

Rwanda 20 years on: investing in life



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Two decades ago, the genocide against the Tutsis in Rwanda led to the deaths of 1 million people, and the displacement of millions more. Injury and trauma were followed by the effects of a devastated health system and economy. In the years that followed, a new course set by a new government set into motion equity-oriented national policies focusing on social cohesion and people-centred development. Premature mortality rates have fallen precipitously in recent years, and life expectancy has doubled since the mid-1990s. Here we reflect on the lessons learned in rebuilding Rwanda's health sector during the past two decades, as the country now prepares itself to take on new challenges in health-care delivery.

Introduction

In 1994, the genocide against the Tutsis led to the deaths of 1 million people in Rwanda (nearly 20% of the population at the time), as well as the displacement of millions more. During the 100 days after Easter, 1994, a bitter post-colonial divide linked to eugenic constructs of race rooted in a previous century—but grimly familiar to those who remember the crimes of the Nazis—tore the country apart. Whether survivor, perpetrator, or member of the diaspora, no Rwandan emerged unaffected. Much of the rest of the world stood idly by.

The health effects of the genocide lasted long after the physical violence stopped that July. An estimated 250 000 women had been raped, and thus did HIV become a weapon of war.¹ One of the 20th century's largest cholera epidemics exploded in refugee camps along Rwanda's western border.² Fewer than one in four children were fully vaccinated against measles and polio in 1994.³ Rwanda's under-5 mortality rate that year was the highest in the world; life expectancy at birth would remain the lowest anywhere through the next few years.^{4,5} Tuberculosis control programmes, weak before the genocide, were in complete disarray; for years afterwards, many patients received only intermittent therapy.⁶ Moreover, most health workers had either been killed or fled the country; many who remained had been complicit in the genocide, and trust in physicians and nurses was frayed.⁷ Destruction of health facilities and the collapse of supply chains for drugs and consumables handicapped the country for years. Capacity to respond to the new crisis of mental health trauma was as strapped as capacity to respond to the trauma usually attended by surgical teams: Rwanda boasted neither psychiatrists nor trauma surgeons.

Some assume that such awful circumstances led to a tardy but emphatic humanitarian response. Such assumptions are wrong. Many were ready to write Rwanda off as a lost cause. In 1995, Rwandans received about US\$0·50 each in foreign assistance for health, the

least of any country in Africa.⁸ Some development experts even advised withholding primary care services from children to stave off population growth and prevent what they called a "Malthusian abyss".^{9,10} From the outside, it appeared that for years to come, Rwanda would be vulnerable to the donor community's shifting whims and divergent prescriptions.

Progress was halting in the years immediately after the end of the genocide.¹¹ In 1998, the new government launched a consultative process to create a national development plan, which led to a document called *Vision 2020*.¹² The idea was to move from the disaster of the mid-1990s towards becoming a middle-income country by 2020. The plan invokes the principles of inclusive, people-centred development and social cohesion. Central to this vision was health equity. Prosperity would not be possible without substantial investments in public health and health-care delivery; recovery from the horrors of 1994 would not be possible without provision of some of the services long monopolised by those who controlled the ship of state. The Rwandan Constitution of 2003 formalised the inalienable right to health;¹³ by contrast with the decades of violence culminating in the 1994 genocide against the Tutsi, the decision now was to invest in life.

Rebuilding the health system

As reviewed elsewhere,^{14,15} early approaches to rebuilding the health system were developed by Rwandans and oriented towards ready access and accountability. The notion of solidarity was often invoked. Community-based health insurance and performance-based financing systems were piloted in three of the country's districts and evaluated before being scaled up nationwide in 2004 and 2005, respectively. In each of Rwanda's 14 837 villages (spread across a country about the size of Maryland or Wales), three community health workers are elected by village members, then trained and equipped by the

