of comparable quality.

The initial search of Medline, Embase and Global Health databases returned 3127 articles, after the removal of duplicates, as shown in **Figure 2**. Sixty–five articles were sourced for the full–text version, and of these, 15 were selected for inclusion in the review. The 50 articles considered irrelevant did not comply with the exclusion/inclusion criteria set for this review; however, some were retained for extra information, mainly in the discussion. The 15 relevant articles [10,20,32-42] were then supplemented by the 21 data sets secured with permission from the IARC [43,44] and the further 21 data sets which were received from the directors of the cancer registries through the IACR [16]. Six articles, which were not suitable for contribution to the estimates of incidence but were sourced for full–text copies, were retained for information on the biological characteristics of CRC diagnosed in SSA. Data from the articles was extracted and complied into spreadsheets in Microsoft Excel. Cases of CRC were separated into age groups and by sex where appropriate. Incidence estimates were either extracted from the included data sets or calculated using the data reported. All estimates were converted to incidence per 100 000 of population (in that sex and age group) per year to allow for direct comparison between results. Data from 6 additional articles, not used for calculating incidence, were extracted for more detailed information on the biological characteristics of CRC.

Case definition used in retained studies

The different definitions of CRC cancer used in the data sets are presented in **Figure 3**. The majority defined it based on the current International Classification of Diseases (ICD–10), as devised by the World Health Organisation [45]. Five data sets, the ones typically undertaken in the 1980s and early 1990s, defined CRC based on the earlier ICD–9. The remaining data sets (labelled 'other' in **Figure 3**) took retrospective data from cancer registries and did not give a specific definition of CRC. However, 20 of these came from the South Africa Cancer Registry and it would be reasonable to assume they may have used ICD–10. The International Classification of Diseases for Oncology (ICD–O) was also used in the diagnosis of CRC for nearly 60% of the data sets, with five using the 1st edition (ICD–O–1) and 28 using the 2nd edition (ICD–O–2).
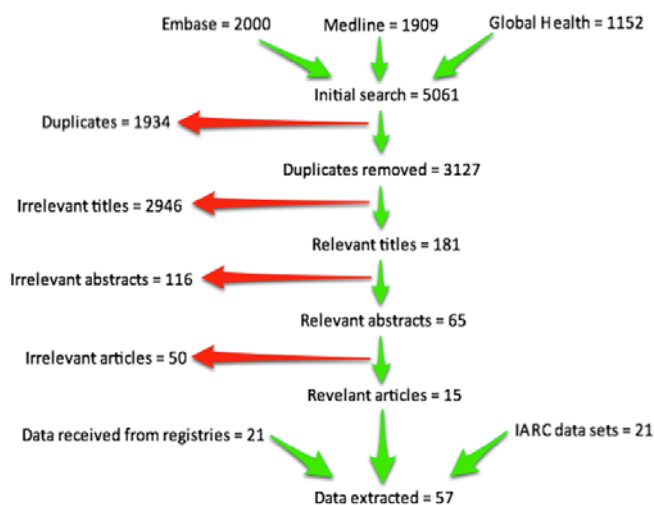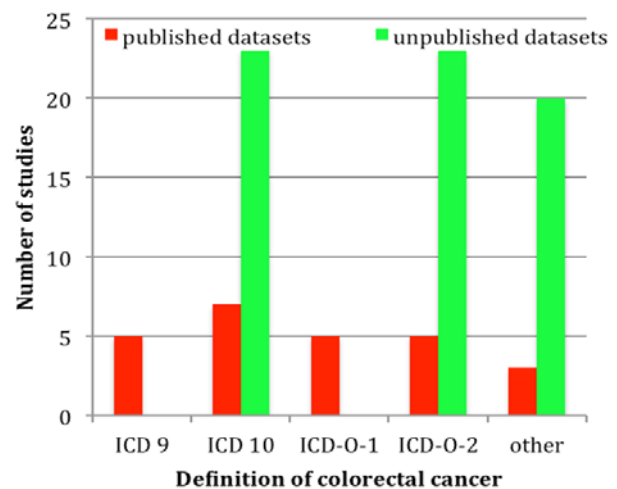

Figure 2 Search strategy.

Figure 3 Definition of colorectal cancer in data sets. ICD – International Classification of Diseases (World Health Organisation).

Data analysis

There were a total of 57 data sets available from the published articles (identified by the systematic review) and the unpublished data from the cancer registries. This provided a total of 601 datapoints for the calculation of incidence. In this pooled series, 28 data sets contained statistics for the population of the area covered by the registry separated by age and sex. They also gave the raw data on the number of cases of CRC diagnosed over in given time period, also separated by age and sex. This allowed for a simple calculation of the incidence for each sex and age group. Five of the data sets did not contain information on the population denominator for each age group. In these cases the total population was either cited or could be calculated by working back from the reported incidence and cases of CRC. This number was then separated into age groups using total population data for the relevant year and country and adjusted to the size of the study population.

In 3 data sets which neither presented the population denominator, nor showed the number of cases of CRC by age group, the average age of the population (separated by sex) was calculated using UN ESA data for the relevant year and country [46]. This was then combined with the overall reported incidence of CRC by sex, calculated using the above method. A few data sets presented the number of cases separately for colon and rectal cancer. However, data for the two were combined to allow for easier comparison with other data sets. Tables were compiled using Microsoft Excel and contained all the information extracted from the data sets (see Online Supplementary Document for further details).

The average age was calculated as the mean age of each age range as reported in the data sets. This resulted in a total of 601 data points of incidence against age, separated by sex. Graphs containing the 601 data points of incidence by age for male, female and both sexes were used to separate incidence estimates into age groups. The age ranges were based on the groups used by the data sets from the IARC. From this, the minimum, maximum, lower quartile, upper quartile and median could be calculated for each age group. This data was used to create box–and–whiskers plots of the collected information. The median values of incidence by age group were then combined with the UN ESA statistics for the total population of SSA to calculate the number of new cases in a year. Examples of this are presented in Online Supplementary Document along with the all–age data that were calculated by each data set.

Moreover, twenty data sets from the South African cancer registry were used to conduct a separate sub–analysis of time trends in incidence of CRC in South Africa from 2000 to 2004. These papers also provided valuable data on the relationship between ethnic group and incidence of CRC.

Furthermore, data from 6 articles excluded from the systematic review nevertheless had useful background information on three aspects of CRC: presenting symptoms, anatomical site of tumour and Duke's Stage of cancer at diagnosis. These papers provided percentage distributions, from which the averages could be calculated.

To ensure that the data was extracted accurately from both the published and unpublished data sets, one author (AG) performed a second data extraction on a random selection of 8 data sets. The number of cases of CRC as well as the underlying population denominator was extracted again. This represented 112 of the total 601 data points, and found that 100% of the data was the same. Therefore it was concluded that the accuracy of the data extraction was high.

RESULTS

The data sets showed a wide geographical distribution in SSA, as shown in **Figure 4**. Approximately 5% of data sets came from Central Africa, and 15%, 55% and 25% from West, Southern and East Africa respectively. However, clusters of data sets came from larger cities or countries known to conduct high levels of research. All data sets reported cancers from all age groups. The average size of the population denominator covered by the cancer registries was approximately 2 million. Ninety percent of the data sets reported data from population–based cancer registries, the remaining six were hospital–based. Some of the national cancer registries combined data from regional hospitals and smaller registries across the country. **Figure 5** shows the distribution of active data sets over time. The majority were
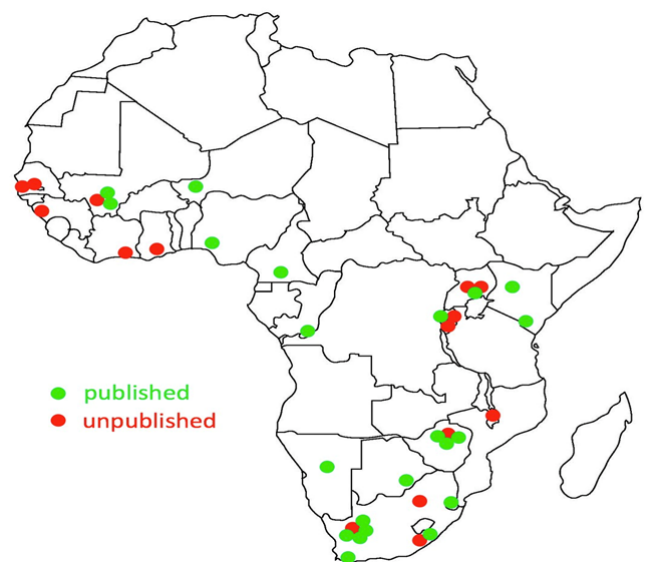

Figure 4 Geographical distribution of data sets. Additional 20 unpublished data sets came from South African Cancer Registry (not shown).
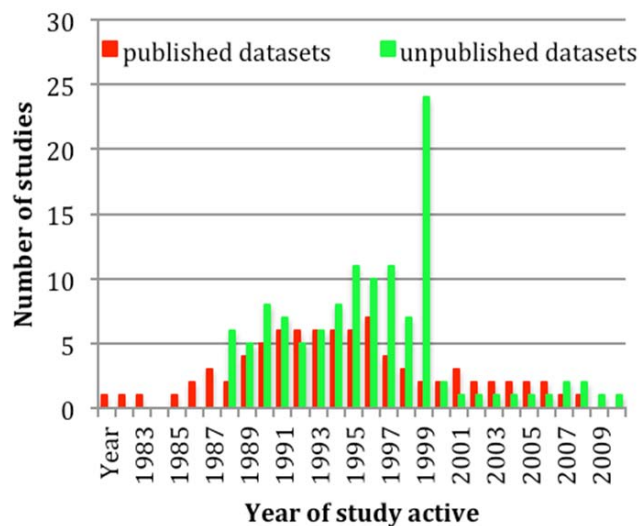
Figure 5 Active data sets active in study years.

conducted in the late 1990s to early 2000s with very little data available for the 1980s and a limited number from the last decade. As a result, any estimates produced by this review should be regarded as referring to 2000.

Incidence of CRC in Sub–Saharan Africa

Figure 6 show the distribution of incidence by age, calculated from all 57 data sets, producing 601 data points. The age–related distribution of incidence shows the predicted pattern, based on the biology of CRC, of substantial increase with age. It can also be noted that the calculated incidences are much higher in males than females. There were large variations in reported all–age incidence, owing to CRC being predominantly a disease of the elderly. As such, incidences were separated into age groups that were decided based on the ranges used by the primary data sources. They were selected to ensure that the majority of data points were the median in the ranges chosen. **Figure 7** shows the box–and–whisker plots produced from allocating the individual data points into age groups. The values used for these graphs are presented in Online Supplementary Document. The median values of incidence for males, females and both sexes by age group are shown in **Table 2**. As expected, the incidence increases with age, with the incidence in people below 35 years being negligible. Again, it is also evident that the incidence of CRC is significantly higher in males than females.

Figure 8 shows the crude incidence of CRC in SSA by African sub–regions. The data used for these figures are presented in Online Supplementary Document. The crude incidence of CRC in SSA was found to be 4.04 cases per 100 000 population. This incidence was significantly higher in Southern Africa, which is discussed later in the text. The median incidence values calculated in **Table 2** were
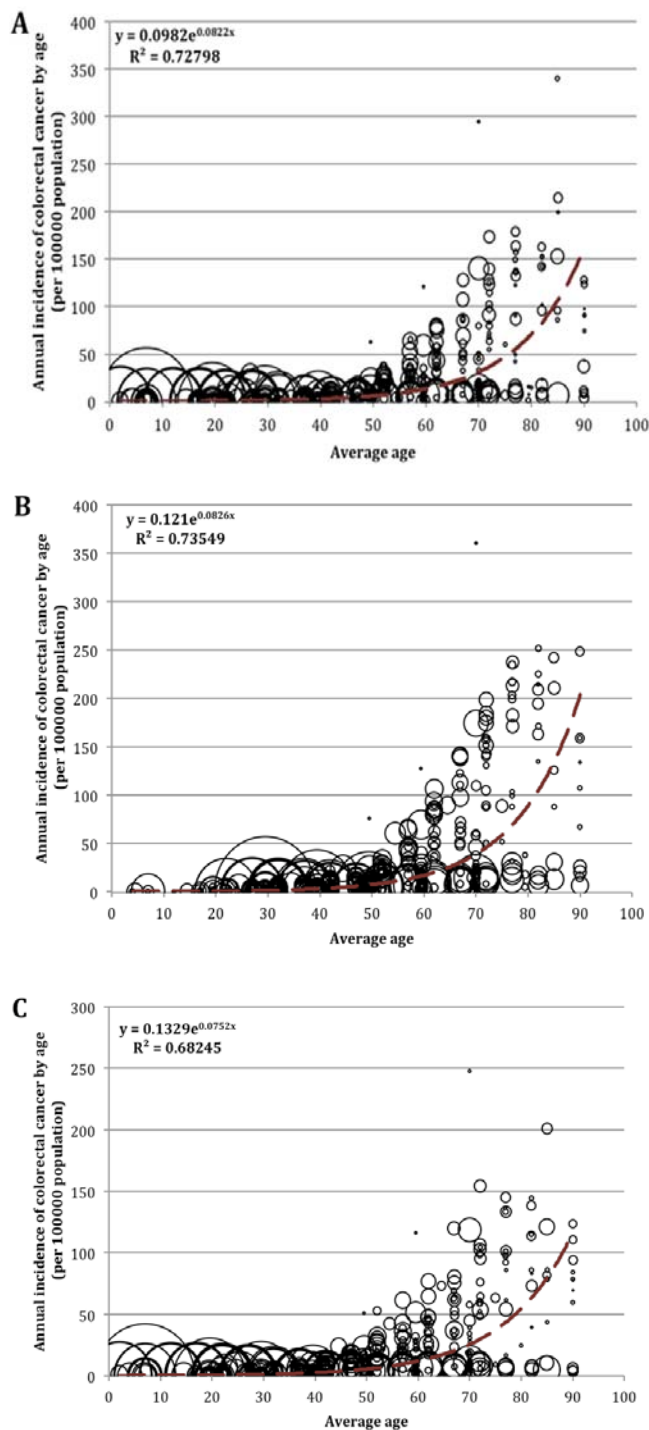
Figure 6 Incidence of colorectal cancer by age groups for both sexes (**A**), men (**B**) and women (**C**).

