

Establishing a Sustainable Cardiothoracic Surgery Program in Rwanda: Conference Proceedings from the 2024 National Cardiothoracic Surgery Symposium

Authors: Yayehyirad Ejigu^{1*}; Bertrand Byishimo¹; Emile Twagirumukiza¹; Kara L. Neil¹, Menelas Nkeshimana²; Eric Remera²; Maurice Musoni²; Ciro Campanella¹; Evariste Ntaganda²

Affiliations: ¹King Faisal Hospital Rwanda, Kigali, Rwanda; ²Ministry of Health Rwanda, Kigali, Rwanda; ³Rwanda Biomedical Centre, Kigali, Rwanda

ABSTRACT

Cardiovascular diseases (CVDs) pose a significant health challenge worldwide, particularly in low- and middle-income countries, including Rwanda.

A National Cardiothoracic Surgery Symposium was held on February 23, 2024, in Kigali, Rwanda. Bringing together key stakeholders and experts in the field, the Symposium focused on the establishment of a sustainable cardiothoracic surgery program in Rwanda.

The Symposium discussed current surgical outcomes, program sustainability, early diagnosis and follow-up strategies, and the development of a cardiovascular disease research agenda. The Symposium highlighted the progress made in identifying and managing cardiac diseases in populations of all age groups and at all levels of service delivery in Rwanda.

The Symposium concluded that Rwanda would continue to bridge knowledge gaps through education and training programs, enhance national and international multidisciplinary collaboration to meet the cardiac healthcare needs of its populations and develop a robust research agenda for informed policy planning.

Keywords: Cardiovascular Diseases, Cardiac Surgery, Rwanda, Congenital Heart Disease, Rheumatic Heart Disease, Non-communicable Diseases

INTRODUCTION

Cardiovascular diseases (CVDs) encompass the diseases that affect health and blood vessels [1]. CVDs continue to pose a significant health challenge worldwide, and Rwanda is no exception. CVDs are the leading cause of death globally,

and the World Health Organization estimates cardiovascular disease to be responsible for 17.9 million lives annually, of which 85% are due to heart attack and stroke [2]. However, the impact of CVD is disproportionately felt in low- and middle-income countries, where the burden of CVD is a daunting 2.5 times higher than in high-income

***Corresponding author:** Yayehyirad Ejigu, MMed, Email: yayehyirad.ejigu@kfhkigali.com, Address: King Faisal Hospital Rwanda, Kigali, Rwanda; **Potential Conflicts of Interest (Col):** All authors: no potential conflicts of interest disclosed; **Potential Conflicts of Interest (Col):** All authors: no potential conflicts of interest disclosed; **Funding:** All authors: no funding was sought; **Academic Integrity.** All authors confirm that they have made substantial academic contributions to this manuscript as defined by the ICMJE; **Ethics of human subject participation:** The study was approved by the local Institutional Review Board. Informed consent was sought and gained where applicable; **Originality:** All authors: this manuscript is original has not been published elsewhere; **Review:** This manuscript was peer-reviewed by three reviewers in a double-blind review process.

Received: 4th October 2024; **Initial decision given:** 7th October 2024; **Revised manuscript received:** 14th October 2024; **Accepted:** 14th November 2024.

Copyright: © The Author(s). This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC BY-NC-ND) ([click here](#)) which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. **Publisher:** Rwanda Biomedical Centre (RBC)/Rwanda Health Communication Center, P. O. Box 4586, Kigali. ISSN: 2079-097X (print); 2410-8626 (online)

Citation for this article: Yayehyirad Ejigu; Bertrand Byishimo; Emile Twagirumukiza, et al. Establishing a Sustainable Cardiothoracic Surgery Program in Rwanda: Conference Proceedings from the 2024 National Cardiothoracic Surgery Symposium. Rwanda Medical Journal, Vol. 81, no. 4, p. 63-68, 2024. <https://dx.doi.org/10.4314/rmj.v81i4.2>

countries [3]. Rwanda, like other low- and middle-income countries, is experiencing a significant increase in CVDs. In 2016, cardiovascular diseases accounted for 14% of all deaths associated with non-communicable diseases (NCDs), according to the Rwanda Biomedical Centre [4]. This statistic is a stark reminder of the pervasive nature of CVDs, including their impact on the health and well-being of the Rwandan population. The reasons behind this trend are multifaceted, involving factors such as a lack of awareness about cardiovascular diseases and a paucity of healthcare providers equipped to address these complex conditions, among others.