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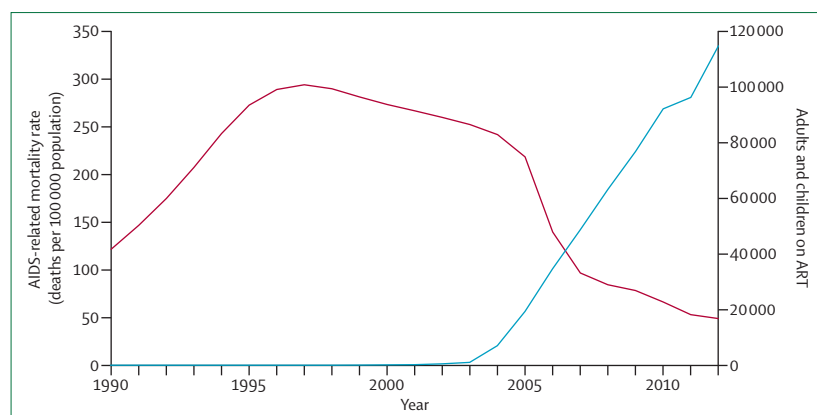


Figure 1: HIV/AIDS in Rwanda, 1990–2012

Population data are from reference 5. Data for antiretroviral therapy and deaths are from reference 28.

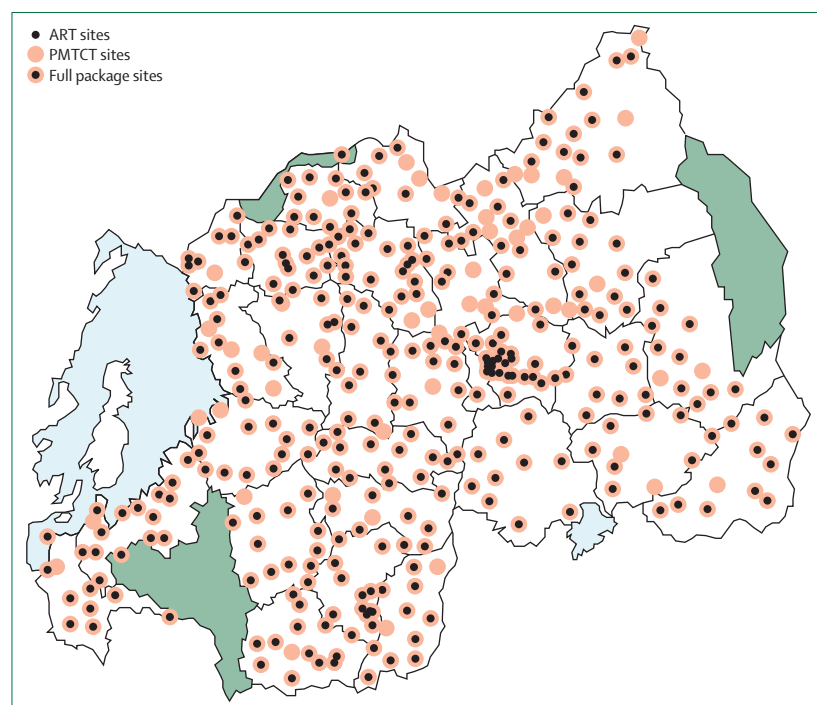


Figure 2: Decentralisation of HIV services in Rwanda, 2012

Figure and data supplied by the Rwanda Biomedical Center.³⁴ ART=antiretroviral therapy. PMTCT=prevention of mother-to-child transmission.

Health Enterprise, Kigali, Rwanda (C Sekabaraga MD); Partners In Health, Boston, MA, USA (M L Rich MD, D Bertrand-Farmer MA, A Habishuti MPA, O Dahl BA, P C Drobac MD); Brigham and Women's Hospital, Boston, MA, USA (J Rhatigan MD, C Cancedda MD, S N Stulac MD, N M Tapela MD, J D Swain MD); Dana-Farber Cancer Institute, Boston, MA, USA (L N Shulman MD); MASS

Ministry of Health to deliver key preventive, diagnostic, and therapeutic interventions to link patients to the formal health-care system. Monitoring and evaluation systems leveraging cell phones and new information technology platforms have been deployed across the country to respond to HIV and challenges in maternal and child health.^{16,17}

Development partners—from foreign governments and multilateral funders such as the Global Fund to Fight AIDS, Tuberculosis and Malaria, to international academic consortia and other non-governmental organisations—work in close coordination with the

Ministry of Health.^{14,18,19} University partnerships are now helping to strengthen research capacity, health education, and clinical care.²⁰ Most publications on health and illness in Rwanda are by Rwandan principal investigators. Some of the organisations that have declined to collaborate within the framework of Rwanda's national strategic plan have been invited to work elsewhere.²¹