Table 2 Crude annual incidence of colorectal cancer in Sub–Saharan Africa (per 100 000 population)

	Age (years)							
	0–14	15–24	25–34	35–44	45–54	55–64	65–74	75+
Both sexes	0.00	0.26	1.15	3.48	8.72	22.11	34.37	86.87
Men	0.00	0.31	1.22	3.40	8.84	21.13	37.00	103.48
Women	0.00	0.10	0.91	2.91	8.09	15.65	23.48	71.36

Figure 8 Annual crude incidence of colorectal cancer by African sub–region (per 100000 population).

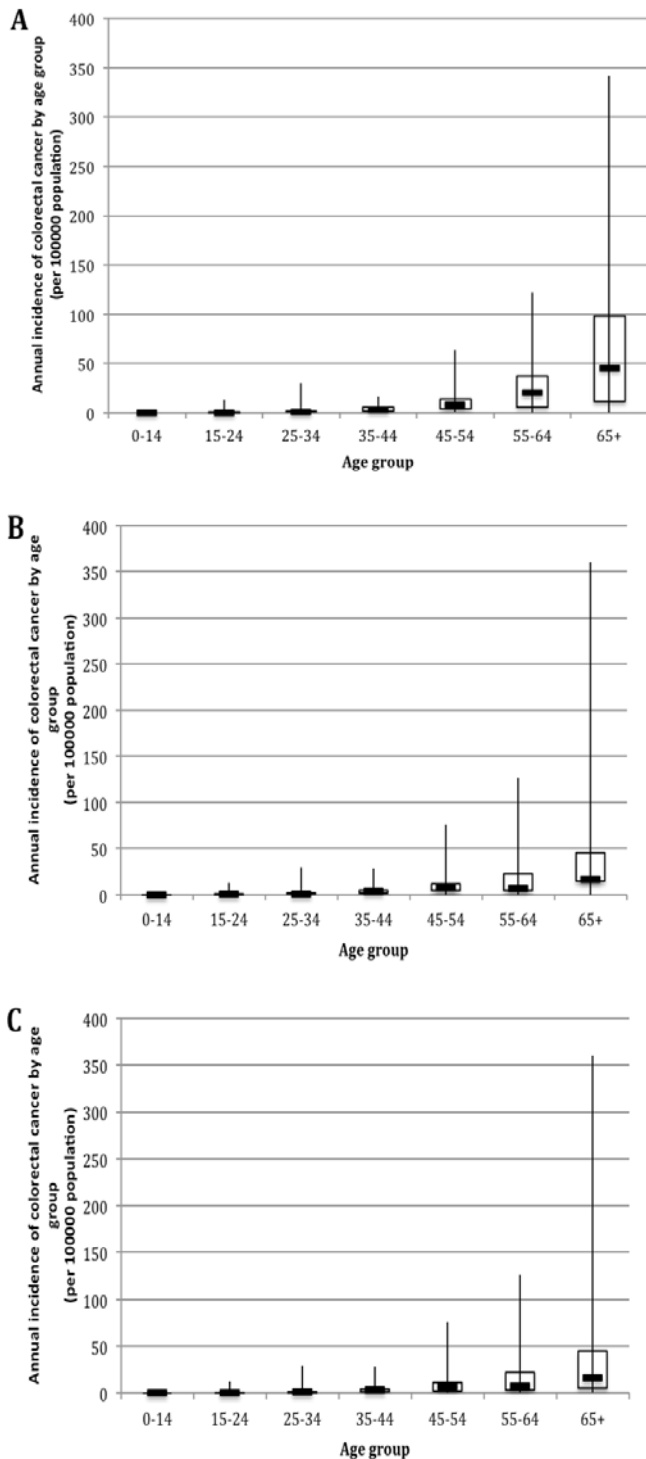**Figure 7** Crude incidence of colorectal cancer by age group for both sexes (**A**), men (**B**) and women (**C**).

combined with the UN ESA 2000 estimates for SSA. This produced **Table 3** showing the estimated number of new cases of CRC reported in that year. The reason for using the 2000 population data are considered in the discussion section of this review. It is apparent that the majority of diagnoses of CRC occur in age groups older than 55 years, again with CRC more frequent in males than females. **Table 4**
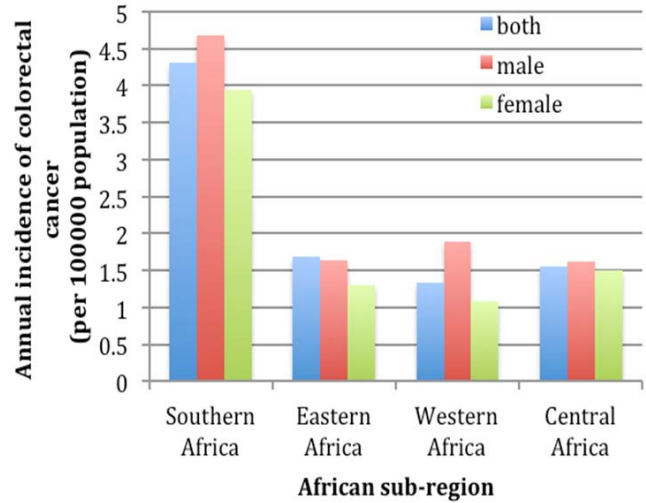
shows a comparison of the estimates produced by this review and those from GLOBOCAN [44]. The estimates are very similar, with the minor difference perhaps explained by the predicted year of the estimates; this will be discussed later in this review.

Subsidiary information

Owing to the high standard of data available from the South African Cancer Registry for 2000–2004, a separate analysis was carried out to assess the relationship between incidence of CRC and ethnicity over time (**Figure 9**). Although the data refers to a relatively short time period, the differences in incidence between different ethnic groups can be observed very clearly. Two of the data sets in this review, with further six found through the systematic review, contained information on the nature of the cases of CRC diagnosed in SSA. Five papers contained information on the

Table 3 Annual number new cases of colorectal cancer in Sub–Saharan Africa in 2000

	Age (years)							
	0–14	15–24	25–34	35–44	45–54	55–64	65–74	75+
Both sexes	0	456	1428	2791	4651	7808	6732	1099
Men	0	267	762	1371	2294	3514	3321	3069
Women	0	67	565	1158	2216	2922	2492	1575

Table 4 Comparison of estimates of annual new cases of colorectal cancer in Sub–Saharan Africa

	Current review's estimate	GLOBOCAN estimate
Both sexes	23 147	24 711
Men	11 300	13 666
Women	9536	11 045

GLOBOCAN – WHO project to provide contemporary estimates of the incidence of, mortality, prevalence and disability-adjusted life years (DALYs) from major type of cancers, at national level, for 184 countries of the world.
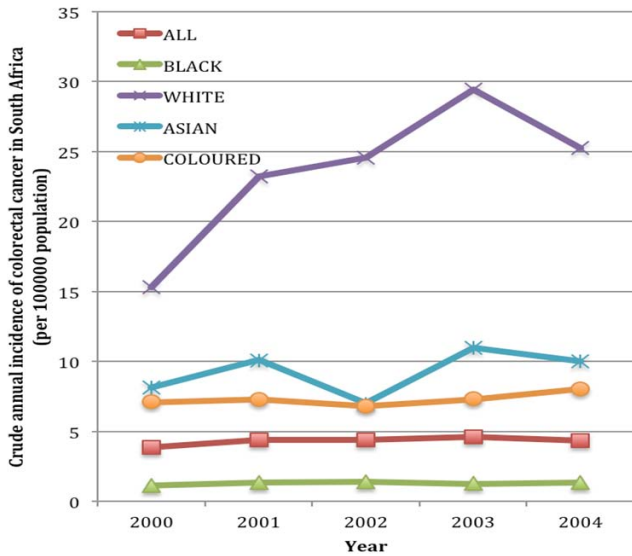
Figure 9 Crude incidence of colorectal cancer in South Africa (per 100 000 population) by ethnicity for 2000–2004.

anatomical sub–site of CRC, and the findings are presented in **Figure 10**. Although the percentage of cases in each anatomical location varied between the papers, all reported the rectum as the most common site, with one paper reporting this to include as high as 60% of cases. Data regarding the symptoms at presentation were obtained from five papers, shown in **Figure 11**. The most common presenting symptom was found to be bloody stool with nearly 57% of patients reporting this. It must be remembered that some patients may have recognised more than one of the symptoms listed. In addition, some patients may not have noticed less dramatic symptoms, such as altered bowel movements, until prompted by a medical professional. **Figure 12** presents information from four papers that contained data on the Duke's Stage of the case of CRC diagnosed. It can clearly be seen that the majority of cases were diagnosed at Stage B, with very few at the first or last stage.
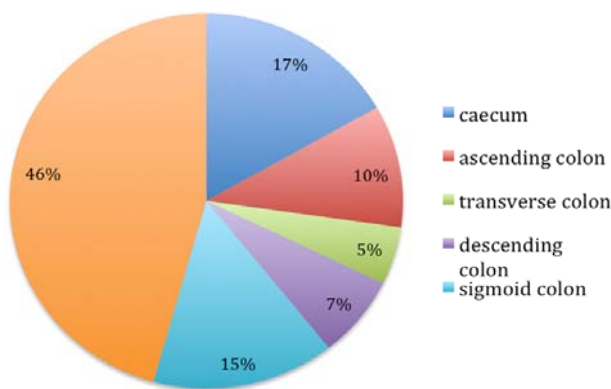

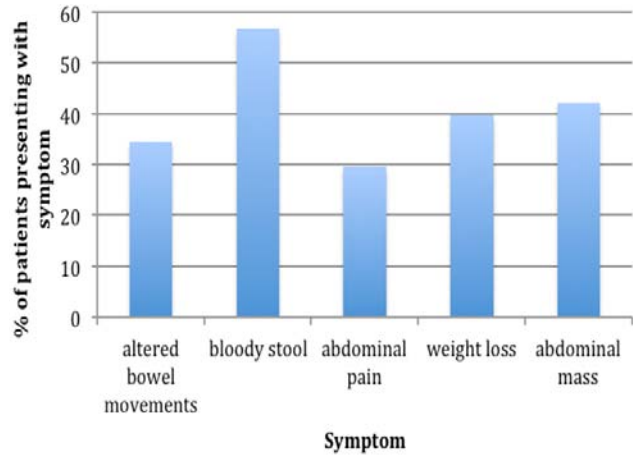**Figure 10** Colorectal cancer by anatomical tumour site.

Figure 11 Presenting symptoms in colorectal cancer.
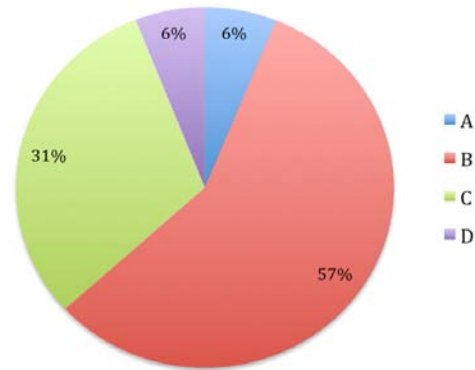

Figure 12 Duke's staging of the colorectal cancer.

DISCUSSION

This study found the incidence of CRC in SSA to be higher in males than females with the peak in the 75+ age group and a crude incidence of 4.04 per 100 000 population. On the basis of the incidence calculated by this review, it was estimated that there were about 23 000 new cases of CRC in 2000, with nearly 59% occurring in males. Based on the available evidence, the incidence of CRC in SSA appears to be much lower than in high–income countries. However, the trends associated with sex and age were very similar. The male:female ratio in the UK is estimated to be 1.26 while this review estimated the SSA ratio to be 1.19 [47]. One of the greatest concerns related to these overall conclusions may be that the incidence of CRC in Africa is systematically under–reported and that it is generally of poorer quality than in high income countries. However, the data from South Africa in the years 2000–2004 provide the best available evidence that the overall conclusions are likely to be true. This is because South Africa has registries of the highest qualities and its diverse demographic structure offers a direct comparison of the rates in different ethnic pop-

ulations. In South Africa, incidence is highest in whites, followed by the Asian and then coloured populations, with blacks having the lowest reported incidence [27-31].

