

# Cutting premature death in Rwanda

Rwanda's successes in delivering healthcare despite its history of conflict and consequent poverty offer lessons to other poor countries, say **Paul Farmer and colleagues**

In the immediate aftermath of the 1994 genocide, which claimed up to a million lives and left two million homeless, Rwanda was among the poorest countries in the world.<sup>1</sup> Health and education systems, already weak and limited in reach before the conflict, lay in ruins; less than 5% of the population had access to clean water; banking had collapsed; almost no taxes were collected. Epidemics of infectious disease, including HIV, malaria, tuberculosis, and waterborne infections, further thinned the population.<sup>2</sup>

Today Rwanda has been transformed. Mass violence has not recurred within its borders, and its gross domestic product (GDP) has more than tripled over the past decade (see box 1 in version on bmj.com). Growth has been less uneven than in other countries in the region, partly because local and national governments have made equity and human development guiding principles of recovery.<sup>3</sup> Recent studies suggest that more than one million Rwandans were lifted out of poverty between 2005 and 2010, as the proportion of the population living below the poverty line dropped from 77.8% in 1994 to 58.9% in 2000 and 44.9% in 2010.<sup>3</sup> Life expectancy climbed from 28 years in 1994 to 56 years in 2012.<sup>4</sup> It is the only country in sub-Saharan Africa on track to meet most of the United Nations' millennium development goals (MDGs) by 2015. Although metrics for equity are disputed, it is an increasingly well known fact that Rwanda today has the highest proportion of female civil servants in the world.<sup>5</sup>

Some have characterised Rwanda's rebirth as good fortune or as a "black box" case with few lessons for others. However, as doctors and researchers who have worked for a decade with Rwanda's Ministry of Health and its development partners, we contend that the country's approach to strengthening its health system offers insights for other countries faced with persistent poverty and lagging health indicators.

## Reining in AIDS

The Rwandan government laid ambitious plans to scale up access to health services in the years immediately after the genocide. Its Vision 2020 strategy for equitable social and economic development, produced in 2000, emphasised health

as a pillar of the national cross-sector approach to reducing poverty. Funds for implementation were scarce, however, and AIDS and tuberculosis epidemics, compounded by a heavy burden of malaria and food insecurity, caused substantial premature death and disability.<sup>2</sup>

In December 2002 only 870 of the tens of thousands of Rwandans with advanced HIV disease were receiving antiretrovirals—most in private clinics in Kigali, and many erratically.<sup>6</sup> In the early 2000s new funding mechanisms, most notably from the Global Fund to Fight AIDS, Tuberculosis and Malaria and the US President's Emergency Plan for AIDS Relief (PEPFAR), substantially increased development assistance for health, but these funds were often restricted to specific programmes, especially for HIV. It soon became apparent that advocacy and funding alone do not guarantee that quality health services will reach those who need them most.

Rwanda sought to control AIDS, tuberculosis, and malaria, strengthening the health system as it did so. Integration of disease control programmes was recognised as a worthy goal. Rwanda's AIDS programme was characterised not only by efforts to integrate prevention and control but also by attention to concomitant problems such as tuberculosis and malnutrition and to strengthening healthcare.

As Rwanda's health minister, Agnes Binagwaho, says, "If you give Rwanda money to save the life of the oldest person in Rwanda today, we will make sure that the infant born tonight benefits too." Disease specific or "vertical" funding from the Global Fund and PEPFAR was used to rebuild health infrastructure and develop robust platforms for primary care.<sup>7</sup> Similar approaches had been successful in rural Haiti.<sup>8</sup>

Scale-up of AIDS services began in cities and towns and then expanded into the rural areas in which most Rwandans live. In June 2012, 108 113 people with advanced HIV disease in Rwanda were receiving antiretrovirals, making Rwanda (along with much richer Botswana) one of only two countries in sub-Saharan Africa to achieve the United Nations goal of universal access to antiretroviral therapy.<sup>9</sup> Rwanda's HIV epidemic has remained at a prevalence of about 3% for the past seven years.<sup>10</sup>