A participatory policy-making approach has enabled swift implementation of new programmes, but also evidence-based changes to existing ones.²² For instance, from the time that the first national *mutuelles de santé* policy was published in 2004 through June, 2011, there was a flat premium for all but the wealthiest Rwandans. After an analysis of the 2005 and 2008 Demographic and Health Surveys showed that the most vulnerable remained disproportionately at risk of catastrophic health spending,²³ the Ministry of Health revised its health financing policy in April, 2010, to institute a three-tiered premium system based on Rwanda's socioeconomic assessment system known as *ubudehe*.²⁴ With health systems strengthening grants from The Global Fund, the government has subsidised premiums and co-payments for around 2 million of the poorest Rwandans.²⁵

Where exclusion and division once defined Rwandan governance, civil society representatives now join ministers in parliamentary meetings at which proposals are discussed within frameworks of scientific evidence and universal access to new services. The Ministry of Health, as chair of the government's Social Cluster, meets regularly with other ministries to review policies with overlapping interests and to harness cross-sectoral synergies.

The AIDS response as a catalyst

Since Rwanda received, only a decade ago, its first major international grants to begin treating HIV, tuberculosis, and malaria, the leadership of the health system has attempted to prioritise the simultaneous decentralisation and integration of services, and to increase domestic funding for health alongside external resources. Setting these priorities required resisting the so-called stove-piping of programmes according to the whims of funders, to avoid the centralising tendencies of all federal bureaucracies and to buck the trends of previous decades, during which many African nations had been pushed to invest less in public institutions (so-called structural adjustment programmes).²⁶

By 2010, 58.4% of foreign assistance to Rwanda was being channelled through national systems (compared with an average of 20.1% in a recent UN survey of foreign aid in post-conflict settings).²⁷ This strengthening of public sector capacity is both cause and effect of a focus on national ownership and oversight; such an approach to shared accountability has also leveraged increasing investment from the Rwandan Government. Between 2000 and 2011, each annual increase of US\$1.00 in foreign assistance for health in Rwanda was accompanied by \$1.29 in additional government spending on health that

year.⁸ Rwanda dedicated 22·1% of general government expenditure to the public health sector in 2011 (constituting 11·0% of gross domestic product).⁸

When the initial flow of these new resources—especially through the US President's Emergency Plan for AIDS Relief and The Global Fund—enabled Rwanda to begin treating HIV-positive patients with antiretroviral therapy (ART) for the first time, the Ministry of Health preferentially initiated scale-up in rural districts, several of which had been without functioning hospitals or clinics since 1994. Despite the fact that more than 150 AIDS-related non-governmental organisations were working in Rwanda in the early 2000s, fewer than 150 people living with HIV outside of the capital city of Kigali were receiving ART by 2003.²¹

Targeted advocacy in Rwanda and around the world in the early 2000s led to accelerated access to treatment. By mid-2007, 50 000 patients in Rwanda were receiving ART; by 2012, 114 600 (figure 1).^{28,29} The equity agenda was explicit: women infected as a result of rape during the genocide were among the earliest to be enrolled.¹ Rwanda attained the UN threshold for universal coverage of ART of 80% in 2009,³⁰ the second nation in Africa to do so.

The Rwandan Government has adopted a target of reducing mother-to-child transmission of HIV to less than 2% of births to mothers living with HIV by 2015.³¹ In many districts, patients initiating ART are provided with adherence support in the form of nutritional supplementation and assistance with transportation. Long-term retention in care has exceeded 90% in several studies.^{28,32} In a nationally representative survey,³³ 82·7% of patients on ART were found to be virologically suppressed. Estimated HIV prevalence decreased from a high of 6·2% to 2·9%.²⁸ According to UNAIDS, new HIV infections fell 60·3% and AIDS-related mortality fell 82·1% between 2000 and 2012.²⁸

During the past decade, the platforms designed to scale up HIV interventions have been used to strengthen primary care and to expand a growing package of health services across the country in an equitable way (figure 2).^{29,34–36} Health facilities originally constructed with donor funding earmarked for the AIDS response were tasked with integrated primary care, and national supply chains conceived to assist ART programmes

were harnessed to deliver drugs and reagents for a wide range of conditions.