This review also found that the major anatomical site of CRC was the rectum (in 46% of cases), followed by the caecum (17%). These trends are fairly similar to those found in the Western world. A study looking at anatomical sub–site of CRC in Europe found the most common sites to be rectum (31%), sigmoid colon (21%) and caecum (10%) [48]. Although the presenting symptoms reported by papers in this review were not very different from those elsewhere in the world, the signs associated with the more advanced stages of the disease, such as rectal bleeding, appear to be more common [49]. Moreover, this review found that a majority (57%) of cases of CRC were at Duke's Stage B at diagnosis, with very few cases being found at the most treatable Stage A. This does not support concerns that in Africa, because of less developed and less efficient health systems, cancer would generally be diagnosed at a later stage – at least it is not true for CRC and in registries that likely over-represent urban areas. However, this may also be due to lack of expert knowledge of the condition, leading to incorrect staging of tumours. This highlights the need for further research into this area in order to improve public health service provision.

In terms of the quality of primary data used in this study, there were two main sources of potential limitation: incomplete data and systematic bias. Although the problem of incomplete data was only encountered in 9 of the 57 data sets, it should not have affected the overall conclusions. Twenty–one of those data sets were obtained from direct contact with cancer registries in SSA. This review should not be affected by a major language bias, as data sets have been retrieved in all major languages used in Africa, including French and Dutch. It is also unlikely that this review is limited by the conventional form of publication bias, as unpublished registry data was also included. It is important to note that the latter may provide more recent data than that from published papers owing to the usual delay in the release of articles. The majority of data sets eligible for inclusion in this review contained data from the late 1990s and early 2000s. As such, any estimates produced by this review essentially refer to a mid–point of the year 2000, and are based on the correct population denominator from UN ESA. This was the best estimate that could be produced with the data available However, it is recognised that rates of NCDs are increasing in the developing world and therefore the estimates for 2000 are likely to be lower than the true current level.

This review made a comparison between the estimated number of new cases of CRC in Africa and estimates produced by GLOBOCAN [44]. Although it appears that this review underestimates the incidence in comparison to GLOBOCAN, it should be noted that there is an 8–year difference, with GLOBOCAN reporting the estimates for the year 2008. However, a short analysis of the data sources used by GLOBOCAN found that the majority of their data points also came from the 1990s. This probably explains the great similarity between the two estimates, which are very supportive of each other. However, because this review uses the same primary data with an additional 36 data sets it could be viewed as more comprehensive.

Finally, this review used information from 57 mutually exclusive cancer registry data sets, 15 of which came from articles published in peer–reviewed journals and 42 from unpublished data sources. The assumption is that the peer–reviewed articles would be of a higher quality so it was important to explore differentiating incidence across these two sources in a simple sensitivity analysis. The results are presented in **Table 5**. Although there are modest differences in incidence, this is partly driven by the inclusion of the South African data sets. The difference in incidence between published and unpublished data sets was significantly lower with the exclusion of South African data from both.

In terms of the validity and reliability of case definitions used to measure the frequency of CRC in the population in Africa, the current National Institute for Clinical Excellence (NICE) provides clinical guidelines that recommend the use of colonoscopy, biopsy, sigmoidoscopy, CT scan and barium enema in the diagnosis of CRC [50]. However, in many resource–poor settings, such as those found in a number of SSA countries, such extensive diagnostic tests are not feasible. Many registries only document histologically–diagnosed cancers, but even this is lacking in some areas [51]. This may result in the number of cases of CRC being underestimated in some settings. Another possible point of concern comes from the notion that some data sets included in this review did not specify whether ICD or another classification system was used as their case definition. Earlier versions of the ICD that preceded ICD–10 were recognized to be less specific [52]. This concern should be noted in regard to interpreting any fluctuations in the reports from cancer registries that were active over a long period of time. It is estimated that only 1% of the population of Africa are covered by cancer registries [53]. With limited resources and critically low numbers of health workers, the imple-

Table 5 Sensitivity analysis of published vs unpublished data sets

	Crude incidence of CRC/100 000 population	
	Published data sets	Unpublished data sets
With South Africa	1.11	4.28
Without South Africa	1.07	2.05

mentation of a cancer registry has not been seen as a priority in tackling the burden of disease in many countries. However, accurate measurement of diseases is vital in achieving effective and efficient intervention programs [54].

Although data for 19 different countries in SSA was obtained, over 75% of the data points came from countries in Southern and Eastern Africa. These regions were found to have the highest incidences of CRC. Given that the majority of these data sets came from South Africa and Zimbabwe, it is important to recognise the differences in the population of these countries in comparison to the rest of SSA. These two countries had the highest incidence of CRC of the countries studied. South African law previously segregated its people into 4 ethnic categories; "Black", "Coloured" (mixed–race), "White" and "Asian/Indian". Although this law was abolished over 10 years ago, much of the population still identify themselves based on these groups and many epidemiology studies still separate the population in this way [55]. This can still be seen as evident in the data provided by the South African Cancer Registry for 2000–2004. Similarly, the data sets from Zimbabwe also separate their population into "African" and "European". This separation between ethnic groups allows for comparison between the groups, especially given the well–documented variation in incidence of CRC between white and black populations, which is consistently shown to be substantial.

South Africa is also known to have the highest numbers of people infected with HIV/AIDS of any country in Sub–Saharan Africa [56]. There is evidence to suggest an increased risk of developing CRC amongst HIV/AIDS infected populations, however the biological mechanism behind this is still poorly understood [57]. Karposi's sarcoma is strongly associated with HIV/AIDS infection and there are documented cases of involvement of the colorectum [58,59]. It is also possible that this may account for the higher incidence of CRC in South Africa. However, countries like Swaziland and Botswana, with higher percentages of HIV/AIDS infected populations had much lower incidence of CRC.

Ideally, cancer registries should be population–based, however, in developing countries, this is often not possible. Problems such as the limited health system infrastructure and cultural and religious obstacles in the reporting of diseases like cancer have contributed to the lack of routine data collection [54]. The alternative option of data collection through a hospital–based registry is better than no registry at all. This type of data will only cover people who have presented and been recognised as symptomatic at a local health facility, have been referred to centres where there are cancer services, and who can access these health care facilities, both physically and financially. However, it can still provide valuable information on cancer, particu-

larly if adjustments can be made for selection biases in the population using the hospital. Because of this triaging system from primary to secondary care, those seeking medical attention are likely to be from higher socioeconomic backgrounds with higher levels of education and a greater awareness of the risk factors for developing diseases such as cancer. However, these people are also more likely to live a 'Westernised' lifestyle; increasing their risk of developing CRC. Hospital–based studies are also often based in urban areas where the risk profile is very different to those people living in rural areas. This highlights the need for national, population–based studies or more sophisticated data adjustments to ensure that any estimates produced are an accurate representation of the whole country.

To illustrate the difference between hospital–based and population–based cancer registries, a comparison of the crude incidence of CRC (per 100 000 population) is presented in **Figure 13**. Again, ideally a more sophisticated sub–group analysis would be undertaken to account for the influence of this apparent difference. Adjustments should be made allowing for the differences in the source of the data (published/unpublished), geographical coverage (particularly with reference to the dominance of South Africa) and the ethnic group of patients.

In many urban areas of SSA, there has been an increase in health risk behaviours associated with CRC, such as smoking, decreased physical activity, alcohol consumption and poor diet. There is also evidence of the increase in the health consequences of these behaviours, in terms of increased rates of obesity, diabetes and hypertension [51]. It is important that health education programs are set up to enable people to be more aware of the consequences of these unhealthy behaviours. Prevention is a more cost–effective and
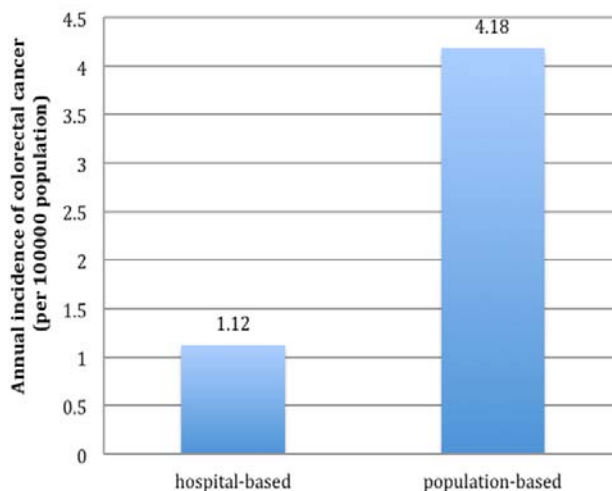

Figure 13 Comparison of incidence of colorectal cancer (per 100 000 population) in sub–Saharan Africa between hospital–based and population–based cancer registries.
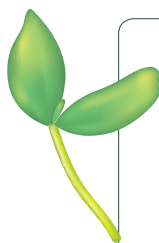
long–term solution to dealing with the burden of cancer than treating the cases once diagnosed [60,61]. Although screening for CRC is thought to be cost–effective in high–income countries, whether this is the case in LMICs is debated. Implementing a screening program for CRC requires the purchase and maintenance of expensive equipment, skilled specialists and education of the public to maximise utilisation. Lambert et al. argue that this is not feasible in resource–poor settings like SSA [62]. However, with more accurate data from population–based studies it may be that the burden of disease attributable to CRC is greater than first thought. In this case, screening programmes, particularly if they are linked to a more generic family health programme engaging both men and women, may be a more cost-effective option to treating more advanced cancers.

In low–resource countries the national budget devoted to health systems is extremely low and as a consequence the public health service provision can be very weak [63]. This has led to the treatment options for patients with all forms of cancer including CRC in SSA being severely limited in comparison to patients in the Western world. For instance, a surgical procedure commonly performed in high–income world as a treatment, such as resection, was noted to only be attempted in very few countries that have specialist cancer hospitals and only in cases where the patients themselves were able to afford the cost of the procedure [24]. Cultural factors are also relevant to the acceptance of treatment, with some patients refusing to undergo surgery because of fear that a colostomy could result in rejection from their community [24,49]. It is estimated that only 18% of the need for radiation treatment in cancer patients is met in Africa as a whole, and this is likely to be even lower in the Sub–Saharan region [64]. Delays in seeking medical attention mean that for many patients with advanced stage of cancers palliative treatment was the only available option [49]. Follow–up of patients in all clinical settings is notoriously poor. One study reported that less that 30% of patients who received adjuvant treatment were seen again after six months. Although the reasons for this will be multifactorial, it was suggested that the treatment for many of these patients was unsuccessful and they had died [49].

In order to improve the volume and quality of information available on cancer in SSA there needs to be stronger investment in cancer registries. Being able to counter the arguments that it is not effective, efficient or ethical to invest scarce resources in setting–up cancer registries purely for epidemiological research purposes is important as such data sources will become an invaluable source of evidence and guidance for policy setting, programme implementation and improving practice.

In summary, this systematic analysis has highlighted the lack of data on CRC, mirroring the lack of data for all cancers in SSA. There is a notable lack of any recent published data. Greater use could be made of cancer registry data through direct contact and open access to their databases. All NCDs, including CRC, are increasing in low–income regions such as SSA. It is vital that the burden of disease attributable to this is accurately and regularly monitored. More information on the dynamics of this burden is also required, including who is affected, where and whether they have adequate access to treatment.

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An estimate of the prevalence of epilepsy in Sub–Saharan Africa: A systematic analysis

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Background Epilepsy is a leading serious neurological condition worldwide and has particularly significant physical, economic and social consequences in Sub–Saharan Africa. This paper aims to contribute to the understanding of epilepsy prevalence in this region and how this varies by age and sex so as to inform understanding of the disease characteristics as well as the development of infrastructure, services and policies.

Methods A parallel systematic search of Medline, Embase and Global Health returned 32 studies that satisfied pre–defined quality criteria. Relevant data was extracted, tabulated and analyzed. We modelled the available information and used the UN population figures for Africa to determine the age–specific and overall burden of epilepsy.

Results Active epilepsy was estimated to affect 4.4 million people in Sub–Saharan Africa, whilst lifetime epilepsy was estimated to affect 5.4 million. The prevalence of active epilepsy peaks in the 20–29 age group at 11.5/1000 and again in the 40–49 age group at 8.2/1000. The lowest prevalence value of 3.1/1000 is seen in the 60+ age group. This binomial pattern is also seen in both men and women, with the second peak more pronounced in women at 14.6/1000.

Conclusion The high prevalence of epilepsy, especially in young adults, has important consequences for both the workforce and community structures. An estimation of disease burden would be a beneficial outcome of further research, as would research into appropriate methods of improving health care for and tackling discrimination against people with epilepsy.

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At the United Nations high–level meeting on the prevention and control of non–communicable diseases (NCDs) in 2011, there was a general consensus that NCDs are already the universal leading causes of death, and that their burden is rapidly increasing [1]. By 2030, NCDs are expected to account for the death of 52 million people [2]. Low– and middle–income countries (LMICs) that lack the resources and infrastructure to cope with the diseases are expected to bear a disproportionate amount of the disease burden [3,4]. Accurate estimates of the burden of NCDs are vital

to the monitoring of diseases and policy planning, but currently lacking in many of these countries [5].