## Rebuilding the health system

Tackling conditions ranging from obstructed labour to chronic infectious diseases requires modern health infrastructure and well-trained staff. Rwanda's health facilities—five referral hospitals, 42 district hospitals, 469 health centres, and many private clinics—are currently staffed by 625 physicians, 8273 nurses, and 240 nurse midwives, heavily concentrated in urban areas.<sup>11</sup> Decades of instability contributed to an exodus of many health workers in the years leading up to the 1994 genocide, when many more were killed. Rwanda faces one of the greatest shortages of human resources for health in the world.

Tackling this shortage by training physicians and nurses will take many years; this effort is now under way. A cadre of 45 000 community health workers has performed many tasks over the past decade. After being elected by their communities, health workers are trained to diagnose and provide empirical treatment for malaria, pneumonia, and diarrhoeal disease. They also play a key role in health promotion efforts for family planning, antenatal care, and childhood immunisations and can refer patients to health centres and hospitals.<sup>12</sup> This approach has extended the reach of the health system, helped prevent the most vulnerable from falling through the cracks, and improved the coordination of care. Rwanda achieved a 91% success rate for community based tuberculosis treatment in 2010<sup>11</sup> and even higher rates of long term adherence for community based HIV care.<sup>13</sup>

Another pillar of Rwanda's health strategy is universal coverage. A national community based health insurance scheme known as "mutuelles de santé" was piloted in 1999 and extended nationwide by the mid-2000s, helped by the country's improved financial situation. As of June 2012, 90.6% of the population was enrolled, while another 7% are covered by civil service, military, or private insurance plans. In addition to annual premiums, subscribers pay 10% copayments at the point of care for services not fully covered. (Many preventive interventions, such as bed nets and vaccinations, are fully covered, along with treatment for HIV disease, tuberculosis, and some cancers.) Since 2006, premiums and copayments have been subsidised for the poorest quarter of the population by the Global Fund and other partners.<sup>14</sup> After research showed that lower income enrollees often faced a high risk of

**Rwanda's turnaround is increasingly well known in public health and development circles, but there is disagreement about the reasons for the success**

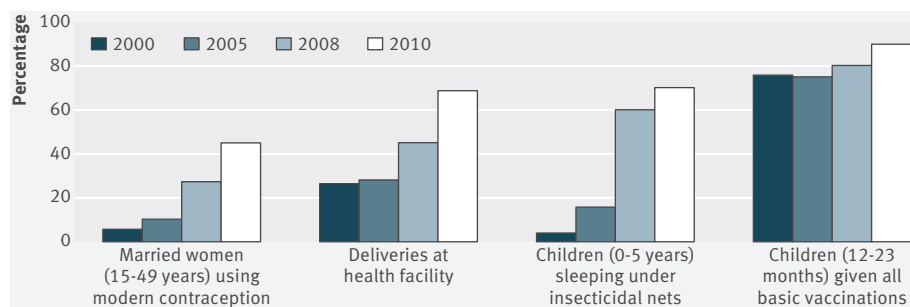


Fig 1 | Uptake of maternal and child health interventions in Rwanda, 2000–10<sup>18–21</sup>

