

ORIGINAL ARTICLES

Making sense of Rwanda's remarkable vaccine coverage success

Julia Robson¹, James Bao², Alissa Wang¹, Heather McAlister³, Jean-Paul Uwizhiwe⁴, Felix Sayinzoga⁴, Hassan Sibomana⁴, Kirstyn Koswin³, Joseph Wong³, Stanley Zlotkin^{*3,5-8}

¹University of Toronto, Toronto, Ontario, Canada

²Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada

³Munk School of Global Affairs and Public Policy, University of Toronto, Toronto, Ontario, Canada

⁴Ministry of Health, Rwanda Biomedical Center, Kigali, Rwanda

⁵The Centre for Global Child Health, The Hospital for Sick Children, Toronto, Ontario, Canada

⁶Department of Paediatrics, University of Toronto, Toronto, Ontario, Canada

⁷Department of Nutritional Sciences, University of Toronto, Toronto, Ontario, Canada

⁸The Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada

Received: December 12, 2019

Accepted: February 14, 2020

Online Published: February 26, 2020

DOI: 10.5430/ijh.v6n1p56

URL: <https://doi.org/10.5430/ijh.v6n1p56>

ABSTRACT

After the Rwandan genocide in 1994, vaccine coverage was close to zero. Several factors, including extreme poverty, rural populations and mountainous geography affect Rwandans' access to immunizations. Post-conflict, various other factors were identified, including the lack of immunization program infrastructure, and lack of population-level knowledge and demand. In recent years, Rwanda is one of few countries that has demonstrated a sustained increase to near universal vaccination coverage, with a current rate of 98%. Our aim was to ask why and how Rwanda achieved this success so that it could potentially be replicated in other countries.

Literature searches of scientific and grey literature, as well as other background research, was conducted from September 2016 through August 2017, including primary fieldwork in Rwanda. We determined that four factors have had a major influence on the Rwandan vaccine program, including strong central government leadership (political will), a culture of accountability, local ownership and a strong health value chain. Rwanda's national immunization program is rooted in a political landscape shaped by unique aspects of Rwandan history and culture. Rwanda has a strong central government and a hierarchical chain of command supported by decentralized implementation bodies. A culture of accountability transcends the entire health system and there is local-level ownership of the immunization program, including the role of engaged community health workers and a strong health information system. Together, these four factors likely account for Rwanda's vaccination coverage success.

Key Words: Vaccinations, Immunizations, Rwanda, Health policy, Communicable diseases

1. INTRODUCTION

Effective childhood immunization programs in low-income countries decrease vulnerability to outbreaks of vaccine pre-

ventable diseases more than any other single intervention. Unfortunately, many countries, both low and high income, have fallen short of expected vaccination coverage rates.^[1]

*Correspondence: Stanley Zlotkin; Email: Stanley.zlotkin@sickkids.ca; Address: The Center for Global Child Health, The Hospital for Sick Children, 525 University Avenue, Suite 701, Toronto, ON M5G2L3, Canada.

Yet, it has been estimated that increasing vaccination coverage to 90% in the poorest countries over the next ten years would prevent an estimated 426 million cases of illness and avert nearly 6.4 million needless childhood deaths worldwide.^[2] Following the Rwandan genocide in 1994, the national immunization coverage was very low (less than 30% in 1995)^[3,4] and the incidence of vaccine preventable diseases (VPD) was high (e.g., 28,000 cases of measles in 1995). As Anuradha Gupta DCEO of GAVI, the Vaccine Alliance recently said: “Like a phoenix from the ashes, Rwanda has emerged as a trailblazer in global health and development since the genocide of 1994. Its troubled past has made Rwanda’s rapid gains all the more remarkable. More than twenty years on, child mortality has been cut in half and basic immunisation coverage now stands at an exceptional 98%.”^[5] We asked ourselves the question, why and how did Rwanda achieve this success – could it potentially be replicated in other countries?