Epilepsy is the most common NCD of neurological origin that affects approximately 50 million people worldwide [1,6]. Unlike many NCDs that are related to aging, epilepsy is more prevalent in children and young adults [7]. Over 85% of epilepsy cases are found in LMICs [8], most of which occur in poor regions of Africa that have the greatest number of the world's population under the age of 15 [9]. Epilepsy severely affects the quality of life for people. The condition is highly stigmatised because of the commonly held misconception that epilepsy is contagious and the negative meanings attached to its outward manifestation, seizures [8,10,11]. In many parts of Sub–Saharan Africa (SSA), epilepsy continues to be associated with witchcraft [11-13]. For these reasons, people with epilepsy are often socially ostracised, have reduced life chances in terms of employment and marriage [8], and are prone to having poorer self–esteem and other mental health conditions such as anxiety and depression [10]. Yet, it is known that about 70% of people with epilepsy could lead full, seizure–free lives if treated [14]. Despite this, over 90% of people in SSA with epilepsy do not receive treatment [14]. Without treatment, people with epilepsy are at high risk of injury especially from burns should seizures occur because of tasks as cooking over an open fire or playing near pit fires [15]. Some background details on the condition are provided in **Box 1** [15-35].

In the only systematic review to date based on the analysis of 28 studies published, Preux and Druet-Cabanac estimated the median prevalence of epilepsy in SSA to be 15/1000 [15], but this estimate is simply a median value from door–to–door studies in several countries. No studies have yet attempted to provide age and sex–specific prevalence of epilepsy for SSA. By way of systematic review, the aims of this study were thus: (i) to provide an updated estimate for the overall prevalence of epilepsy in SSA; (ii) to give sex and age–specific breakdown for the epilepsy prevalence for SSA; and (iii) to assess the limitations of the available data. It is hoped that the findings of this study would help improve the evidence base for informing health policy regarding epilepsy in SSA.

METHODS

Search strategy

Initially, a literature search was carried out based on the terms 'epilepsy' AND 'Africa' to scope out the information available. The final literature review of Medline, Embase and Global Health was undertaken on 6 March 2012. **Table 1** shows the Medline search terms. Embase and Global Health were searched with terms adjusted as necessary,

Table 1 Medline search strategy

1	"africa south of the sahara"/ or africa, central/ or central african republic/ or chad/ or congo/ or "democratic republic of the congo"/ or equatorial guinea/ or gabon/ or africa, eastern/ or burundi/ or djibouti/ or eritrea/ or ethiopia/ or kenya/ or rwanda/ or somalia/ or sudan/ or tanzania/ or uganda/ or africa, southern/ or angola/ or botswana/ or lesotho/ or malawi/ or mozambique/ or namibia/ or south africa/ or swaziland/ or zambia/ or zimbabwe/ or africa, western/ or benin/ or burkinafaso/ or cape verde/ or cote d'ivoire/ or gambia/ or ghana/ or guinea/ or guinea-bissau/ or liberia/ or mali/ or mauritania/ or niger/ or nigeria/ or senegal/ or sierra leone/ or togo/
2	comoros/ or madagascar/ or mauritius/ or reunion/ or seychelles/
3	mayotte.mp.
4	(sao tome and principe).mp. [mp=title, abstract, original title, name of substance word, subject heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]
5	saint helena.mp.
6	prevalence/
7	prevalen*.tw.
8	incidence/
9	incidence*.tw
10	(disease adj3 burden*).tw.
11	epilep*.tw.
12	epilepsy/ or epilepsies, myoclonic/ or myoclonic epilepsies, progressive/ or lafora disease/ or merrf syndrome/ or unverricht-lundborg syndrome/ or myoclonic epilepsy, juvenile/ or epilepsies, partial/ or epilepsy, complex partial/ or epilepsy, frontal lobe/ or epilepsy, partial, motor/ or epilepsy, partial, sensory/ or epilepsy, rolandic/ or epilepsy, temporal lobe/ or epilepsy, benign neonatal/ or epilepsy, generalized/ or epilepsy, absence/ or epilepsy, tonic-clonic/ or spasms, infantile/ or epilepsy, posttraumatic/ or epilepsy, reflex/ or landau-kleffner syndrome/ or seizures/ or seizures, febrile/ or status epilepticus/ or epilepsiapartialis continua/
13	1 or 2 or 3 or 4 or 5
14	6 or 7 or 8 or 9 or 10
15	11 or 12
16	13 and 14 and 15
17	limit 20 to yr="1980-Current"

as shown in Online Supplementary Document and yielded 381 and 165 results respectively. Countries were included under the heading Sub–Saharan Africa based on the UN data on geographical regions and composition [36]. The searches were limited to articles published between 1980 and the search date, yielding 701 results total. This limit was put in place to ensure that the results would be relevant to the current situation in SSA. No other limits were placed on the search.

Results of the 3 searches were then combined and duplicates removed, yielding 480 papers. The titles and abstracts of these 480 papers were then analysed and included if they indicated a value for prevalence in the abstract or clearly stated that a value would likely be present in the text. This generated 83 relevant papers (**Figure 1**). The full text articles were then searched to assess whether each of the studies met the full selection criteria (see **Box 2** for details of the selection criteria). Bibliographies of the selected articles and relevant review papers were searched to identify any further papers not generated by the literature searches.

Box 1 Aetiology and treatment of epilepsy

Epilepsy is diagnosed when an individual experiences multiple seizures, where a seizure is disordered discharging of cerebral neurones [14]. This can occur throughout the brain, causing a generalised seizure, or be confined to one area, causing a partial seizure. These seizure types are further classified to include, amongst others, absence and atonic seizures. The likelihood of an individual to have seizures depends upon their seizure threshold, which can be lowered when the neurons develop a tendency to be hyperexcitable. This can result from a variety of risk factors [14].

Central nervous system infections

Epilepsy can result from CNS infection by viruses such as measles, secondary to bacterial meningitis or encephalitis, fungi and parasites, most commonly neurocysticercosis (NCC) [14]. A significant association has been recognised between cysticercosis, parasitic infection with *Taeniasolium* tapeworm larvae, and epilepsy [16,17]. The prevalence of cysticercosis is higher in developing countries where sanitation facilities are less advanced and vectors include pigs, food and faecal contamination on the water supply. Epilepsy has been shown to be more frequent in areas highly endemic for onchocerciasis [18].

Malaria is highly prevalent in many areas of SSA [19], and contracting *Plasmodium falciparum* malaria in childhood is associated with nearly a 50% chance of developing cerebral malaria and a 37.5% chance of developing epilepsy [20]. Other infectious risks include meningitis and encephalitis [14].

Birth complications

In Sub–Saharan Africa, two thirds of women requiring emergency obstetric care are unable to receive it [21]. Untreated adverse perinatal complications are associated with a increased risk of suffering a period of hypoxic–ischaemic encephalopathy and subsequently developing epilepsy [22,23].

Febrile convulsions

Children under the age of 5 may also experience febrile convulsions in the event of high fever and, whilst this is not considered epilepsy, a small number of these children go on to develop epilepsy [14]. There is a recognised association between febrile seizures and epilepsy in Sub–Saharan Africa [23,24]. The definition of epilepsy used in this paper refers to seizures unprovoked by any immediate identified cause [25], and therefore febrile convulsions themselves are excluded from calculations.

Head injury

A common cause of childhood epilepsy is perinatal head injury. Later in life, a traumatic head injury or surgery may also result in epilepsy. It has been noted that even mild head trauma leads to an increased risk of epilepsy and this risk is present for more than 20 years following the injury [26]. Indeed, the study found the most significant risk of developing epilepsy to be associated with war injuries. In SSA head injuries have been identified as risk factors for epilepsy [24], and in this region road traffic accidents and violent conflict are important the risk factors for head injury [15].

A number of other risk factors exist including tumours [15], vascular disease and potentially brain stressors: malnutrition and low economic conditions [27]. A proportion of people with epilepsy also have no identifiable cause, for example in Cameroon 29% had idiopathic epilepsy [28]. There are also several known genetic causes of epilepsy [29] and, although a genetic mutation cannot be identified in many individuals with epilepsy, a family history of epilepsy is often present [30].

Treatment options

Phenobarbitone is most commonly used antiepileptic drug in SSA [16,31] and is widely affordable [32], despite widespread poverty, as it costs only US$ 5 per person per year [33,34]. However, there is a 65–95% treatment gap [10]. In Benin, 64% of children were not being treated and 50% of those who were received treatment from traditional healers [34]. In addition, this situation, where a large number of people with epilepsy do not have access to any treatment at all, is likely to result in feelings of helplessness and frustration. Given that 70% of people will epilepsy could lead full, seizure–free lives if treated [14,35], it is important to consider the role that AEDs could play in decreasing this association and therefore decreasing the likelihood that people with epilepsy move into lower socioeconomic groups.

Data extraction and analysis

The data from 31 published articles that met the criteria were extracted and tabulated. Age and gender–specific prevalence data were extracted along with the size of the population that provided a denominator for the prevalence value. Available data regarding the types of seizures experienced by the participants were also extracted. Relevant data regarding the seizure types of those with active epilepsy were found in 15 papers and were categorised based on the International League Against Epilepsy (ILAE) clas-
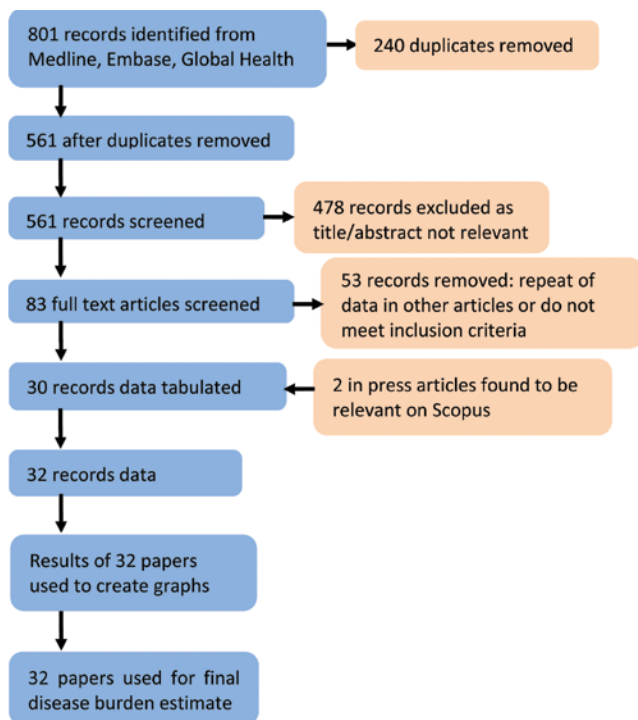
PAPERS

Figure 1 Search strategy.

Inclusion criteria
  – All age ranges
  – Both sexes
  – All countries in Sub–Saharan Africa
  – Studies conducted to examine the epidemiology of epilepsy
  – Population based studies
  – Measure of disease must include a numerator and denominator
  – Clear time period of study (studies were included without this factor, if all other criteria were satisfied, and the year of publication was used instead)

Exclusion criteria
  – Health service or health record based studies
  – Studies published before 1980
  – Studies conducted in a population with characteristics that clearly indicated it to be unrepresentative of the national population
  – Febrile convulsions and provoked seizures included in the estimation of epilepsy prevalence

Quality criteria

Clear case definition and diagnosis of epilepsy [14,25]:

Epilepsy: condition characterized by recurrent (two or more) epileptic seizures, unprovoked by any immediate identified cause. Multiple seizures occurring in a 24–h period are considered a single event. An episode of status epilepticus is considered a single event. Individuals who have had only febrile seizures or only neonatal seizures as herein defined are excluded from this category [25].

'Active' epilepsy: a prevalent case of active epilepsy is defined as a person with epilepsy who has had at least one epileptic seizure in the previous 5years, regardless of antiepileptic drug (AED) treatment. A case under treatment is someone with the correct diagnosis of epilepsy receiving (or having received) AEDs on prevalence day [25].

Diagnosis: "Diagnosis of epilepsy is essentially clinical, based on a *bona fide* history of epileptic seizures. Diagnosis should be confirmed by a health professional with expertise in epilepsy, using available medical history, seizure description, and neurologic examination. Standardized study methods should be used to obtain information about the above three diagnostic elements, and standardized criteria should be used for their interpretation. If available, EEG records and other diagnostic tools should also be used, but lack of these instruments should not preclude the diagnosis of epilepsy. EEG contributes but does not always confirm a diagnosis of epilepsy: An abnormal EEG must not be considered as a requisite for inclusion since it could be normal (or indicate non-specific abnormalities) in epileptic subjects. On the other hand, an abnormal EEG (with epileptiform abnormalities), after an isolated seizure, could suggest classification of the seizure as epilepsy" [25].

sification of seizures [14,25]. For each study, mean age was calculated for each available subset of data with prevalence. If an age group had two boundaries, the median of the range was used. If an age group contained a lower age limit and older (eg, '60 years or more'), United Nations Population Division's (UNPD) population estimates for the country and the year in which the study was conducted were used to estimate the mean age. Where there was an absence of a denominator, mean age was calculated for the amount of data for which there was a denominator (usually the whole study). This last rule also applies to age bands with only one given boundary.