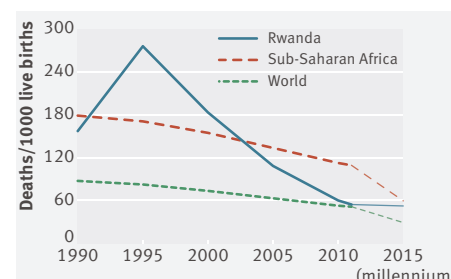


Fig 2 | Mortality among children up to age 5 years, 1990–2011<sup>36</sup>

	2000	2011	Total reduction (%)	Annual rate of reduction (%)	Regional rank	Global rank*
<b>HIV/AIDS</b>						
HIV incidence/100 000	207	88†	57.5	9.5	5	8
AIDS deaths/100 000	190	41†	78.4	17.0	1	1
<b>Tuberculosis</b>						
Incidence/100 000	326	94	71.2	11.3	1	4
Mortality/100 000	48	11	77.1	13.4	1	5
<b>Malaria</b>						
Total cases	1 654 246‡	208 858	87.4	34.45	NA	NA
Total deaths	2 581‡	380	85.3	31.9	NA	NA
<b>Child and maternal mortality</b>						
Deaths/1000 live births	183	54	70.4	11.1	1	1
Total deaths	61343	22 813	62.8	9.0	2	4
Maternal mortality ratio/100 000 live births	840	340§	59.5	9.0	1	6

\*Only countries with populations greater than 500 000 included. †2009 data. ‡2005 data. §2010 data.

catastrophic medical expenditure,<sup>15</sup> the Ministry of Health introduced a three tiered fee structure, so that poorer people pay smaller premiums.<sup>16</sup>

A performance based financing system, launched in 2005, rewards community health worker cooperatives, health centres, and district hospitals for better patient follow-up and improved primary care indicators, such as the proportion of women delivering at health facilities and children receiving a full course of basic immunisations.<sup>17</sup> Such incentives have helped boost the use of maternal and child health services (fig 1).<sup>18–21</sup>

Rwanda has also been an early adopter of technological, clinical, and programmatic innovations. The country's online health management information system<sup>22</sup> and national AIDS informatics system, TRACnet,<sup>23</sup> aggregate data and improve information flow between procurement and distribution divisions of the ministry, in addition to facilitating management of the performance based financing system. A mobile phone based alert and audit service for maternal and child health, RapidSMS, links community health workers to nearby health facilities.<sup>12</sup> An open source electronic medical record system, OpenMRS, piloted at 24 health facilities, is currently being rolled out across the country.<sup>24</sup>

Rwanda was among the first countries to integrate the rotavirus, pneumococcal, and human

papillomavirus (HPV) vaccines into its national immunisation system, achieving greater than 93% coverage for each of nine vaccines (rotavirus data are not yet available).<sup>25</sup> This includes 93.2% coverage for all three doses of the HPV vaccine among eligible girls in 2011<sup>26</sup>; by contrast, less than a quarter of eligible girls in the United States have received a complete series.<sup>27</sup> Rwanda's school based HPV vaccination programme serves as an example of cross sectorial collaboration, during which health authorities partner with the Ministries of Education, Gender, and Local Government as well as development partners, religious organisations, and community members.

Rebuilding health systems requires long term strategies and investment. For more than 15 years Rwanda's government has placed a premium on Rwandan leadership of foreign aid efforts, at national and local levels.<sup>28</sup> The health ministry demands robust financial management, transparency, and accountability standards of all its partners.<sup>29</sup> Some non-governmental organisations reluctant to work in accordance with national strategies were asked to leave the country.<sup>30</sup>

Donors are taking note: in early 2012 Rwanda became one of the first nations to receive direct budget support from PEPFAR.<sup>31</sup> In August 2012, in partnership with the US government and the Global Fund, Rwanda launched its ambitious human resources for health programme, a seven



More than four fifths of Rwandans take part in mutual health insurance programmes

year plan to build capacity by boosting training in 10 priority specialties through long term partnerships with US universities.<sup>32</sup>

### Vital signs

What are the results of these investments and policies? Over the past decade Rwanda has seen large falls in premature mortality (table). Mortality associated with HIV disease fell by 78.4% (the greatest reduction in the world during that time-frame)<sup>2</sup> and mortality from tuberculosis by 77.1% (the greatest decline in Africa).<sup>33</sup> From 2005 to 2011 deaths from malaria dropped by 85.3%.<sup>34</sup> Between 2000 and 2010 the country's maternal mortality ratio fell by 59.5%.<sup>35</sup> The probability of a child dying by age 5 years fell by 70.4% between 2000 and 2011—falling below half of the regional average and approaching the global mean (fig 2).<sup>36</sup>