The results of such a health systems approach have been impressive in a country that only 20 years ago lay in ruins. Today, more than 97% of Rwandan infants are vaccinated against ten different diseases (diphtheria, tetanus, pertussis, hepatitis B, *haemophilus influenzae* B, polio, measles, rubella, pneumococcus, and rotavirus; adolescent girls are also vaccinated against human papillomavirus)^{3,37} and 69% of births are attended by trained clinicians at health facilities³⁸—health workers trained in programmes to prevent mother-to-child transmission deliver babies whether mothers are HIV-positive or not. Rates of under-5 mortality, maternal mortality, and deaths due to tuberculosis and malaria have fallen alongside the burden of HIV, and Rwanda is now on track for each of the health-related Millennium Development Goals (MDGs)^{15,39} (table).^{4,5,28,40} After spikes during the 1990s, Rwanda's levels of under-5 mortality and tuberculosis mortality have since converged with world averages (figure 3), and are now cited as evidence of how disparities in premature mortality might be addressed to help other countries meet the MDGs.⁴¹ Although 44·9% of Rwanda's 11 million citizens still lived below the poverty line in 2012, this number has fallen from 58·9% in 2000;⁴² gross domestic product per head has more than trebled (from US\$200 to \$600) since 2003.⁵

Counter to some experts' forecasts after the genocide,⁹ reduced child mortality has correlated closely with higher family planning uptake. More children surviving means parents no longer have additional children to offset the expected deaths of some;⁴³ smaller families leave parents with more resources to invest in the health and education of each child.⁴⁴ Between 2005 and 2010, Rwanda's total fertility rate dropped by 25% (from 6·1 to 4·6 births per woman), and 45·1% of eligible women now use some form of modern contraception.³⁸ Unmet need remains high in some parts of the country, but it is clear that promoting women's health through family planning can be linked to other women's health services, including prenatal care. A dozen so-called one-stop centres to serve victims of gender-based violence have been launched around the country during the past 5 years.

Major challenges to continued improvements in health-care delivery in Rwanda remain, with significant

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	1990	2000	2012	AARR 2000–12	2015 MDG target	2015 projection (from AARR)
Under-5 mortality (deaths per 1000 livebirths)	151	182	55	10·0%	50	40
Maternal mortality (deaths per 100 000 livebirths)	910	550	340*	9·0%	228	212
AIDS-related mortality (deaths per 100 000 population)	121	273	49	14·3%	61	30
Tuberculosis mortality (deaths per 100 000 population)	37	49	10	13·2%	19	7
Life expectancy at birth (years)	33	48	63

Child mortality data are from reference 4. Life expectancy and population data are from reference 5. AIDS death data are from reference 28. Maternal mortality ratio and tuberculosis death data are from reference 40. AARR=average annual rate of reduction. *Latest available value for maternal mortality ratio is for 2010.