The mean age of each data subset, its corresponding prevalence, and sample size were combined into a graph to illustrate the pattern of epilepsy prevalence across the age range of 0 to 60+. Each data point is represented by a circle proportional to the sample size. Ten–year age groups were used as they corresponded with the age groupings of the majority of the studies. The weighted mean of the prevalence for each age group and their 95% confidence interval were also calculated. The weighted mean of the prevalence for each age group was then multiplied by the corresponding population estimate by the UNPD for SSA for the year2010 [36]. Data for the year 2010 was used because we found no statistically significant changes in standardized prevalence of epilepsy over the period 1980–2012, while the largest and most reliable studies were conducted in the past decade. This provided an estimation of the number of people with active and lifetime epilepsy in SSA over-

all, as well as age and gender breakdown. For the data extracted on seizure classification, the total number of each seizure type found in all the relevant studies were calculated, and then divided by the total number of people with

epilepsy. This provided a percentage value to represent the proportion of people with epilepsy likely to experience each type of seizure in SSA.

Subsequent to the literature search, two articles in press were found on Scopus and were included in the review. A study by Prischich et al was excluded from the final analysis because it was conducted in an area with high levels of onchocerciasis and contains outlier data that is not representative of the general population [37]. Osuntokun et al was removed as it was published in 1982 and gave no date for when the study was conducted, but this was likely before 1980 and therefore not relevant to this review [38].

RESULTS

Study characteristics

Table 2 shows the main characteristics of the studies retained for our final analysis. They included countries from East, West, Middle and Southern Africa, and therefore can be considered reasonably representative of SSA as a whole (**Figure 2**). Only 9.4% of studies were conducted on less than 1000 individuals, 53.1% were conducted on more than 5000 individuals. There were 59.4% of the studies conducted in rural areas; as studies conducted in both rural and urban populations have shown that epilepsy is more prevalent in rural areas, the overrepresentation of rural studies in this review might represent a slight bias towards higher prevalence [30,39]. **Figure 3** shows that the studies included in the analysis were all published after 1980, with two–thirds of them published after 2000. The

Table 2 Study characteristics (see Online Supplementary Document for full table of study characteristics)

Characteristics	No. studies
Country:	
Benin	3
Burkina Faso	2
Cameroon	1
DRC	1
Ethiopia	1
Gabon	1
Gambia	1
Kenya	3
Liberia	1
Madagascar	1
Nigeria	3
Rwanda	1
Senegal	1
South Africa	1
Tanzania	4
Togo	3
Uganda	2
Zambia	1
Sample size:	
<1000	3
1000–4999	11
5000–9999	7
10 000–49 999	6
50 000–200 000	4
Setting:	
Rural and urban	1
Nationwide	2
Rural	19
Semirural	2
Urban	6
Year of study:	
Unknown	6
1980–1984	2
1985–1989	5
1990–1994	1
1995–1999	6
2000–2004	7
2005–2009	4
2010–2012	1
Study design:	
Cross–sectional	4
Door–to–door	22
Random sampling	3
Key informant	2
Unclear	1

Figure 3 The distribution of studies according to the year of publication.

majority of the studies (68.8%) were door–to–door surveys, which are consistent with the 'gold standard' research for epilepsy prevalence estimates [40].

Case definitions

The ILAE Guidelines for Epidemiological Studies on Epilepsy [25] describe the diagnosis as 'essentially clinical'. They recognise that EEG facilities are not always available,

Figure 2 Map showing the prevalence of epilepsy by country in Sub–Saharan Africa (adapted from http://www.worldatlas.com/webimage/countrys/africa/afoutl.htm).

and note that EEG is not required for diagnosis. All studies included in this review comply with the ILAE guidelines as they each provide an appropriate set of criteria for clinical symptoms and diagnosis of epilepsy based upon a fitting history. Active epilepsy was diagnosed if an individual had at least one of their multiple seizures in the previous 5 years. Whilst the studies all had appropriate conditions, many had more stringent criteria for active epilepsy: 34.4% only included people who had had seizures within the last year, 15.6% in 2 years, 31.3% in 3 years and 25% in 5 years. This is likely to have led to an underestimation of the prevalence of active epilepsy. When these studies were separated based upon different definitions of active epilepsy, the median prevalence for each category was 14.4/1000 for studies re-

quiring a seizure to have taken place in the last 1 year, 10.2 for 2 years, 38.3 for 3 years and 8.6 for 5 years. **Table 3** summarizes case definitions used in the retained studies. It shows that studies generally included a definition of active epilepsy, usually defined as a seizure within one or five years. Only five studies did not give details of the questionnaire used for case identification, while only six studies did not state that a neurologist confirmed the diagnosis.

Active epilepsy prevalence in the population of SSA

The data points represented by a hollow blue circle in **Figure 4** show the mean age of either a subset, or the entire study population, and the corresponding prevalence for

Table 3 Epilepsy definitions and diagnostic criteria used by included studies

Authors	Neurol-ogist	EEG	At least one seizure within previous year					Questionnaires used	Sensitivity	Specificity
			1	2	3	5	Life-time			
Case confirmed by neurologist; EEG used:										
Balogou et al [33]	Y	Y	+				+	PAANS (2000) [41]	95%	65.10%
Balogou et al [33]	Y	Y	+					PAANS (2000) [41]	95%	65.10%
Burton et al [22]	Y	Y				+		Based on Placencia et al, 1992 [42]	98%	92%
Mung'ala-Odera et al [23]	Y	Y	+					TQQ (Durkin, et al., 1994) [43]	100%	93%
Ndoye et al [44]	Y	Y	+					GCAE (Wang et al, 2003) [45]	100%	78.50%
Osuntokun et al [38]	Y	Y		+				Based on Osuntokun et al, 1987 [38]	91%	85%
Tekle-Haimanot et al [46]	Y	Y					+	Based on Osuntokun et al, 1987 [38]	91%	85%
Kanobana et al [17]	Y	Y				+		TQQ (Durkin et al, 1994) [43]	–	–
Neurologist; no EEG:										
Andriantseheno et al [47]	Y	N				+		PAANS (2000) [41]	95%	65.10%
Avode et al [34]	Y	N					+	PAANS (2000) [41]	95%	65.10%
Christianson et al [48]	Y	N	+				+	TQQ (Durkin, et al, 1994) [43]	100%	93%
Coleman et al [49]	Y	N				+	+	Based on Placencia et al, 1992 [42]	98%	92%
Debrock et al [50]	Y	N					+	PAANS (1996) [51]	95%	65.10%
Dent et al [52]	Y	N				+	+	PAANS (1996) [51]	95%	65.10%
Longe et al [53]	Y	N	+					Based on Osuntokun et al, 1987 [38]	91%	85%
Ngoungou et al [32]	Y	N				+	+	PAANS (2000) [41]	95%	65.10%
Njamnshi et al [28]	Y	N					+	PAANS (2000) [41]	95%	65.10%
Rwiza et al [54]	Y	N		+				Based on Osuntokun et al, 1987 [38]	91%	85%
Winkler et al [55]	Y	N				+	+	Based on Placencia et al, 1992 [42]	98%	92%
Yemadje et al [31]	Y	N				+		PAANS (2000) [41]	95%	65.10%
Dozie et al [56]	Y	N		+				Based on Shorvon & Farmer, 1988 [57]	–	–
Dumas et al [58]	Y	N					+	No details of questionnaire	–	–
Kaamugisha & Feksi [59]	Y	N	+					No details of questionnaire	–	–
Kabore et al [60]	Y	N					+	Based on Osuntokun et al, 1987 [38]	–	–
Kaiser et al [18]	Y	N	+					History taking (epilepsy in local language)	–	–
Case not confirmed by neurologist; no EEG:										
Almu et al [61]	N	N	+					Based on Osuntokun et al, 1987 [38]	91%	85%
Birbeck et al [8]	N	N	+					Based on Placencia et al, 1992 [42]	98%	92%
Edwards et al [24]	Notes only	N	+					Two questions asked: convulsive seizure history, serious head injury	95%	52.30%
Goudsmit et al [62]	N	N	+					No details of questionnaire	–	–
Duggan [40]	N	N					+	No details of questionnaire	–	–
Nitiema et al [63]	N	N			+			PAANS (1996) [51]	95%	65.10%
Simms et al [39]	N	N	+					Based on Atijosan et al, 2007 [64]	99%	97%

N – no, Y – yes, PAANS – Pan African Association of Neurological Sciences, TQQ – Ten Questions' Questionnaire, GCAE – Global Campaign Against Epilepsy, WHO – World Health Organization
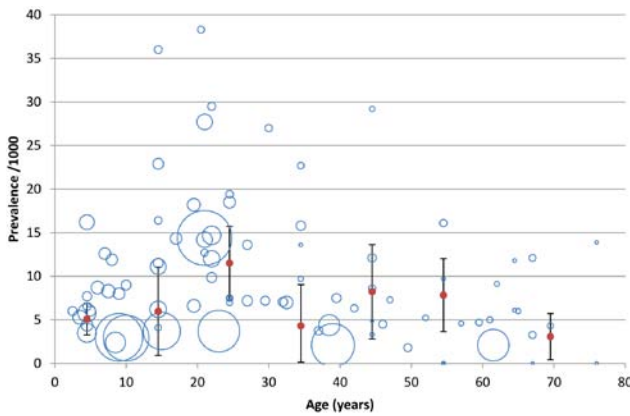
Figure 4 Prevalence of active epilepsy by age: the size of the bubble is determined by the size of the sample for which the prevalence was calculated in original data, while the solid red data points represent the weighted mean of the prevalence for each 10–year age group, along with the error bars representing the 95% confidence intervals.

that age group. The size of the bubble is proportionate to the sample size for which the prevalence was calculated. There is a wide range of prevalence values, from 0/1000 to 36/1000. The studies with larger population base mostly yield lower prevalence values. In addition, the sample size decreases as the mean age of the study population increases. The solid pink data points represent the weighted mean of the prevalence for each 10–year age band. There is a peak of 11.6/1000 in the 20–29 age group, and a less pronounced peak of 8.2/1000 in the 40–59 age group. From the calculated weighted mean of the prevalence for each age group, the number of people in each age group with active epilepsy was calculated. In total, 5.6 million people were estimated to have active epilepsy in SSA currently. Of this, the greatest number (1.7 million) of the cases was found in the 20–29 age group (**Table 4**).

Lifetime epilepsy in the population of SSA

In contrast to the bimodal nature of the prevalence trend seen in active epilepsy, prevalence of lifetime epilepsy peaks in the 20–29 age group (**Figure 5**) before decreasing to a plateau in the 40–59 age group, and then further decreases in the 60+ age group. The number of people with lifetime epilepsy was calculated to be 7.0 million, with 2.7 million in the 20–29 age group (**Table 5**).The prevalence ranged between 0/1000 and 33.5/1000. Larger studies, represented by larger circles in **Figure 6**, typically reported lower prevalence values, while higher prevalence values are mostly seen in smaller study populations.

Sex–specific patterns of prevalence

Figures 6 and **7** illustrate the pattern of prevalence by sex and age. The prevalence of active epilepsy among males and females is very similar for the 0–39 age groups, though
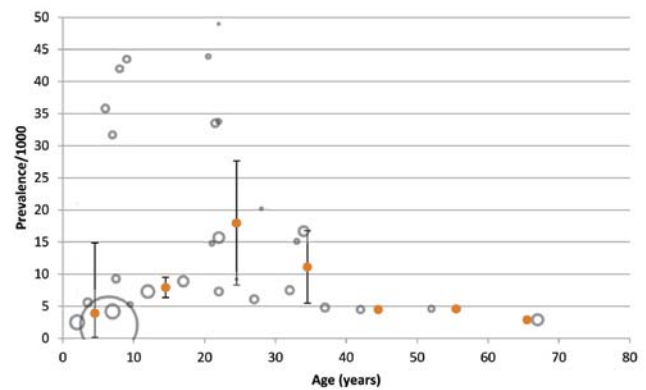

Figure 5 Prevalence of lifetime epilepsy by age: the size of the bubble is determined by the size of the sample for which the prevalence was calculated in original data, while the solid orange data points represent the weighted mean of the prevalence for each 10–year age group, along with the error bars representing the 95% confidence intervals.

Table 4 Calculated weighted mean of the prevalence of active epilepsy per age group and an estimated number of cases with active epilepsy in Sub-Saharan Africa in 2010

Age group (y)	Population of SSA in 2010 (in thousands)	Number of data points	Weighted mean of the prevalence (per 1000 population) with uncertainty range (95% CI)	Estimated number of cases with active epilepsy
0–9	258 336	16	5.09 (3.27–6.91)	1 314 930
10–19	196 731	13	5.98 (0.92–11.04)	1 176 453
20–29	148 772	18	11.50 (7.29–15.71)	1 710 877
30–39	100 929	11	4.31 (0.00–9.05)	435 006
40–49	64 594	9	8.23 (2.82–13.64)	531 608
50–59	43 907	7	7.84 (3.65–12.03)	344 233
60+	43 058	12	3.08 (0.43–5.73)	132 617
Total	856 327			5 645 723

y – years, CI – confidence interval

Table 5 Calculated weighted mean of the prevalence of lifetime epilepsy per age group and an estimated number of cases with lifetime epilepsy in Sub-Saharan Africa in 2010

Age group (y)	Population of SSA in 2010 (in thousands)	Number of data points	Weighted mean of the prevalence (per 1000 population) with uncertainty range (95% CI)	Estimated number of cases with lifetime epilepsy
0–9	258 336	10	3.91 (0.00–14.85)	1 010 093
10–19	196 731	2	7.93 (6.36–9.50)	1 560 078
20–29	148 772	10	17.96 (8.29–27.63)	2 671 943
30–39	100 929	4	11.12 (5.46–16.78)	1 122 336
40–49	64 594	1	4.51 (N/A)	291 318
50–59	43 907	1	4.65 (N/A)	204 169
60+	43 058	1	2.92 (N/A)	125 728
Total	856 327			6 985 666

y – years, CI – confidence interval, N/A – not applicable

Figure 6 Weighted mean of the prevalence of active epilepsy per age group for men and women.