If these gains can be sustained Rwanda will be the only country in the region on track to meet each of the health related MDGs by 2015. Yet, not long ago, it was the country least likely to do so: the goals measure progress against a 1990 baseline, so they do not account for the events of 1994, when child immunisation rates plummeted below 25% and more than one in four children died before their 5th birthday.<sup>25 36</sup> From 2000 to 2011 the absolute number of child deaths annually fell by 62.8%<sup>36</sup> (even as the population grew by 35.1%),<sup>5</sup> while Rwanda's regional ranking for

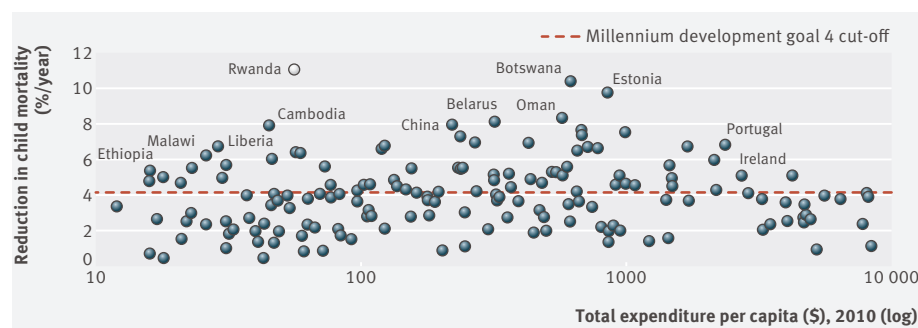


Fig 3 | Global health expenditure and annual reductions in child mortality from 2000 to 2011 (includes only countries with population >500 000)<sup>33 36</sup>

child mortality went from 42nd to seventh. Its average annual rate of reduction of 11.1% for this period was the world's highest (fig 3).

### Contributing factors

Rwanda's turnaround is increasingly well known in public health and development circles, but there is disagreement about the reasons for the success.<sup>37</sup> Some have claimed that Rwanda's progress largely reflects high spending on health-care, much of it financed by foreign aid. Certainly the proportion of public spending on health is high, at 20%, but Rwanda's total annual health spending per person (\$55.51 (£34.60)) is similar to that of other low income countries.<sup>38</sup> Of 49 countries in sub-Saharan Africa Rwanda came 22nd in terms of health spending per capita in 2010, while the relative scale of its recent reductions in premature mortality exceed those of other countries in the region (table). Moreover, the pace of these reductions has accelerated as Rwanda approaches its millennium development goal targets.

Others argue that the 1994 genocide presented an opportunity for reform that renders Rwanda's rebuilding strategies inapplicable elsewhere. But in 1995, most development agencies were ready to give up on Rwanda—then one of the poorest and most fragile countries in the world.<sup>1</sup> Rwanda received less foreign assistance for health per capita that year than any other country in sub-Saharan Africa.<sup>38</sup> Life expectancy remained the lowest in the world from 1989 to 1997.<sup>5</sup>

Substantial credit for Rwanda's progress is due to the central government, including the health ministry. For the past decade health authorities have resisted pitting prevention against care, public sector against private, and vertical programmes against primary care. The ministry has sought instead to identify and tackle the leading causes of mortality and morbidity, while expanding access to basic health services to the poor and strengthening the health system. For example, Rwanda has included wraparound social support (including funding travel costs and providing food supplements) in its national treatment

programmes for AIDS and tuberculosis. Recent research in rural areas shows that investing in comprehensive health systems can help break the cycle of poverty and disease described across the continent.<sup>39 40</sup>

But Rwanda's progress has not been uniform, and many challenges lie ahead. Chronic childhood malnutrition remains high: 44.2% of children were classified as stunted in 2010 (down from about 51% in 2005).<sup>21</sup> Severe anaemia among children and women rose from 2008 to 2010.<sup>20 21</sup> Despite a fourfold increase in family planning uptake and a decline in the total fertility rate from 6.1 to 4.6 between 2005 and 2010, contraception remains unavailable to (or under-used by) many Rwandans.<sup>20 21</sup> While infant and child mortality have decreased dramatically, neonatal mortality remains a challenge. Newborns accounted for 39% of all deaths among children in 2011.<sup>36</sup> Rwanda also faces a substantial burden of non-communicable diseases.<sup>41</sup>