2. METHODS

Literature searches of scientific and grey literature, as well as other background research, was conducted from September 2016 through August 2017, including primary fieldwork in Rwanda. Secondary sources included review of primary databases, grey literature, and peer-reviewed literature that was identified through searches in Google Scholar and PubMed for articles written in English and published since Jan 1, 2000, using combinations of the search terms “Rwanda,” “vaccination,” “immunisation,” and “programme.” No study design, or language limitations were imposed on the search. To ensure literature saturation, we also scanned the reference lists of included studies and other identified reviews for relevant titles. This included successive screening by title, abstract, and full-text. Our review of the academic and grey literature showed that there is evidence that Rwanda’s vaccination rates and program are exceptional compared to regional comparators. This review of the literature uncovered a variety of factors that seemed to have contributed to Rwanda’s excellent success in achieving and sustaining high childhood vaccination rates. Although the academic literature explained some aspects of these factors, our interviews were essential in expanding on and completing these explanations, answering our questions, and highlighting other factors not previously addressed in the literature. We used snow-ball sampling to recruit interviewees. A total of 24 separate, semi-structured interviews with government, NGO and international organization representatives, as well as two site visits were conducted in the Kigali, Rwamagana, and Rulindo districts in August 2017. Once all the interviews had been fully transcribed, we independently read them to iden-

tify both ideas and themes that had previously been identified in our pre-interview literature review as well as new themes. This work resulted in our four consolidated factors, which we describe in detail in the paper. Approval for this project was provided by the University of Toronto’s Research Ethics Board, and the Rwanda Biomedical Center.

3. RESULTS

3.1 Local setting

Several factors including extreme poverty, rural populations and mountainous geography, affect Rwandans’ access to goods and services, including vaccinations. Further, the 1994 genocide devastated health and governing infrastructure within Rwanda and led to a major exodus of health workers, resulting in low to non-existent immunization services and high childhood mortality.^[4,6] Post-conflict, the Ministry of Health, in collaboration with local and international NGOs, identified various other factors that accounted for poor vaccination coverage, such as the lack of immunization program infrastructure, and lack of population-level knowledge and demand for childhood vaccinations. Yet it determined that an enhanced immunization program would be essential to reaching the Millennium Development Goal (MDG) to reduce under-five mortality by two-thirds by 2015.

We identified four factors that had a major influence on the Rwandan vaccine program, including strong central government leadership (political will), a culture of accountability, local ownership and a strong health value chain.

3.1.1 Strong central government leadership (political will)

The success of Rwanda’s national immunization program is rooted in a political landscape shaped by unique aspects of Rwandan history and culture. Rwanda has a strong central government and a hierarchical chain of command that extends down to the local level.^[7] The Rwandan government’s strong political will begins with a top-level commitment to equity in all aspects of service delivery, motivated by the legacy of the 1994 genocide. The government has clearly expressed its commitment to equitable service delivery that reaches all citizens, even those who are hardest to reach. Strong central government leadership is supported by decentralized implementation bodies, including those focused on health in general and immunization in particular. At annual meetings, government personnel from the central and district levels of government discuss and set national targets, such as for particular vaccination program coverage rates. District mayors then meet with local authorities at lower levels of government to formulate and agree on more detailed plans adapted to local circumstances. For example, if a certain district had relatively low average coverage rates, efforts would

be made to understand why this is the case, and to adjust annual plans accordingly.

3.1.2 Culture of accountability

A culture of accountability permeates the entire health system. In particular, *imihigo* (a “vow to deliver”) performance contracts bind all government personnel to levels of authority above and along the entire chain of decentralized imple-

mentation.^[8,9] In the context of Rwanda’s immunization program, central ministries are bound by *imihigos* with the president, the district mayors with the central ministries, and the health centers with the district mayors. This way, the health system is represented at all levels of government to ensure the effective delivery of vaccinations and other health services (see Figure 1).