Table: Progress toward Millennium Development Goals (MDGs) 4, 5, and 6 in Rwanda

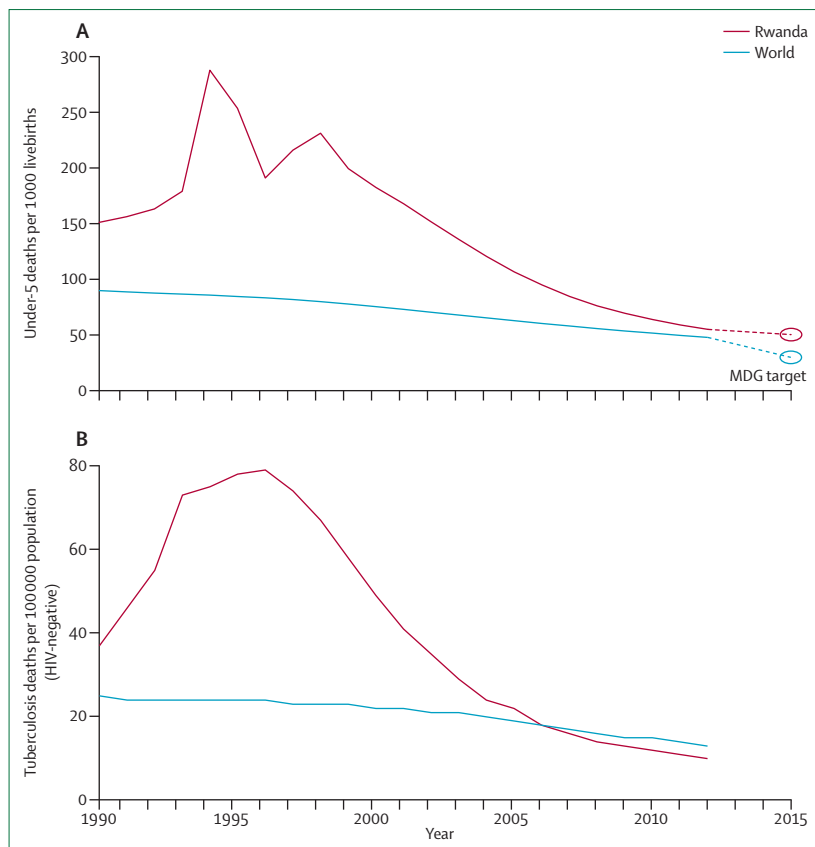


Figure 3: Towards convergence: child mortality and tuberculosis mortality
Data for child mortality are from reference 4. Data for tuberculosis mortality are from reference 40.
MDG=Millennium Development Goal.



Figure 4: Butaro District Hospital, Rwanda

implications for sustained economic development. Most notably, 44.7% of children were chronically malnourished in 2010;³⁸ a national campaign launched in 2013 aims to reduce this number substantially. Non-communicable

diseases (NCDs), mental illness, injuries, and neonatal disorders together constitute more than 50% of Rwanda's burden of disease.⁴⁵ A new national strategic plan for NCDs and the 2012 launch of a major health worker training partnership with 25 American medical institutions¹⁸ are important starts, but much work lies ahead.^{46,47}

Investing in the future

In the aftermath of one of the worst spasms of mass violence in recorded history, few imagined that Rwanda might one day serve as a model for other nations committed to health equity. Even a decade ago, few believed that Rwanda would meet any of the MDGs, nor that it would deploy its own peacekeepers with the goal of genocide prevention in other settings across the continent.

Today, at the mountaintop location of a former military base in Rwanda's Northern Province, the first cancer treatment centre in rural Africa has treated more than a thousand patients in its first years of opening.⁴⁸ These patients come from across Rwanda and neighbouring countries (many Rwandans remember what it means to be unable to return home and to be deprived of essential health services). The construction of Butaro District Hospital and its Cancer Center of Excellence (figure 4) has created hundreds of new jobs; dozens of small businesses have been established in the surrounding communities. It is premature, in the eyes of some, to deem this development as a swords-to-ploughshares parable. But, although the scars of 1994 remain, it would be cynical to deny that healing might accompany recovery from such social cataclysm.

Investment in health has stimulated shared economic growth as citizens live longer and with greater capacity to pursue lives they value. The lesson of the post-genocide period for Rwanda—and for countries around the world hoping for recovery from social upheaval of many kinds—is that a nation's most precious resource is its people.

Contributors

AB and PEF conceived of the manuscript. All authors contributed to the programmes described, assisted with the analysis presented, and critically revised the manuscript for content.

Declaration of interests

All authors work or have worked in or with the Rwandan health sector; no specific competing interests exist.

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References

- 1 Cohen MH, d'Adesky AC, Anastos K. Women in Rwanda: another world is possible. *JAMA* 2005; **294**: 613–15.
- 2 Siddique AK, Salam A, Islam MS, et al. Why treatment centres failed to prevent cholera deaths among Rwandan refugees in Goma, Zaire. *Lancet* 1995; **345**: 359–61.
- 3 WHO and UN Children's Fund. WHO and UNICEF estimates of national immunization coverage 2013: Rwanda. http://www.who.int/immunization/monitoring_surveillance/data/rwa.pdf (accessed March 2, 2014).