District and referral hospitals have developed action plans to tackle these and other unmet chal-

### Box 2 | Lessons from Rwanda: strategies for strengthening comprehensive health systems

**National leadership**—High level political commitment to equity and to service delivery as well as a clear plan for action

**Health systems approach**—Harnessing funding for disease specific or other “vertical” programmes to build and strengthen platforms for integrated service delivery

**Country ownership**—Health system spending managed by or in partnership with national and local government

**Community based care**—For example, using community health workers to increase the effectiveness and efficiency of care delivery, especially for chronic diseases

**Evidence based policy making**—A critical “feedback loop” linking research to service and training to promote accountability and improve the quality of care

**Cross-sector collaboration**—Strengthening health systems with partnerships between the public and private sectors and also across sectors and ministries

lenges.<sup>42</sup> Implementing them will require resolve and a continued commitment to partnership and to surmounting the barriers that impede delivery of health services to the poor and underserved.

### Conclusion

During the 2011 UN high level meeting on non-communicable diseases Binagwaho reminded the assembly that prioritising equity in the health sector was “not only a moral imperative but also an epidemiological and economic imperative if we want to grow as a nation.”

Certainly, Rwanda will face great challenges if it is to meet its goal of becoming independent of aid by 2020: nearly half of its health sector budget was externally financed in 2010.<sup>37</sup> Even if Rwanda sustains its impressive pace of economic growth in the coming decade (and many believe it is well positioned to do so),<sup>43</sup> redistributive funding mechanisms such as PEPFAR and the Global Fund will continue to have a crucial role in the future success of global health initiatives.

But the challenges ahead do not diminish the present successes or dilute the lessons learnt (box 2). The impressive reduction in premature mortality speaks for itself. Linking sound analysis to a collaborative approach to strengthening health systems, Rwanda has instituted policies that have produced remarkable outcomes. This has occurred in concert with economic growth. Although the term “local ownership” is often invoked in development circles, it is rare to see it implemented successfully. The lessons from Rwanda's success should inform the work of those around the world who seek to deliver on the commitment of comprehensive and equitable healthcare for all.

**Paul E Farmer** professor, Department of Global Health and Social Medicine, Harvard Medical School, Boston, Massachusetts; Division of Global Health Equity, Brigham and Women's Hospital, Boston; Partners In Health, Boston paul\_farmer@hms.harvard.edu

**Cameron T Nutt** research fellow, Dartmouth Center for Health Care Delivery Science, Hanover, New Hampshire; **Claire M Wagner** research fellow, Global Health Delivery Partnership, Boston; **Claude Sekabaraga** senior health financing specialist, World Bank, Nairobi, Kenya; **Tej Nuthulaganti** human resources for health programme director, Clinton Health Access Initiative, Kigali, Rwanda; **Jonathan L Weigel** doctoral candidate, Department of Government, Harvard University; **Didi Bertram Farmer** director of community health and social development; **Antoinette Habinshuti** deputy director of Rwanda programmes, Partners In Health/Inshuti Mu Buzima, Rwinkwavu, Rwanda; **Soline Dusabeyesu Mugeni** technical adviser, Clinton Health Access Initiative, Kigali; **Jean-Claude Karasi** researcher, CRP-Santé, Luxembourg; **Peter C Drobac** director of Rwanda programmes, Division of Global Health Equity, Brigham and Women's Hospital; Partners In Health/Inshuti Mu Buzima

Accepted: 26 November 2012

Contributors and sources: For details see version on bmj.com. Provenance and peer review: Commissioned; externally peer reviewed.

Acknowledgments and references are in version on bmj.com.