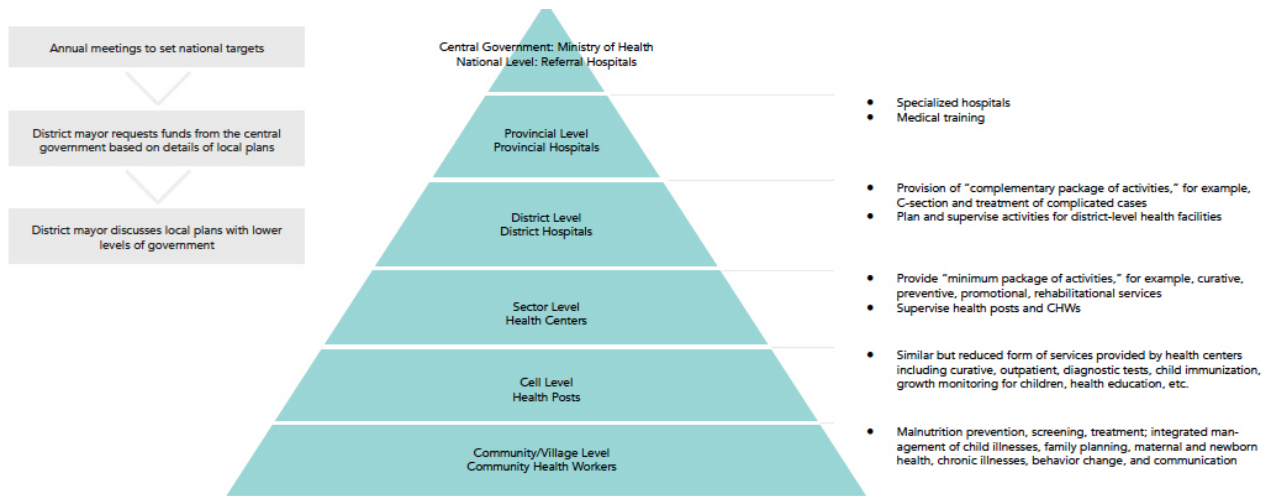


Figure 1. Levels in the chain of command of the Rwandan health care system, and associated responsibilities

3.1.3 Local ownership

Rwanda’s success can also be attributed to local-level ownership of the immunization program, which is an important strength of the program compared to those in other countries. Community Health Workers (CHWs) are elected representatives of the health system at the local level.^[6] CHWs’ responsibilities include comprehensive childhood vaccination education, and ensuring that all children in the community receive their vaccines. Although they do not perform vaccinations themselves (these occur at district health centers), CHWs are essential for mobilizing communities to get children vaccinated. Since CHWs live and work in local communities they are responsible for the identification of all children in their communities. CHWs attend monthly meetings at their district health center and report on community health indicators. At these meetings, health centers provide CHWs with a list of any children who have not been vaccinated. The CHWs’ existing knowledge of their community is cross-referenced with this list. As needed, CHWs accompany mothers and unvaccinated children to the health center to ensure children receive all necessary vaccinations.

Each CHW is trained to identify and report cases of vaccine preventable diseases to ensure a rapid response in the event of an outbreak. CHWs also collect community level vaccination data through RapidSMS, a cellphone-based program.

CHWs strengthen community health and help ensure complete community vaccine coverage by serving as educators and as early identifiers of missed vaccinations.

3.1.4 Strong health value chain

Having a national health information system means every single child can potentially be tracked and thus receive their vaccinations. A national monitoring system can identify children in need of vaccination and facilitate an efficient supply chain to ensure that the vaccines reliably reach where they need to be. Through a bottom-up approach, data from Rwandan CHWs form the foundation of this effort. At the local level, the health information system uses two complementary data collection systems to identify children who have not received their vaccinations: the RapidSMS data collection program and the mUbuzima community-level health information system (interactive voice response [IVR] technology to enable CHW team leaders in each village to submit data on a monthly basis relating to health indicators, including vaccination rates and other health statistics).^[7] The Ministry of Health trains district monitoring and evaluation officers in data analysis and has access to data from all districts. As a result, districts have the ability to analyze data in a timely manner to adapt local programming, while data are communicated centrally for aggregated analysis. Thus, monitoring occurs at multiple levels, with clearly assigned responsibilities.

ties. At the national level, the Ministry of Health combines data sources through Rwanda's National Data Warehouse. This allows for rapid identification of lower than expected vaccination rates, and guides the implementation of required follow-up activities.