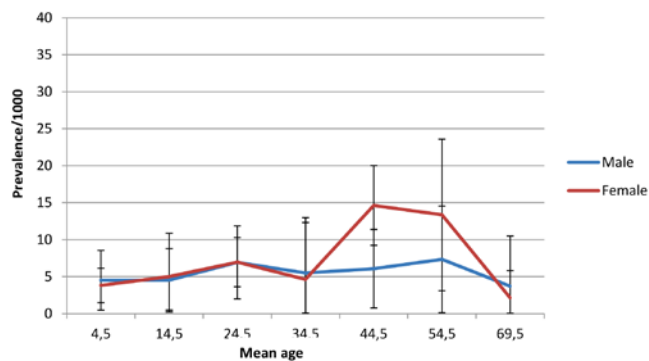**Figure 7** Weighted mean of the prevalence of lifetime epilepsy by sex and age group.

a noticeably higher prevalence of active epilepsy was observed among women relative to men in the 40–59 age group (**Figure 6**). When the prevalence trend of lifetime epilepsy is analysed by sex, the peak in the 20–39 age group is higher for men, but the second peak in the 50–59 age group is seen only in women (**Figure 7**). It is important to note that data was not included in the above graphs from all studies as not all studies provided data for separate sexes, which explains differences in comparison to **Figures 4** and **5**.

Seizure types

Online Supplementary Document shows the distribution of seizure types in the study groups for which the data were available, given that an individual may experience multiple seizure types. There was a predominance of generalised over partial seizures, with the most common generalised seizure type being tonic–clonic. Partial seizures made up 36.3% of all seizures, with a large proportion of these developing into generalised seizures. Simple partial seizures were seen more often than complex seizures.

DISCUSSION

This paper sought to examine the prevalence trend of epilepsy in SSA by age groups and sex. The prevalence of active epilepsy can be seen to peak at two points across the lifespan: at age 20–29 and 40–59. The pattern of lifetime epilepsy also showed a peak in at age 20–29 but did not show a second peak. However, very few data were available for age 40 years and above, limiting the understanding of prevalence trends in older age groups. The peak in prevalence of active epilepsy seen in the 20–29 age group is supported by evidence in LMICs outside of SSA that saw similar peaks in young adulthood [65,66]. Whilst many studies in high–income countries have observed bimodal distribution [67], a second peak in the 40–59 age group is rarely documented in LMICs. This may be due to the fact
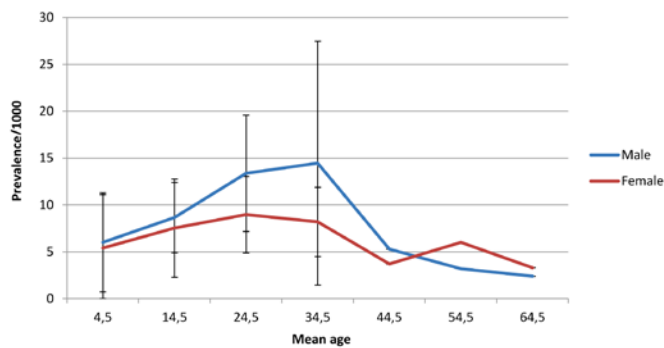
that LMIC populations tend to have lower mean ages, and therefore older age groups are less accessible to research studies. Furthermore, as fewer data points contribute to the calculation of the weighted mean of the prevalence the older age groups, the second peak may be less reliable.

A total of 32 studies were suitable for inclusion from 18 SSA countries, resulting in a limited evidence base from which to estimate epilepsy prevalence. The searches were limited to papers published post–1980. The number of studies conducted in the past decade suggests that research interest in epilepsy in SSA has increased over the past two decades. Publication bias, where researchers conduct studies in areas where they are aware of high prevalence or high levels of risk factors (eg, onchocerciasis), might have contributed to an over estimation of the true prevalence.In contrast, stringent case definitions of active epilepsy (as having had a seizure in less than 5 years) in the majority of the studies could have resulted in an underestimation of the prevalence.

Door–to–door studies are considered to be the best available method for obtaining disease prevalence data. However, as there were not enough studies using the standard method, we also included the studies if they were population based and did not rely on medical facilities or records, because it was assumed that a number of cases exist unknown to the medical system [68]. This included cross–sectional studies which relied on census data. One study was based in a school, and could have underestimated the epilepsy prevalence because related stigma and/or brain damage associated could have kept children out of mainstream education. Furthermore, a variety of questionnaires and data collection methods have been used, which may have varied in accuracy for identifying cases of epilepsy. This is particularly relevant in epilepsy given the wide range of seizure types, some of which present vary differently to the stereotypical tonic–clonic seizure. A larger number of the studies took place in rural areas where accurate records detailing the members of the populations

and where they live can be challenging. Furthermore, an address system may not be in place by which homesteads can by systematically visited. This may result in those conducting the studies missing households located in more isolated areas.

Epilepsy diagnosis can be challenging as it relies on disease history recounted by individuals rather than definitive tests, leaving ample opportunities for misinterpretation of previous events (eg, interpreting fainting as epilepsy, failure to recognise more subtle forms of epilepsy such as absence seizures) or denial of having experienced or witnessed seizures due to stigma [69]. As many people live in shared bedrooms in SSA [69], nocturnal seizures could have been witnessed and reported more accurately in history taking. As a recommendation for further epidemiological research, an increase in the number and size of population–based studies conducted in SSA would contribute to an estimation of the prevalence of greater accuracy and reliability. It would be important that further studies be conducted in accordance with the criteria recommended in **Table 6**, so as to ensure that they reap accurate results and are suitable for inclusion in future systematic reviews.

The stigma associated with epilepsy in SSA has significant implications for the individual. In some communities, a seizure is seen as a sign that the individual is being, or has been possessed by spirits, resulting it hem either being viewed as dangerous or as powerful by those around them and themselves [70]. Furthermore, epilepsy is considered by some groups as infectious, with 40.6% of Tanzanian individuals involved in a study believing that epilepsy was infectious and could be spread through physical contact

[71]. This may lead to those with epilepsy being ostracised from their community, with a likely impact on mental health as well as physical health if stigma prevents the receipt of medical attention. The high prevalence of 11.5/1000 for epilepsy in 20–29 year-olds in SSA may affect whether women can marry and have children and whether they can fulfil their expected role in society. Furthermore, it can impact on childcare with families struggling to manage seizures or refusing to allow the child in public communal places with other family and village members. For men aged 20–29, they may find themselves excluded from manual labour or factory work because of the danger of injuries from machinery and fires. This has serious financial implications for the family and can lead to decreased socioeconomic status or even destitution [30]. The second prevalence peak affects individuals who are likely to be become grandparents and, given the epidemic of HIV in SSA increasing the number of grandparent caregivers [72], this may result in a decreased level of care for children and limited finances available to cover the basic needs of the family.

The mission statement of the Global Campaign Against Epilepsy is "To improve acceptability, treatment, services and prevention of epilepsy worldwide" [73]. This paper highlights populations that are at risk of developing epilepsy, and with whom treatment and prevention strategies should be focused. Given the wide range of environmental and genetic factors known to contribute to this prevalence, and their differing impact across time and place, it is clear that local, national and international policies are required to tackle this disease. Epilepsy care and treatment is likely to span a range of services from initial presentation of seizures to putting in place a care plan and dealing with ongoing complications, and any treatment side effects. For this to be most effective, health services need to be integrated. Given that seizures generally take place in the community and the likelihood of a seizure being witnessed by a health professional is small, it may be beneficial for health professionals to ask about seizure symptoms during consultations with general patients. Furthermore, all health professionals must be trained in the recognition of the varying presentation of this population–spanning disease. By building the effectiveness of the formal and informal health service in dealing with epilepsy, it should be expected that improved management and treatment of the seizures will reduce the fear and stigma associated with them in the community. It may be helpful to work with traditional healers who may have greater contact with people with epilepsy than health services. Epilepsy awareness and education campaigns with an aim to decrease the stigma and discrimination associated with epilepsy could provide more understanding of the nature of the disease especially in community settings. This may increase the readiness of

Table 6 Criteria for retaining identified articles on epilepsy in Africa for further analysis

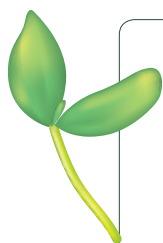| Criteria	Minimum standard
Study method	A census should be conducted by the study team prior to the survey to establish the demographics of the study population. Door–to–door surveys should be conducted. Known and potential risk factors in the area should be documented.
Case definition	ILAE – active epilepsy is defined as having had two or more seizure with at least one in the previous 5 y.
Population	Studies should include all age groups and be representative of the study population. Data should be presented in 10 y age bands (0–9 y, 10–19 y, 20–29 y etc. until 60+) and be divided into males and females for each group to allow for comparisons between studies. Numerators and denominators should be available in addition to calculated prevalence.
Study size	>1000
Mode of assessment	A standardised questionnaire should be administered by workers trained in identification of a history consistent with epilepsy, including behaviours or events that are likely to be consistent with seizure activity, frequency and duration of episodes.

ILAE – International League Against Epilepsy

individuals to admit to the condition and access treatment, while decreasing the negative reactions of those around them. Indeed, such campaigns also provide an opportunity to educate the population regarding safety hazards in the home for people with epilepsy, such as stoves and fires. Programmes in Togo and Kenya, combining medical treatment and psychosocial therapy, have achieved some success in reintegrating people with epilepsy into society [74,75]. The impact of any policies developed should continually be evaluated to assess whether they are achieving their goals of reducing stigma, improving treatment access and ultimately decreasing prevalence.

CONCLUSION

Our study provided an estimate of the burden of epilepsy in Sub–Saharan Africa in the year 2010. It is likely to represent an underestimate of the true burden of the problem, because door–to–door studies are unlikely to recognize all forms of epilepsy, but rather only the most dramatic cases. More methodologically rigorous studies are needed in different parts of the SSA to improve estimates and for understanding the varying patterns of epilepsy by geographic location over time, and to inform policy more effectively. Moreover, trained health professionals and neurologists are in demand to provide more accurate diagnosis of epilepsy within this type of public health research, as well as provide care and treatment for people diagnosed. Reducing stigma could help improve diagnosis as it relies on disease history that many are ashamed to admit. Regardless of the limitations in the amount and quality of available information, this study should help inform health policy and planning in efforts to tackle this important problem in low–resource settings.

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Estimating the burden of rheumatoid arthritis in Africa: A systematic analysis

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Background Rheumatoid arthritis (RA) has an estimated worldwide prevalence of 1%. It is one of the leading causes of chronic morbidity in the developed world, but little is known about the disease burden in Africa. RA is often seen as a minor health problem and has been neglected in research and resource allocation throughout Africa despite potentially fatal systemic manifestations. This review aims to identify all relevant epidemiological literature pertaining to the occurrence of RA in Africa and calculate the prevalence and burden of disease.

Methods A systematic literature review of Medline, Embase and Global Health Library retrieved a total of 335 publications, of which 10 population studies and 11 hospital studies met pre–defined minimum criteria for relevance and quality. Data on prevalence was extracted, analysed and compared between population and hospital studies. Differences between genders were also analysed.

Results The estimated crude prevalence of RA in Africa based on the available studies was 0.36% in 1990, which translates to a burden of 2.3 million affected individuals in 1990. Projections for the African population in 2010 based on the same prevalence rates would suggest a crude prevalence of 0.42% and the burden increased to 4.3 million. Only 2 population studies have been conducted after 1990, so projections for 2010 are uncertain. Hospital–based studies under–report the prevalence by about 6 times in comparison to population–based studies.

Conclusion The availability of epidemiological information on RA in Africa is very limited. More studies need to be conducted to estimate the true burden and patterns of RA before appropriate health policies can be developed.

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Rheumatoid arthritis (RA) is one of the most common chronic diseases, with an estimated global prevalence of 1% [1], and is one of the leading causes of chronic morbidity in industrialised nations [2]. RA is an auto-immune disease that primarily affects the small joints of the hand, wrist, and feet. If left untreated, it can lead to extensive erosion of the cartilage, causing deformity and disability [3]. Common symptoms include pain

and stiffness, but prolonged disease is also associated with psychological problems such as depression [3]. The cause of onset is currently unknown, but a genetic susceptibility to an environmental trigger seems the most plausible [4]. Various bacteria and viruses have been suggested as the initial trigger; with a form of molecular mimicry imitating human antigens activating an immune response against the host's own cells [3]. The disabilities caused by RA can have extensive impacts on quality of life, with loss of productivity due to damaged and deformed joints inhibiting fine movements of the hand [5]. This disability can lead to a loss of career and sources of income, which is a particular problem in low income settings. For a certain subset of the population, jobs in Africa involve a level of manual labour and the resource–starved African states can afford only limited or no welfare support for disabled individuals [2]. Along with the increase in non–communicable diseases (NCD) in developing countries, an increase in RA occurrence could stress medical services that are already struggling with a high burden of acute infectious illness to an extent that they may be unable to cope with the fast changing patterns of disease distribution seen in Africa today [6].