Cite this as: *BMJ* 2013;346:f65



coming decade (and many believe it is well positioned to do so),<sup>43</sup> redistributive funding mechanisms such as PEPFAR and the Global Fund will continue to have a crucial role in the future success of global health initiatives.

But the challenges ahead do not diminish the present successes or dilute the lessons learnt (box 2). The impressive reduction in premature mortality speaks for itself. Linking sound analysis to a collaborative approach to strengthening health systems, Rwanda has instituted policies that have produced remarkable outcomes. This has occurred in concert with economic growth. Although the term “local ownership” is often invoked in development circles, it is rare to see it implemented successfully. The lessons from Rwanda’s success should inform the work of those around the world who seek to deliver on the commitment of comprehensive and equitable healthcare for all.

We thank Cassia van der Hoof Holstein, Jon Niconchuk, Michael Rich, Grace Ryan, Mickey Sexton, and Dana Thomson for their contributions. We also thank reviewers Suwit Wibulpolprasert and Frank Chimbwandira for feedback. Although this policy analysis was not funded by any specific grants, the authors are grateful for the support of Partners In Health, the Brigham and Women’s Hospital, Harvard Medical School, and the Doris Duke Charitable Foundation African Health Initiative.

**Contributors and sources:** The authors, who include physicians, other service providers, and policy experts, have worked in Rwanda with non-governmental organisations and institutions of higher learning for the past decade. This review draws in large part on data presented in the Rwanda Demographic and Health Survey, implemented by the National Institute of Statistics of Rwanda in collaboration with the Ministry of Health. The funding for the survey was provided by national and multilateral funding mechanisms; publicly available reports of this survey, its methodologies, and its results have been presented to partners and funders and may be accessed at <http://measuredhs.com/what-we-do/survey/survey-display-364.cfm>. PEF conceived the central argument, led the writing process, provided direction on the organisation of the manuscript, drafted sections of the manuscript, and serves as the guarantor. CTN collected data, created the tables and figures, conducted the literature review, and drafted sections of the manuscript. CMW developed and synthesised the argument, conducted the literature review, and drafted sections of the manuscript. CS, TN, JLW, DBF, AH, SDM, and JCK participated in analysis and drafted sections of the manuscript. PCD contributed to data analysis and coordinated review of the manuscript. All authors revised the manuscript critically for content.

**Competing interests:** All authors have completed the ICMJE unified declaration form at [www.icmje.org/doi\\_disclosure.pdf](http://www.icmje.org/doi_disclosure.pdf) (available on request from the corresponding author) and declare: CS and JCK have worked for the Ministry of Health of Rwanda. All authors have collaborated with the Ministry of Health of Rwanda on other research initiatives. No current employee of the Rwandan Ministry of Health or other governmental entity read the manuscript prior to publication.

**Provenance and peer review:** Commissioned; externally peer reviewed.

- Uvin P. Aiding violence: the development enterprise in Rwanda. Kumarian Press, 1998.
- World Health Organization. World Health Statistics 2012. [www.who.int/gho/publications/world\\_health\\_statistics/2012/en/](http://www.who.int/gho/publications/world_health_statistics/2012/en/).
- Ministry of Finance and Economic Planning. Vision 2020. Government of Rwanda, 2000.
- National Institute of Statistics of Rwanda. The third integrated household living conditions survey (EICV3). 2012. [www.statistics.gov.rw/publications/third-integrated-household-living-conditions-survey-eicv-3-main-indicators-report](http://www.statistics.gov.rw/publications/third-integrated-household-living-conditions-survey-eicv-3-main-indicators-report).
- World Bank. DataBank: world development indicators and global development finance. 2012. <http://databank.worldbank.org/>.
- National AIDS Control Commission of Rwanda. Country progress report January 2008–December 2009: United Nations General Assembly special session on HIV and AIDS, 2010. [http://data.unaids.org/pub/Report/2010/rwanda\\_2010\\_country\\_progress\\_report\\_en.pdf](http://data.unaids.org/pub/Report/2010/rwanda_2010_country_progress_report_en.pdf).
- 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.
- Walton DA, Farmer PE, Lambert W, Léandre F, Koenig SP, Mukherjee JS. Integrated HIV prevention and care strengthens primary health care: lessons from rural Haiti. *J Pub Health Policy* 2004;25:137–58.