3.2 Outside support

Support from NGOs and international organizations (IOs) has benefitted Rwanda's vaccination program in many ways, including improved cold chain capacity, procurement of newly developed vaccines, and funding for vaccination programs for refugees in Rwanda. Furthermore, the national government and Ministry of Health have strong mechanisms in place to coordinate the efforts of important development partners, which include Gavi, Partners in Health, and UNICEF. Regular coordination meetings ensure that development partners are on track to contribute to the government's goals. They also ensure that, as much as possible, services are neither financed nor delivered in "siloes." The government has also leveraged disease-focused funding sources to build system-wide health care infrastructure. Finally, Rwanda, unlike its neighboring countries, has decreased measures of corruption in recent years. (The World Bank's Worldwide Governance Indicators 2016 report shows that Rwanda improved in its corruption ranking from the 50th percentile in 2006 to the 75th percentile in 2016, suggesting improved corruption prevention efforts.)^[8] Low levels of corruption mean that internal and external funding is more likely to be used effectively. Rwanda's ability to consistently meet or exceed expected results after receiving funding from Gavi and other funders contributes to the country's continued ability to secure necessary external funding.

4. DISCUSSION

After the destruction caused by the 1994 genocide and war, immunization programs in Rwanda were essentially non-existent. Since then, Rwanda has experienced a remarkable transformation and is now a robust example of the effectiveness of immunization programs in low-income countries. Through a combination of literature reviews and key-informant interviews, we identified four main factors that had a major influence on the Rwandan vaccine program, including strong central government leadership (political will), a culture of accountability, local ownership and a strong health value chain.^[9] While the existing literature has mainly focused on the chronology of the development of the immunization program and specific geo-political features, our research has helped to confirm these factors and tie them together to create a broader understanding of the importance of each.

As reported by the Global Citizen organization in 2015, when President Kagame of Rwanda was asked why Rwanda has been so successful in reforming itself and achieving the Millennium Development Goals (MDGs), his answer was chiefly related to "political will": "Political will is the one thing that holds the rest together."^[10] Rwanda has demonstrated rapid economic development, a reduction in poverty and mortality rates, access to health care, equal opportunity for education, and policies that empower women. Under the leadership of President Kagame, Rwanda has transformed from a dysfunctional post-conflict nation in the late 1990s into one of the more productive and stable economies in Africa. Described as the "Singapore of Africa," Rwanda is one of the fastest growing economies in Africa, and in the past decade has lifted more than a million people out of poverty.^[11] President Kagame's vision and political will has helped create much of Rwanda's stability. In his 2013 *New York Times* article, Jeffrey Gettleman wrote: "No country in Africa, if not the world has so thoroughly turned itself around in so short a time."^[12] The Rwanda model has proven that foreign aid, coupled with political will, can turn the fate of even the poorest of nations.

We identified that accountability and local ownership likely explain much of the success of the vaccine program in Rwanda. The Rwandan government defines accountability as "the culture of setting goals and achieving them." The concept of accountability in Rwanda has become synonymous with the act of making pledges and fulfilling them under the *imihigo* or performance contract system. Beginning in 2006 the term was adopted to apply to modern results-based management concepts: identifying objectives, setting targets and indicators, and reporting on achievement at the end of a set period.^[13] After the war and genocide, the health system in Rwanda was failing. Three approaches were initially trialed and then institutionalized to improved health outcomes: the process of pledges and goal setting (*imihigo* performance contracts), incentive payments for basic health and communicable diseases, and a rigorous evaluation of impact.^[14-16] The need to motivate and empower providers to produce better outcomes was critical. The pay-for-performance approach provided such an opportunity by financing results rather than inputs. Participating health facilities received financial payments for incremental increases in the quantity of basic health services provided, such as immunization, prenatal care, and assisted deliveries. The overriding goal was to enhance the use of health services by motivating providers. It was possible to scale up these three approaches nationally due to Rwanda's commitment to good governance, including policies aimed at increasing accountability and enhancing the effectiveness of service delivery. By the early 2000s,

there was increasing evidence that measles coverage, for example, increased by almost 11 percentage points in the performance-based financing (PBF) districts, compared to only 1 percentage point in the non-PBF districts.^[17] The combination of performance-based contracts (*imihigo*) and financing was improving immunization coverage.