- 4 UN Inter-Agency Group for Child Mortality Estimation. Under-five mortality rate estimates. <http://www.childmortality.org/> (accessed March 2, 2014).
- 5 World Bank. DataBank: development indicators. <http://data.worldbank.org/indicator> (accessed March 2, 2014).
- 6 Umubyeyi AN, Vandebriel G, Gasana M, et al. Results of a national survey on drug resistance among pulmonary tuberculosis patients in Rwanda. *Int J Tuberc Lung Dis* 2007; **11**: 189–94.
- 7 Hall P. Alleged role of medical personnel in genocide in Rwanda. *Lancet* 1996; **347**: 1265.
- 8 WHO. Global health expenditure database. <http://apps.who.int/nha/database/DataExplorerRegime.aspx> (accessed March 18, 2014).
- 9 King M, Elliot C. Cairo: damp squib or Roman candle? *Lancet* 1994; **344**: 528.
- 10 King M, Wang EY. Looking into the Malthusian abyss. *Lancet* 2006; **367**: 730.
- 11 Crowe S. Rural model used to rebuild health care in Rwanda. *Lancet* 1997; **349**: 1751.
- 12 Ministry of Finance and Economic Planning. Vision 2020. Kigali: Government of Rwanda, 2000. http://www.minecofin.gov.rw/fileadmin/General/Vision_2020/Vision-2020.pdf (accessed March 2, 2014).
- 13 Government of Rwanda. Constitution of the Republic of Rwanda. Kigali: Government of Rwanda, 2003. http://www.parliament.gov.rw/fileadmin/Images2013/Rwandan_Constitution.pdf (accessed March 2, 2014).
- 14 Logie DE, Rowson M, Ndagije F. Innovations in Rwanda's health system: looking to the future. *Lancet* 2008; **372**: 256–61.
- 15 Farmer PE, Nutt CT, Wagner CM, et al. Reduced premature mortality in Rwanda: lessons from success. *BMJ* 2013; **346**: 20–22.
- 16 Ngabo F, Nguimfack J, Nwaigwe F, et al. Designing and implementing an innovative SMS-based alert system (RapidSMS-MCH) to monitor pregnancy and reduce maternal and child deaths in Rwanda. *Pan Afr Med J* 2012; **13**: 31.
- 17 Nsanzimana S, Ruton H, Lowrance DW, et al. Cell phone-based and internet-based monitoring and evaluation of the National Antiretroviral Treatment Program during rapid scale-up in Rwanda: TRACnet, 2004–2010. *J Acquir Immune Defic Syndr* 2012; **59**: e17–23.
- 18 Goosby E, Von Zinkernagel D, Holmes C, Haroz D, Walsh T. Raising the bar: PEPFAR and new paradigms for global health. *J Acquir Immune Defic Syndr* 2012; **60** (suppl 3): S158–62.
- 19 Binagwaho A, Kyamanywa P, Farmer PE, et al. The human resources for health program in Rwanda—a new partnership. *N Engl J Med* 2013; **369**: 2054–59.
- 20 Rwandan Research and Implementation Writing Group. Building health research infrastructure in Rwanda. *Lancet Glob Health* 2014; **2**: e9–10.
- 21 Drobac P, Basilico M, Messac L, et al. Building an effective rural health delivery model in Haiti and Rwanda. In: Reimagining global health. Berkeley: University of California Press, 2013: 133–83.
- 22 Binagwaho A, Nutt CT, Mutabazi V, et al. Shared learning in an interconnected world: innovations to advance global health equity. *Global Health* 2013; **9**: 37.
- 23 Lu C, Chin B, Lewandowski JL, et al. Towards universal health coverage: an evaluation of Rwanda Mutuelles in its first eight years. *PLoS One* 2012; **7**: e39282.
- 24 Ministry of Health. Rwanda community-based health insurance policy. Kigali: Government of Rwanda, 2010. http://www.moh.gov.rw/fileadmin/templates/Docs/Mutual_policy_document_final1.pdf (accessed March 2, 2014).
- 25 Kalk A, Groos N, Karasi JC, Girschbach E. Health systems strengthening through insurance subsidies: the GFATM experience in Rwanda. *Trop Med Int Health* 2010; **15**: 94–97.
- 26 Kim JY, Millen JV, Irwin A, Gershman J, eds. Dying for growth: global inequality and the health of the poor. Monroe: Common Courage Press, 2000.
- 27 UN Office of the Special Envoy for Haiti. Can more aid stay in Haiti and other fragile settings? How local investments can strengthen governments and economies. New York: United Nations, 2012. http://lessonsfromhaiti.org/download/Report_Center/osereport2012.pdf (accessed March 18, 2014).
- 28 Joint UN Programme on HIV/AIDS. AIDSInfo online database. <http://aidsinfoonline.org/> (accessed March 2, 2014).