RA is not just a debilitating disease of small joints. It is also associated with significant extra–articular manifestations and mortality, with an average decreased life expectancy of 3–7 years in America [3]. Complications of RA can have extremely serious consequences, most commonly involving the respiratory, cardiac and visual systems [7]. The disease has been shown to increase the risk of stroke by up to 65% and through the development of rheumatic nodules the risk of myocardial infarctions, pleural effusions and lung infections is increased [7,8]. Since RA is an autoimmune disease, it can affect any part of the body, especially those that relay on small vessel beds or extensive nerve systems, and can contribute to the development of a whole plethora of life threating conditions [7]. The importance of NCDs in low and middle income countries has recently been internationally recognised by the United Nations (UN) as a problem that perpetuates and drives poverty and is a "threat to human, social, and economic development" [9,10]. Thereby, RA not only contributes significantly to this burden, but also contributes by increasing the rate of heart disease and stroke [7], certain cancers [11], and possibly diabetes [12]. RA is also a cause of gender inequality as it predominantly affects woman [3]. The prevention and management of RA could help reduce other NCDs by reducing shared risk factors and prevalence of systemic manifestations [13]. A historic perspective and specific considerations related to RA in the African context are provided in **Box 1** [2,4,5,14-22].

The primary aim of this review will be to assess the prevalence of RA in Africa and to identify the key gaps in information. We will also study differences in RA prevalence between rural and urban populations, between male and female gender, and between hospital–based and community–based studies, aiming to identify all available, well conducted studies investigating the prevalence of RA in Africa.

METHODS

Search strategy

A systematic review of the public electronic databases, Ovid Medline (from 1946 onwards, in–process and non–indexed), Embase and Embase classic (from 1947), and Global Health Library (from 1910) was undertaken to find relevant literature. Searches using Google Scholar provided no additional references. Cross checking reference lists from review articles, editorials and study publications did not provide additional population based studies. The MeSH headings and key search terms used for Ovid Medline are described in **Table 1**. Search terms were altered when appropriate for other databases and the additional terms of prevalence, incidence and mortality were used alongside morbidity and burden of disease presented in the search strategy. All searches were completed on February 6th, 2012.

Table 1 Search terms used in the review of the literature

1.	(rheumatoid adj3 arthritis).af.
2.	exp arthritis, rheumatoid/ or exp caplan syndrome/ or exp felty's syndrome/ or exp rheumatoid nodule/ or exp rheumatoid vasculitis/
3.	(rheum* adj3 arth*).tw.
4.	rheumatoid arthritis.tw.
5.	exp africa/ or exp africa, northern/ or exp algeria/ or exp egypt/ or exp libya/ or exp morocco/ or exp tunisia/ or exp "africa south of the sahara"/ or exp africa, central/ or exp cameroon/ or exp central african republic/ or exp chad/ or exp congo/ or exp "democratic republic of the congo"/ or exp equatorial guinea/ or exp gabon/ or exp africa, eastern/ or exp burundi/ or exp djibouti/ or exp eritrea/ or exp ethiopia/ or exp kenya/ or exp rwanda/ or exp somalia/ or exp sudan/ or exp tanzania/ or exp uganda/ or exp africa, southern/ or exp angola/ or exp botswana/ or exp lesotho/ or exp malawi/ or exp mozambique/ or exp namibia/ or exp south africa/ or exp swaziland/ or exp zambia/ or exp zimbabwe/ or exp africa, western/ or exp benin/ or exp burkina faso/ or exp cape verde/ or exp cote d'ivoire/ or exp gambia/ or exp ghana/ or exp guinea/ or exp guinea-bissau/ or exp liberia/ or exp mali/ or exp mauritania/ or exp niger/ or exp nigeria/ or exp senegal/ or exp sierra leone/ or exp togo/
6.	africa.tw.
7.	5 or 6
8.	1 or 2 or 3 or 4
9.	(burden and disease).tw.
10.	(disease adj3 burden*).tw.
11.	exp morbidity/
12.	morbidity.tw.
13.	9 or 10 or 11 or 12
14.	7 and 8 and 13

PAPERS

Box 1 Rheumatoid arthritis in the African context

The extent of the problem caused by RA in Africa is presently uncertain, as very few epidemiological studies have been conducted [14]. Historically, RA in Africa has been seen as a rare disease with a mild onset compared to Europe and America [15], and in the face of acute life threating illness such as HIV, malaria, tuberculosis, and severe malnutrition, it has been largely ignored and given a low priority for medical research and resource allocation [16]. RA has a significant impact on the burden of disease in many other developing regions of Asia and South America, so it is likely the situation is similar in Africa [2]. Most of the data for this low prevalence and mild course has come from studies conducted between the 1950s and 1980s [15,16]. Since the 1980s there has been a dearth of publications concerning RA, which is in opposition to the trends of disease research in Africa for other fields [17], and as such the current burden of RA remains unknown [2]. The limited data available appears to show an increasing prevalence and severity of RA in Africa, particularly for urban populations [15]. The literature would suggest that the first reported case in Africa has only been described in 1956 [18], since when an increasing number of cases have been identified across Africa. A good example is from a sequence of studies undertaken in a hospital in Mulago, Uganda, in which increasing number of patients with RA were identified over a period of decades. The first 6 confirmed cases were seen in 1969, but more than 400 further cases were seen in the same hospital by 1980 [15]. RA is believed to have first been described in the Americas, with evidence of its existence from records before European settlement; the first reported cases in Europe only date to the 17th century [4]. This would support the hypothesis of the disease being triggered by an interaction with an unknown infectious agent, and it would explain rare occurrence in rural populations, as any spread would initially be to large settlements with international connections [4,19]. In addition, the estimated prevalence of 0.2–0.3% in Africa is very small compared to the 2% seen in Jamaica [20].

Given that any reviews of the evidence will need to rely on an almost historic set of studies in Africa, one of the major concerns is how did political realities of the times in which the studies were conducted reflect upon the demographic structure of the study sample? Many studies in this review were conducted in South Africa, in the period between 1975 and 1988. In those times, it is possible that the studies were mainly addressing the prevalence of RA in the minority of European immigrant populations, while the studies conducted in other African countries may have also been disproportionately capturing the rates within the subpopulations of European colonizers. This is particularly likely to be true for hospital–based studies at the time.

Despite the scarcity of information regarding the prevalence of RA in Africa, some steps have been made to improve the coverage and support of the rheumatic diseases. In 1989 the African League of Associations for Rheumatology (AFLAR) was created in recognition of the large burden that this group of illness represents [21]. In association with the Community Oriented Program for Central Control of Rheumatic Diseases (COPCORD), created by WHO to record the burden caused by rheumatic disorders through populations surveys, AFLAR has been tasked to record and improve the care of rheumatic patients in Africa [22]. In diffidence to this initiative, only Egypt and Tunisia have a COPCORD centre in Africa, and only a single survey has been published regarding the prevalence of RA by AFLAR [22]. As it stands, very little significance is given to rheumatic disease in Africa, with only a single rheumatologist providing for the 16 million strong population of Kenya and thirty for the 40 million of South Africa as recently as 2003 [16].

Despite its serious health problems RA is a treatable disease if caught in the early stages [2]. A combination of disease–modifying anti–rheumatic drugs (DMARDs) and low dose steroids prescribed aggressively can drastically slow down the progression of the disease and even cause remission [2]. Unfortunately, the most effective biological drugs are very expensive and far beyond the means of resource–starved African countries [2]. An effective and cost-effective alternative to the front line drugs used in the industrial nations has been developed by COPCORD and can drastically alter the prognosis of the disease [5]. This set of treatment guidelines uses cheap generic drugs. Initially all 5 drugs are used in combination until remission is achieved. Once remission is seen, the intravenous drugs are withdrawn, leaving only oral drugs. The aim is to maintain remission without the need for any drug therapy as a stimulus [5]. This is a safe, cost-effective alternative to the usual high maintenance programs and highlights the need for epidemiological data to map the patterns of the disease, so that implementation can be started in the appropriate settings to maximise the cost-effectiveness of the programme. A degree of caution is warranted before certain DMARDs are prescribed in an Africa, as the immunosuppressant properties of the drugs can exacerbate problems associated with endemic infections such as TB, HIV, and malaria [16]. Some drug combinations have been shown to be safer than others but currently little research has been conducted and the safety parameters remain unknown [16].

Inclusion and exclusion criteria

As few studies were expected to have been published the initial inclusion criteria and search strategy was broad to minimise overlooking any publications. The inclusion criteria were: population or hospital based studies undertaken in Africa with a clearly expressed numerical form of disease prevalence showing a denominator population. A clear case definition was needed with the diagnosis of RA by a specified criteria of a modified or revised form of the Rome criteria [23], American Rheumatism Association (ARA) criteria of 1959, 1961 or 1968 [24-26], or the 1987 Criteria by the American College of Rheumatology (ACR) [27]. No date limit was applied.

Any non–population based studies were excluded from the main analysis, but hospital based studies were retained for the secondary analysis and review articles for a source of reference. Papers with incomplete detailing on the cohort population, papers that excluded prevalence data, papers based on unsound epidemiological methods and duplicated papers were all excluded. All forms of arthritis other than RA where excluded, as were forms of early onset RA (juvenile idiopathic arthritis), which is classified as a separate disease [28].

Systematic analysis

The initial search of Ovid Medline, Embase and Embase classic, and Global Health Library identified 335 papers. All papers deemed relevant after screening of titles were also screened using their abstracts; whenever abstracts were not available, full text sources were found and assessed. Any papers whose abstract or full text could not be located were appropriated through the InterLibrary Loan internet accessible database (ILLiad) and assessed once received. In total, 10 articles were received through ILLiad. Towards the end of the exclusion process, 80 articles were selected for abstract review, with 11 population studies and 18 hospital studies being identified after screening for quality and relevance. Reviews of full text articles retained only 10 population–based studies; 11 hospital studies were also kept for secondary aim of studying the difference in prevalence estimates between population and hospital–based studies. The literature search process is summarised in **Figure 1**.

Data extraction and analysis

Selected studies where extracted and analysed in an Excel file. Information extracted included information on the studies such as the title, author(s), date, journal name, publication date and quantitative data. Specific quantitative information was recorded for the study size and number of reported RA cases calculated as a proportion. Wherever possible, information was broken into age groups for male, female, and combined populations. Cases of RA were de-
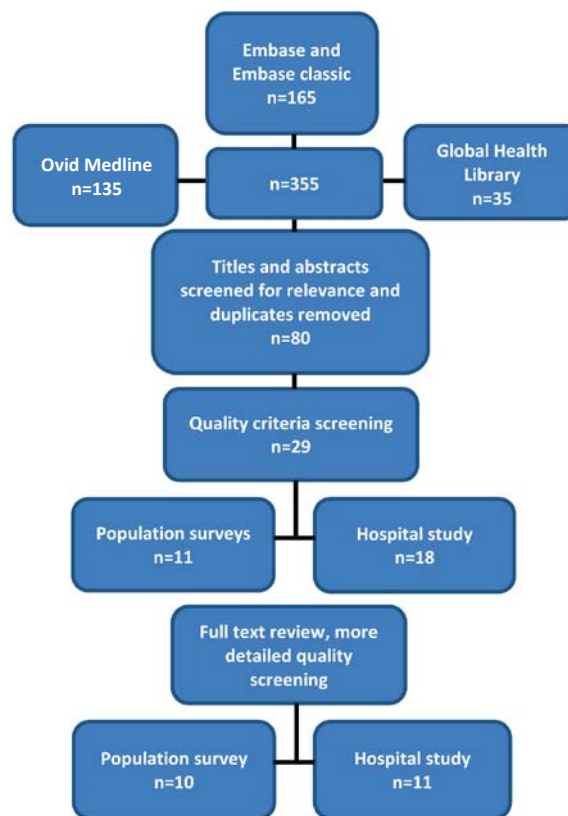

Figure 1 A summary of search strategy used in this study.

fined as 'probable' or 'definite'. The definition of 'probable' combined the American Rheumatism Association (ARA) and Rome criteria. The term 'definite' used the American College of Rheumatology (ACR) criteria. The setting of the paper, either rural or urban, was also recorded. This process was repeated for hospital–based studies.

The extracts of information typically contained the average age of a specific age group, the size of the population within this age group, and the reported prevalence. Whenever an open age bracket was given (ie, 75+), the average age for the age group was calculated using country population estimates from the closest year to the year of study using United Nations Population Division's (UNPD) data [29]. If the study date was between UNPD years the most recent year was used as the data was deemed more likely to be accurate. If no age break down was supplied, the data was combined into a single average age with prevalence and cohort size for the whole study. These data points were then combined into age subgroups of 10–year gaps, with the first interval having a 15 year gap (0–15, 15–25, 25–35, etc.). Different subgroups were used for hospital studies because of different data distribution. Once all the data was combined into a single table (see Online Supplementary Document), a weighted prevalence was calculated using the cohort size for each data point. Once a prevalence and cohort size for each age subgroup has been found, 95% confidence inter-

vals were calculated [30]. This process was repeated separately in male and female groups.