A further example of the Government of Rwanda’s leadership is the effectiveness of its efforts to prioritize human development and equity. In addition to other factors such as community health workers (CHWs), *Mutuelles de Santé*, continuous monitoring, and a performance-based financing system, the government’s focus on health equity has also contributed significantly to high immunization coverage rates.^[18–20] Holmes focuses on the success of Rwanda’s immunization program in reaching rural populations and points to the decentralized structure of Rwanda’s health services, CHWs, referral systems, and the combination of vaccination services with other health services, as important factors.^[21] While we agree that many of these features of the Rwandan immunization program are important, we found that cultural factors within and outside the government in addition to structural factors were key.

Local ownership was apparent in both the overall immunization program and the implementation of specific new vaccines.^[22] Gatera et al. reviewed the process by which four new vaccines were introduced to Rwanda. This process included awareness days, dissemination of information by CHWs, and the establishment of outreach vaccination sites in remote areas.^[23] For example, during the introduction of the pneumococcal conjugate vaccine, “awareness days were held for local authorities, teachers, traditional healers, religious leaders and community-based non-governmental organizations.”^[23] These activities were intended to encourage acceptance and spread knowledge of the vaccine. During the rollout of the rotavirus vaccine in May 2012, timelines were specific to each health center, and focus groups helped to determine which messaging strategies would be most effective.^[23]

Finally, several factors contribute to the strength of the health value chain in Rwanda. National-level data quality from health centres is very strong and has been improving since 2008.^[24] The literature on logistical aspects of Rwanda’s immunization program also helped frame our understanding and shape our interview instruments. For example, prior to rolling out the pneumococcal conjugate and human papillomavirus vaccines, government immunization staff completed a detailed assessment of the country’s cold storage capacity, including “refrigerators, cold boxes, and vaccine carriers” (p. 3423) and its “human resources for health” capacity to deter-

mine the need for additional infrastructure and health personnel to accommodate distribution of the new vaccines.^[22,23] Ultimately the success of a vaccine program is judged by coverage and “reach.” Coverage at 98% is probably as good as it gets anywhere, and importantly, immunization equity among income quartiles is particularly strong compared to other countries.^[25]

5. CONCLUSION

To the best of our knowledge, the development of Rwanda’s immunization program has not previously been analyzed in a broad and multidimensional way. In this article, we aimed to understand both historical and current factors that likely contributed to the success of the immunization program. However, our methodology was limited in that we were able to conduct interviews over a limited period of time, with only government-approved sources. Furthermore, our analysis of interview transcripts did not include a formal blinded thematic approach, and could have been influenced by the themes we identified during pre-interview research.

Despite these limitations, there are valuable lessons to be learned from Rwanda’s achievements, as shown in Table 1 below. Rwanda’s success is not a one-dimensional story, but a collection of interconnected and coherent narratives that together resulted in the country’s current 98% immunization coverage rate. At the governmental level, Rwanda has demonstrated strong political will characterized by the government’s dedication to equality, a decentralized implementation structure and an effective accountability mechanism. At the local level, a strong sense of ownership is shown through the work of CHWs and community-level campaigns, supported by a robust logistics system which allows for efficient supply chain management and purposeful use of funds.