- 29 Farmer PE. Shattuck Lecture. Chronic infectious disease and the future of health care delivery. *N Engl J Med* 2013; **369**: 2424–36.
- 30 WHO, Joint UN Programme on HIV/AIDS, and UN Children's Fund. Towards universal access: scaling up priority HIV/AIDS interventions in the health sector. Progress report 2010. Geneva: World Health Organization, 2010. <http://www.who.int/hiv/pub/2010progressreport/report/en/> (accessed March 2, 2014).
- 31 Ministry of Health of Rwanda. National strategic plan for elimination of mother-to-child transmission of HIV in Rwanda: 2011–2015. Kigali: Ministry of Health, 2011.
- 32 Rich ML, Miller AC, Niyigena P, et al. Excellent clinical outcomes and high retention in care among adults in a community-based HIV treatment program in rural Rwanda. *J Acquir Immune Defic Syndr* 2012; **59**: e35–42.
- 33 Elul B, Basinga P, Nuwagaba-Biribonwoha H, et al. High levels of adherence and viral suppression in a nationally representative sample of HIV-infected adults on antiretroviral therapy for 6, 12 and 18 months in Rwanda. *PLoS One* 2013; **8**: e53586.
- 34 Rwanda Biomedical Center. TRACNet: HIV/AIDS information system database. Kigali, Rwanda.
- 35 Price JE, Leslie JA, Welsh M, Binagwaho A. Integrating HIV clinical services into primary health care in Rwanda: a measure of quantitative effects. *AIDS Care* 2009; **21**: 608–14.
- 36 Shepard DS, Zeng W, Amico P, Rwiwerek AK, Avila-Figueroa C. A controlled study of funding for human immunodeficiency virus/acquired immunodeficiency syndrome as resource capacity building in the health system in Rwanda. *Am J Trop Med Hyg* 2012; **86**: 902–07.
- 37 Binagwaho A, Ngabo F, Wagner CM, et al. Integration of comprehensive women's health programmes into health systems: cervical cancer prevention, care and control in Rwanda. *Bull World Health Organ* 2013; **91**: 697–703.
- 38 National Institute of Statistics of Rwanda and Macro International Inc. Rwanda Demographic and Health Survey 2010. Calverton: Macro International Inc, 2012. <http://dhsprogram.com/pubs/pdf/FR259/FR259.pdf> (accessed March 2, 2014).
- 39 Norwegian Agency for Development Cooperation (Norad). The global campaign for the health Millennium Development Goals. Report 2013: accelerating progress in saving the lives of women and children. <http://www.norad.no/en/thematic-areas/global-health/maternal-child-and-womens-health/global-campaign-for-the-health-mdgs;jsessionid=D46232C026D7C9464890E628FDD51129> (accessed March 2, 2014).
- 40 WHO. Global health observatory data repository. <http://apps.who.int/gho/data/?theme=main> (accessed March 2, 2014).
- 41 Jamison DT, Summers LH, Alleyne G, et al. Global health 2035: a world converging within a generation. *Lancet* 2013; **382**: 1898–955.
- 42 National Institute of Statistics of Rwanda. The third integrated household living conditions survey (EICV 3). Kigali: National Institute of Statistics, 2012. <http://www.statistics.gov.rw/publications/third-integrated-household-living-conditions-survey-eicv-3-main-indicators-report> (accessed March 18, 2014).
- 43 Westoff CF. The recent fertility transition in Rwanda. *Popul Dev Rev* 2013; **38** (suppl): 169–78.
- 44 Habumuremyi PD, Zenawi M. Making family planning a national development priority. *Lancet* 2012; **380**: 78–80.
- 45 Institute for Health Metrics and Evaluation. Global burden of disease 2010 study: GBD cause patterns visualization. <http://ihmeuw.org/1cy0> (accessed March 2, 2014).
- 46 Binagwaho A, Muhimpundu MA, Bukhman G, and the NCD Synergies Group. 80 under 40 by 2020: an equity agenda for NCDs and injuries. *Lancet* 2014; **383**: 3–4.
- 47 Alleyne G, Binagwaho A, Haines A, et al, and the Lancet NCD Action Group. Embedding non-communicable diseases in the post-2015 development agenda. *Lancet* 2013; **381**: 566–74.
- 48 Stefan DC, Elzawawy AM, Khaled HM, et al. Developing cancer control plans in Africa: examples from five countries. *Lancet Oncol* 2013; **14**: e189–95.