To assess the number of people suffering from RA in Africa, the weighted prevalence was calculated for each age group and applied to UNPD population data for Africa in 1990 [29]; 1990 was selected as it was the year to the period when most studies were conducted. The burden according to UNPD 2010 data was also calculated, using an estimated projection for the prevalence in 2010.

All processes specified for data analysis were repeated for hospital studies, population and hospital studies combined, rural studies, and urban studies. Confidence intervals were calculated for all of the aforementioned studies (see Online Supplementary Document). Hospital–based studies were analysed separately from population–based studies because they are inherently biased and unrepresentative of the larger African population; only those individuals living in an urban environment, with enough money to pay for treatment, or in the end stages of severe illnesses, would be expected to seek medical attention [31]. Two of the identified studies had more than one distinct population group, so have been counted separately in the analysis. The study in the Western Cape of South Africa identified a rural cohort living on a reserve in Rietpoort, and an urban cohort living in Hout Bay [32]. Another study identified three cohorts, two of which were based in Nigeria and one in Liberia [33].

RESULTS

Study characteristics

Only a small number of studies reporting the prevalence of RA were identified. The majority of studies were concentrated in a few countries (South Africa, Nigeria and Uganda), while for vast areas of Africa no data was available (**Figure 2**). In ten population–based studies the pe-
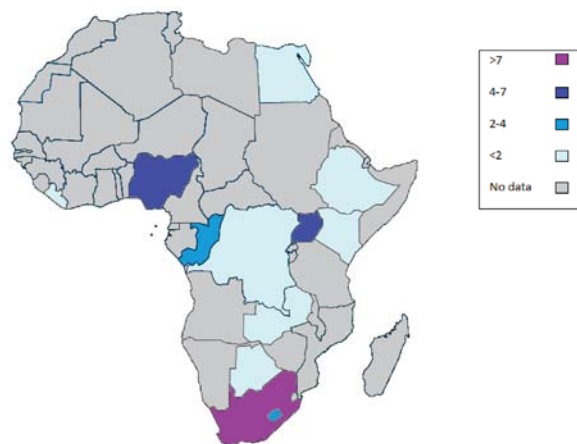

Figure 2 Geographic distribution of studies reporting prevalence of RA in Africa (number of studies from each country is indicated by different colours).

riod of study, cohort size and setting varied widely. The date range was from 1968–2009, with the majority conducted in 1970s and 1980s. Only two papers were identified that were publishedafter 1990. The cohort sizes ranged from 35 to 5120 individuals. The majority of studies were conducted in rural settings. Three studies did not provide breakdown of their cohorts by age, and four (including those three) did not provide information on gender differences. Main study characteristics are provided in **Table 2**. Three different sets of criteria for defining RA were used: the Rome, ARA, and ACR criteria. A full list of hospital–based study characteristics are available in Online Supplementary Document. Only three hospital–based studies were published after 1990, and three were conducted in a rural setting.

Findings

We extracted all the information on sub–samples from the 11 population–based studies which were defined by distinct age group, size of sub–sample in that age group, and reported prevalence for the age group. This database is vi-

Table 2 Characteristics of 10 identified population–based studies on rheumatoid arthritis

Author	Country	Setting	Publication year	RA criteria	Cohort size	Prevalence (%)	Prevalence (%, men only)	Prevalence (%, women only)
Abdel-Nasser et al [4]	Egypt	rural	2009	ACR 1987 [4]	5120	0.29	–	–
Beighton et al [34]	South Africa	rural	1975	Rome 1963 [34]	801	0.87	1.60	0.40
Brighton et al [35]	South Africa	rural	1988	Rome 1963 [35]	543	0.00	0.00	0.00
Meyers et al [36]	South Africa	rural	1977	Rome 1963 w/ ARA exclusions [36]	433	2.30	–	–
Meyers et al [32]	South Africa	rural	1982	ARA 1968 [32,36]	127	0.79	–	–
Meyers et al [32]	South Africa	urban	1982	ARA 1968 [32,36]	35	0.57	–*	–
Moolenburgh et al [37]	Lesotho	rural	1986	ARA 1959 [37]	1070	1.80	1.80	1.80
Muller et al [33]	Uganda and Liberia	rural	1972	ARA 1961 [33]	607	2.47	3.10	1.90
Silman et al [38]	Nigeria	rural	1993	ACR 1987 [38]	1994	0.00	0.00	0.00
Solomon et al [39]	South Africa	urban	1975	Rome 1963 [39,40]	551	3.27	2.60	3.70
Truswell et al [41]	Botswana	rural	1968	–	154	0.00	0.00	0.00

RA – rheumatoid arthritis, ARA – American Rheumatism Association

sualized in **Figure 3**. There was an apparent increasing trend with age, which we further characterized by computing the weighted mean age for each group of sub–samples within the same age band, and assigning it a weighted mean prevalence and 95% confidence intervals (**Figure 4**). Using this information and the information on the demography of the African population in 1990, we estimated that the crude prevalence of RA in Africa is 0.36%. This estimate is still considerably lower than the 1% for North America and Europe [4], but greater than the 0.2–0.3% which was a previous estimate for Africa [16]. If the prevalence in **Figure 4** was applied to the UNPD data for African population size in 2010, crude prevalence would increase to 0.42%. These figures would translate into an overall burden of disease of over 2.5 million of people living with disease in Africa according to 1990 demographic profiles, but more than 4 million individuals in 2010 (see Online Supplementary Document for rationales and methods behind these estimates).

Although the overall prevalence for Arica is 0.36%, there is a large variations in prevalence with age, sex, geographical region and setting. A large difference in the reported burden of RA was noted between population and hospital studies, with almost a 10-fold reduction in reporting from hospital reports (Online Supplementary Document).

DISCUSSION

Our literature review identified a number of population–based studies conducted in Africa that provided information on RA prevalence. To our knowledge, this study is the first systematic literature review that has combined all available publications on epidemiology of RA for Africa. Still, the scarcity of available information limits the generalizability of the results presented in this manuscript. The

consistent trend of prevalence increasing with age was seen in every study. The difference in reported prevalence between population and hospital studies is substantial, with a 6:1 ratio in favour of population studies, with a likely explanation that fewer individuals with RA seek hospital care and most of them remain undiagnosed. Patients with acute illness such as infections or major trauma are more likely to seek medical attention, while hospitals themselves are unlikely to focus on identifying cases of RA given their burden and lack of resources [35,42]. An unexpected finding of this study was the similarity between the rates reported for males and females [35,38]. There are many possible explanations, including biases inherent to recruiting male individuals in rural population (with predominantly older and ill persons taking part), and cultural sensitivities surrounding the positive diagnosis in females [33].

Attempts were made to reduce bias as much as possible. A high sensitivity search criteria with abstract screening was implemented to identifying as many publications as possible. By extending the search criteria to the entire Africa from before and after 1990 a larger number of studies were identified. The inclusion of North African states is often questioned, as their ethnic and cultural background is distinct from Sub–Saharan Africa [43]. The inclusion of publications from before 1990 was a necessity as only two studies have been conducted after 1990s. Older studies have a different demographic pattern, generally being smaller and younger than contemporary populations [29]. This is why we used the population of Africa in 1990 as the most appropriate to estimate the overall burden.

Given that our review is based on an almost historic set of studies in Africa, one of the major concerns is how did political realities of the times in which the studies were conducted reflect upon the demographic structure of the study
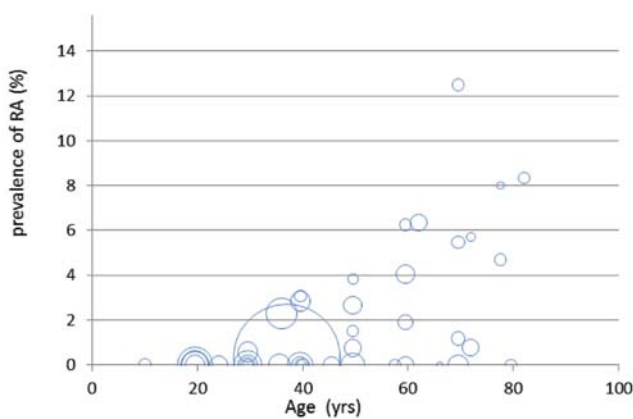

Figure 3 Relationship between the weighted mean age (in years) of examinees from 10 population–based studies belonging to different age groups and the observed prevalence (the size of bubbles is proportional to sample size of each sub–sample).
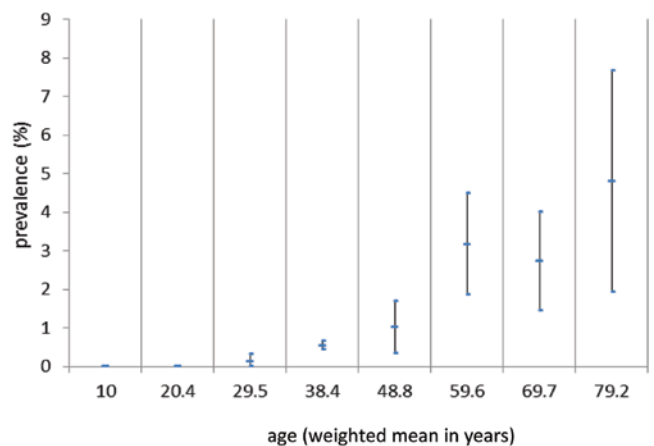
Figure 4 Relationship between the weighted mean age (in years) of examinees from 10 population–based studies belonging to different age groups and the observed prevalence (with 95% confidence intervals).

sample? Many studies in this review were conducted in South Africa, in the period between 1975 and 1988. In those times, it is possible that the studies were mainly addressing the prevalence of RA in the minority of European immigrant populations, while the studies conducted in other African countries may have also been disproportionately capturing the rates within the subpopulations of European colonizers. This is particularly likely to be true for hospital–based studies at the time.
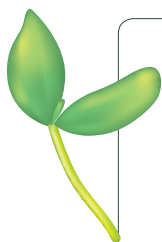
One of the critical issues when estimating prevalence based on studies which span over such a long period of time is to ensure that diagnostic criteria did not change. Before 1990 two sets of criteria were used: the Rome and ARA. The ARA criteria are more clinically based and not always applicable to studying remote communities [35]. Even the simplified Rome criteria would be difficult to implement, due to the requirement of a detailed history of polyarthritis. Interpreters are often needed and detailed histories and can lead to ambiguous responses. Due to this difficulty, all papers using Rome definitions applied modified criteria that omitted past history, subsequently needing 2 of 3 positive findings from clinical, radiological and serological test being required to establish a diagnosis (rather than 3 of 4), which could lead to over–diagnosis. The ARA criteria appear to be more sensitive that the Rome set, but also prone to over–diagnosing [33]. Diagnostic tools, especially rheumatoid factor (RF) in serum, appear extremely unreliable [36,41,44]. Another problem in Africa is low participation rate and subsequent loss to follow up, due to simple superstitions and fears, cultural barriers and migration [45]. An incentive to motivate the population into attendance can greatly reduce rates of attrition, with Brighton et al 1988 having a 97% response rate due to a free health clinic set up in parallel with the study to support the local population [35].

A crude prevalence of 0.36% implied through these rare conducted studies, with a resulting burden of over 2 million persona in 1990 and more than 4 million in 2010, is relatively small compared to that in industrialized countries. However, it is still an important cause of morbidity. Given the limitations of the data presented here, any resource allocation based on these estimates would also need to be provisional. The most important policy implication from this review is an urgent need for more studies to be conducted. The publications used to generate an estimate is based on studies more than 20 years old and concentrated in a few countries, with the vast majority of Africa having no information over the past 50 years. A distinct correlation between age and prevalence is evident, but the usual gender ratios were not observed. More studies with better controlling for population bias are needed to confirm whether this is a true finding, so that programmes can be tailored to target high risk groups more effectively. This paper succeeded in revealing the importance of population–based estimates over hospital–based ones, as extensive under–reporting was noticed in hospital–based studies.

The basic infrastructure, with the African League of Associations for Rheumatology (AFLAR), is already present and should be built on to improve the coverage and research of RA. Despite the creation of AFLAR, little has been done to further the understanding of the epidemiology of RA in Africa. Cheap and effective treatments are available [5], so it is imperative that more studies are conducted to identify the true burden of RA and properly implement treatment.

Currently, this systematic review presents the only available systematic study of the burden of RA in Africa and it is suggestive of a larger prevalence than previously thought. This estimate is based on limited data, and further research is needed to consolidate our understanding of the true prevalence. Suggestions for future research are to use full (or randomly selected) area census, with a large cohort size (of more than 2000–3000 participants) using the ACR criteria as the most reliable diagnostic criteria currently available [27]. Local groups should be involved, particularly AFLAR and local clinics, as they have an existing capacity to monitor the population and their involvement may encourage increased interest and awareness of RA as an emerging African health problem.

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