Table 1. Main contributors to equitable immunization coverage in Rwanda, 1995-2017

1. Strong central government leadership and commitment to equity
2. Culture of accountability and accountability mechanisms
3. Decentralized implementation structure and local ownership
4. Robust logistics and data collection systems

Future research

While many factors of Rwanda’s success are rooted in its unique local circumstances, several aspects of its immunization program could be applicable beyond its boundaries. First, the importance of equity-driven government leadership complemented by strong accountability of officials at all levels of government could be a significant factor in improving implementation of vaccination programs and health service provision more broadly. Although most sub-Saharan

countries use a CHW model to deliver services, the strong culture of accountability that transcends the entire health system, in particular, *imihigo* performance contracts bind the CHWs to levels of authority above and along the entire chain of decentralized implementation. It would be helpful to know whether Rwanda's CHW model, including aspects of data collection, could be successfully applied at scale in other countries to improve their immunization programs.

Technical lessons can also be drawn from Rwanda's data collection capacity. Both high- and low-income countries could learn from Rwanda's implementation of electronic data collection techniques, which might be able to better identify areas with low vaccination rates in the effort to prevent outbreaks of vaccine-preventable diseases. Future research that includes case studies of successful immunization pro-

grams in other countries and the errors made by unsuccessful programs will advance our understanding of the challenges associated with vaccine programs. In Rwanda specifically, studies that validate future immunization program-related metrics would be valuable, as would comparisons using district-level data to identify specific best practices, especially in the hardest-to-reach areas.

FUNDING

This research was supported by the Mastercard Center for Inclusive Growth. Dr. Zlotkin's contribution was supported by the Mining4Life Chair in Mineral Metabolism.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare no conflicts of interest.

REFERENCES

- [1] Stack M, Ozawa S, Bishai D, et al. Estimated economic benefits during the 'decade of vaccines' include treatment savings, gains in labor productivity. *Health Affair*. 2011 June; 30(6): 1021-1028. PMID:21653952. <https://doi.org/10.1377/hlthaff.2011.0382>
- [2] Shen A, Fields R, McQuestion M. The future of routine immunization in the developing world: challenges and opportunities. *Global Health: Science and Practice*. 2014 Dec; 2(4): 381-394. PMID:25611473. <https://doi.org/10.9745/GHSP-D-14-00137>
- [3] World Health Organization and United Nations Children's Fund. WHO vaccine-preventable diseases: monitoring system: WHO UNICEF estimates time series for Rwanda. WHO and UNICEF; 2018. [cited 2020 Jan 30]; Available from: http://apps.who.int/immunization_monitoring/globalsummary/estimates?c=RWA
- [4] Binagwaho A, Farmer PE, Nsanzimana S, et al. Rwanda 20 years on: investing in life. *Lancet Public Health*. 2014 Apr; 384(9940): 371-375.
- [5] Gupta A. Rwanda's virtuous cycle of vaccination and innovation [Internet]. Gavi The Vaccine Alliance. [cited 2020 Jan 30]; 2018. Available from: <https://www.gavi.org/vaccineswork/rwandas-virtuous-cycle-of-vaccination-and-innovation>
- [6] Condo J, Mugeni C, Naughton B, et al. Rwanda's evolving community health worker system: a qualitative assessment of client and provider perspectives. *Hum Resour Health*. 2014 Dec; 12(71): e2-e7. PMID:25495237. <https://doi.org/10.1186/1478-4491-12-71>
- [7] World Health Organization. Assisting community health workers in Rwanda: MOH's RapidSMS and mUbuguzima. World Health Organization; 2013. [cited 30 Jan 2020]. Available from: <http://www.who.int/iris/handle/10665/92814>
- [8] World Bank. Worldwide Governance Indicators Interactive Data Access; 2018. [cited 30 Jan 2020]. Available from: <http://info.worldbank.org/governance/wgi/#reports>
- [9] Kamuzinzi M. Imihigo: A hybrid model associating traditional and modern logics in public policy implementation in Rwanda. *International Journal of African Renaissance Studies*. 2016 Aug; 11(1): 123-141. <https://doi.org/10.1080/18186874.2016.1212477>
- [10] Keating K. Rwandan President Kagame on political will. New York: Global Citizen; c2012-2020 [cited 2020 Feb. 6]. Available from: <https://www.globalcitizen.org/en/content/rwandan-president-kagame-on-political-will/>
- [11] The World Bank Data [Internet]. Washington (DC): The World Bank. 2019 - [cited 2020 Feb 6]. Available from: <https://data.worldbank.org/country/rwanda>
- [12] Gettleman J. The global elite's favorite strongman. *The New York Times Magazine*. 2013 Sept. 4. Available from: <https://www.nytimes.com/2013/09/08/magazine/paul-kagame-rwanda.html>
- [13] Hieder C. Annual Report 2015: Deepening Impact. Washington (DC): World Bank Group Independent Evaluation Group; 2015. 30 p. Available from: <http://ieg.worldbank.org/evaluations/ar2015>
- [14] Honeyman CA. Accountability practices and policies in Rwanda's education system. New York (NY): UNESCO Global Education Monitoring Report; 2017. 25 p.
- [15] Beschel RP, Cameron BJ, Kunicova J, et al. Improving public sector performance: through innovation and inter-agency coordination (English). Global Report Public Sector Performance. Washington (DC): World Bank Group; 2018. 200 p. Available from: <http://documents.worldbank.org/curated/en/833041539871513644/Improving-Public-Sector-Performance-Through-Innovation-and-Inter-Agency-Coordination>
- [16] Ministry of Health, Republic of Rwanda. Rwanda's Performance in Addressing Social Determinants of Health and Intersectoral Action. A Review Against the Five Themes of the Rio Political Declaration. WHO Regional Office for Africa. 2019. Available from: <https://www.knowledge-action-portal.com/en/content/rwandas-performance-addressing-social-determinants-health-and-intersectoral-action>
- [17] Rusa L, Schneidman M, Fritsche G, et al. Rwanda: Performance-based financing in the public sector. Washington (DC): Center for Global Development; 2009. 214 p.
- [18] Farmer PE, Nutt CT, Wagner CM, et al. Reduced premature mortality in Rwanda: lessons from success. *BMJ Brit Med J*. 2013 Jan;