- World Health Organization, Joint United Nations Program on HIV/AIDS, United Nations Children’s Fund. Towards universal access: scaling up priority HIV/AIDS interventions in the health sector. 2010. [www.who.int/hiv/pub/2010progressreport/en/index.html](http://www.who.int/hiv/pub/2010progressreport/en/index.html).
- Rwanda Biomedical Center. Country progress report for Joint United Nations Program on HIV/AIDS 2012. [www.unaids.org/en/dataanalysis/knowyourresponse/countryprogressreports/2012countries/ce\\_RW\\_Narrative\\_Report.pdf](http://www.unaids.org/en/dataanalysis/knowyourresponse/countryprogressreports/2012countries/ce_RW_Narrative_Report.pdf).
- Ministry of Health of Rwanda. (2012). Rwanda health statistics booklet 2011. [http://moh.gov.rw/english/wp-content/uploads/2012/05/MOH\\_Annual\\_booklet-2011.pdf](http://moh.gov.rw/english/wp-content/uploads/2012/05/MOH_Annual_booklet-2011.pdf).
- Mugeni C. Rwanda’s community health system: from policy to action. First annual international community health summit. Kigali, Rwanda, 25 January 2011. [www.icchrwanda.org/index.php?option=com\\_content&view=article&id=60&Itemid=3](http://www.icchrwanda.org/index.php?option=com_content&view=article&id=60&Itemid=3).
- Rich ML, Miller AC, Niyigena P, Franke MF, Niyonzima JB, Soccia A, 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.
- Kalk A, Groos N, Karasi JC, Gierbach E. Health systems strengthening through insurance subsidies: the GFATM experience in Rwanda. *Trap Med Int Health* 2010;15:94–7.
- Lu C, Chin B, Lee J, Basinga P, Hirschhorn LR, Hill K, et al. Towards universal health coverage: an evaluation of Rwanda mutuelles in its first eight years. *PLoS ONE* 2012;7:e39282.
- Ministry of Health of Rwanda. Rwanda Community-Based Health Insurance Policy. 2010. [http://moh.gov.rw/english/wp-content/uploads/2012/05/Mutual\\_policy\\_document\\_final1.pdf](http://moh.gov.rw/english/wp-content/uploads/2012/05/Mutual_policy_document_final1.pdf).
- Basinga P, Gertler PJ, Binagwaho A, Soucat ALB, Sturdy J, Vermeersch CMJ. Effect on maternal and child health services in Rwanda of payment to primary health-care providers for performance: an impact evaluation. *Lancet* 2011;377:1421–8.
- National Institute of Statistics of Rwanda, Macro International. Rwanda demographic and health survey 2000. <http://measuredhs.com/what-we-do/survey/survey-display-165.cfm>.
- National Institute of Statistics of Rwanda, Macro International. Rwanda demographic and health survey 2005. <http://measuredhs.com/what-we-do/survey/survey-display-252.cfm>.
- National Institute of Statistics of Rwanda, Macro International. Rwanda interim demographic and health survey 2007–2008. <http://measuredhs.com/what-we-do/survey/survey-display-323.cfm>.
- National Institute of Statistics of Rwanda, Macro International. Rwanda demographic and health survey 2010. <http://measuredhs.com/what-we-do/survey/survey-display-364.cfm>.
- Ministry of Health of Rwanda. Health management information system. 2012. [http://moh.gov.rw/english/?page\\_id=2221](http://moh.gov.rw/english/?page_id=2221).
- Nsanangimana S, Ruton H, Lowrance DH, Cishahayo S, Nyemazi JP, Muhayimpundu R, 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.
- Amoroso CL, Akimana B, Wise B, Fraser HS. Using electronic medical records for HIV care in rural Rwanda. *Stud Health Technol Informat* 2010;160:337–41.