- 346(f65): 1-7. PMID:23335479. <https://doi.org/10.1136/bmj.f65>
- [19] Logie D, Rowson M, Ndagije F. Innovations in Rwanda's health system: looking to the future. *The Lancet*. 2008 July; 372(9634): 256-261. [https://doi.org/10.1016/S0140-6736\(08\)60962-9](https://doi.org/10.1016/S0140-6736(08)60962-9)
- [20] Sayinzoga F, Bijlmakers L. Drivers of improved health sector performance in Rwanda: a qualitative view from within. *BMC Health Serv Res*. 2016 Apr; 16(122): 1-10. PMID:27059319. <https://doi.org/10.1186/s12913-016-1351-4>
- [21] Holmes D. Rwanda: an injection of hope. *The Lancet World Report*. 2010. 376: 945-946. [https://doi.org/10.1016/S0140-6736\(10\)61436-5](https://doi.org/10.1016/S0140-6736(10)61436-5)
- [22] Binagwaho A, Kyamanywa P, Farmer PE, et al. The human resources for health program in Rwanda-a new partnership. *New Engl J Med*. 2013 Nov; 369(21): 2054-2059. PMID:24256385. <https://doi.org/10.1056/NEJMs1302176>
- [23] Gatera M, Bhatt S, Ngabo F, et al. Successive introduction of four new vaccines in Rwanda: High coverage and rapid scale up of Rwanda's expanded immunization program from 2009 to 2013. *Vaccine*. 2016 June; 34(29): 3420-3426. PMID:26704259. <https://doi.org/10.1016/j.vaccine.2015.11.076>
- [24] Nisingizwe MP, Iyer HS, Gashayija M, et al. Toward utilization of data for program management and evaluation: quality assessment of five years of health management information system data in Rwanda. *Global Health Action*. 2014 Nov; 7(1): 1-5. PMID:25413722. <https://doi.org/10.3402/gha.v7.25829>
- [25] Hinman A, McKinlay M. Immunization equity. *Am J Prev Med*. 2014 Aug; 49(6): S399-S405. PMID:26282089. <https://doi.org/10.1016/j.amepre.2015.04.018>