- World Health Organization. WHO-UNICEF vaccination coverage estimates time series for Rwanda. 2012. [http://apps.who.int/immunization\\_monitoring/en/globalsummary/timeseries/tswucveragebycountry.cfm?country=RWA](http://apps.who.int/immunization_monitoring/en/globalsummary/timeseries/tswucveragebycountry.cfm?country=RWA).
- Binagwaho A, Wagner CM, Gatera M, Karema C, Nutt CT, Ngabo F. Achieving high coverage in Rwanda’s national human papillomavirus vaccination programme. *Bull World Health Organ* 2012;90:623–8.
- Hirth JM, Tan A, Wilkinson GS, Berenson AB. Completion of the human papillomavirus vaccine series among insured females between 2006 and 2009. *Cancer* 2012;118:5623–9.
- Rwangombwa J. The struggle for ownership of assistance: health and HIV/AIDS in Rwanda. *Development Outreach* 2011;11:11–3. <https://openknowledge.worldbank.org/handle/10986/4566>.
- Logie D, Rowson M, Ndagije F. Innovations in Rwanda’s health system: looking to the future. *Lancet* 2008;372:256–61.
- Porter ME, Lee S, Rhatigan J, Kim JY. Partners in Health: HIV care in Rwanda. Harvard Business School Case 709474. Harvard Business School Press, 2009.
- 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:S158–62.
- Ministry of Health of Rwanda. Rwanda human resources for health program. <http://hrhconsortium.moh.gov.rw>.
- World Health Organization. Global tuberculosis report 2012. [http://apps.who.int/iris/bitstream/10665/75938/1/9789241564502\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/75938/1/9789241564502_eng.pdf).
- World Health Organization. World malaria report 2012. [http://www.who.int/malaria/publications/world\\_malaria\\_report\\_2012/en/index.html](http://www.who.int/malaria/publications/world_malaria_report_2012/en/index.html).
- World Health Organization, United Nations Children’s Fund, United Nations Population Fund, World Bank. (2012). Trends in Maternal Mortality: 1990 to 2010. Geneva, Switzerland: World Health Organization. [www.who.int/reproductivehealth/publications/monitoring/9789241503631/en/index.html](http://www.who.int/reproductivehealth/publications/monitoring/9789241503631/en/index.html).
- United Nations Children’s Fund, World Health Organization, World Bank, United Nations Population Division. Levels and trends in child mortality. 2012. [www.unicef.org/media/files/UNICEF\\_2012\\_IGME\\_child\\_mortality\\_report.pdf](http://www.unicef.org/media/files/UNICEF_2012_IGME_child_mortality_report.pdf).
- Farmer P, Nizeye B, Stulac S, Keshavjee S. Structural violence and clinical medicine. *PLoS Med* 2006;3:e449.
- World Health Organization. Global health expenditure database. <http://apps.who.int/nha/database/DataExplorerRegime.aspx>.
- Alsan MA, Westerhaus M, Herce M, Nakashima K, Farmer PE. Poverty, global health, and infectious disease: lessons from Haiti and Rwanda. *Infect Dis Clin N Am* 2011;25:611–22.
- Bonds MH, Dobson AP, Keenan DC. Disease ecology, biodiversity, and the latitudinal gradient in income. *PLoS ONE* 2012;10:e1001456.
- Kidder A, Bukhman G, eds. The Partners In Health Guide to chronic care integration for endemic non-communicable diseases. Rwanda edition. Cardiac, renal, diabetes, pulmonary, and palliative care. 2011. <http://act.ph.org/ncdguide>.
- Ministry of Health of Rwanda. District hospital action plans. 2012. [http://moh.gov.rw/english/?page\\_id=2200](http://moh.gov.rw/english/?page_id=2200).
- Crisafulli P, Redmond A. Rwanda, Inc.: how a devastated nation became an economic model for the developing world. Palgrave Macmillan, 2012.

**Accepted:** 26 November 2012

**Cite this as:** *BMJ* 2013;346:f65