Nevertheless, Rwanda has made commendable progress with screening and surgical camps and other initiatives to treat patients with CVDs. Routine surgical camps, often facilitated by surgeons from abroad, have undoubtedly brought healing to countless patients [5,6]. These endeavors reflect Rwanda's commitment to tackling CVDs. However, the success of these initiatives is ultimately tempered by a deficit in research output, as well as an insufficient approach to collecting vital data from cardiovascular disease patients, which hampers the holistic control and management of CVDs within the country. Hence, in recognizing the depth of this challenge, an opportunity to ignite change by gathering and sharing expertise in tackling CVDs through a symposium is also seen. The 2024 Symposium represented a significant step towards addressing the existing gap in CVDs and uniting all stakeholders in the pursuit of more effective and informed strategies for tackling CVDs in Rwanda. Through interdisciplinary collaboration and shared enthusiasm, the knowledge gap could be bridged, data could be translated into meaningful action, and a journey towards effective control and management of CVDs could be embarked on.

This paper summarizes the key points presented at the National Cardiothoracic Surgery Symposium, which took place on February 23, 2024, in Kigali, Rwanda. The session covered several thematic areas, including the current adult and pediatric surgical outcomes, strengthening program sustainability, ensuring early diagnosis and follow-up strategies, as well as defining a cardiovascular disease research agenda.

METHODS

A one-day national symposium was facilitated by the Ministry of Health, Rwanda Biomedical Centre, Rwanda Social Security Board, King Faisal Hospital Rwanda, and the Rwanda Non-Communicable Diseases Alliance. Members of each of these organizations were in full attendance, and up to 100 additional participants attended, including patients, health professionals, researchers, and policymakers, among others. The conference covered a range of topics, including testimonies of patients, panel discussions, speeches, and addresses.

RESULTS

The overarching theme of the symposium was establishing a sustainable cardiac surgery program in Rwanda. Objectives included harmonizing cardiac data collection and management, leveraging partnerships in CVD research, disseminating research outcomes, articulating a shared research agenda, and fostering evidence-informed decisions in CVD management.

The State of Cardiac Surgery in Rwanda: Separate presentations were given on the state of adult and pediatric cardiothoracic surgery in Rwanda, and how they contribute to CVD care from a surgical perspective. There has been tremendous progress since the in-house adult cardiothoracic surgery program was established in early 2024 at King Faisal Hospital Rwanda. With a permanent team, more surgeries were conducted, and nurses, surgeons, and cardiologists progressed since the exposure had grown from a monthly basis to a daily running program. New procedures were initiated, including aortic aneurysm and arterial revascularization. As of the Symposium, 23 in-house adult procedures were performed.

The pediatric cardiac surgery program also began regular operations in October 2022. Before this, cardiac patients were operated on by visiting teams from Australia, Canada, Belgium, and the United States, performing up to 30 cases per year. Currently, the number of pediatric cardiac surgeries is 4 per week, and the projected number of surgeries per year is 200. Up until now, 206 pediatric cardiac procedures have been performed in 18 months. Among them, 58 were conducted in the presence of visiting teams, with the local team

actively participating, whereas the local team exclusively operated the rest. There is a mortality rate of 1.9% for all patients operated by the team in Rwanda. The mix of cases includes from a simple patent ductus arteriosus (PDA) ligation to cases like neonatal arterial switches but with anything in between, such as arterial septal defect (ASD), ventricular septal defect (VSD), coarctation of the aorta (COA), atrioventricular canal and tetralogy of Fallot (TOF) repairs. On top of the clinical service delivery, the programs gained and retained knowledge and experience from rotating foreign teams with international trips and the exchange of foreign teams, and numbers substantially decreased.

Starting a cardiothoracic surgery program is a significant endeavor because a hospital should have sufficient infrastructures (e.g., ward, theater, ICU, and an outpatient clinic), a specialized team (surgeons, fellows, residents, theater ICU nurses, and perfusionists), and clinical systems in place. Patient access also requires having a sustainable insurance scheme and a referral system, and budget and financial commitments are also needed to start a stronger program. Other items needed include quality assurance and standards, collaboration and partnership, public awareness and education, and regulatory and ethical considerations, among others. As the program is still growing, the King Faisal Hospital (KFH) team targets to introduce new technologies, including minimally invasive cardiac surgery like off-pump coronary artery bypass graft (CABG) and minimally invasive mitral and aortic valve surgery.

Equitable Access to CVD Care: Access to CVD care was another focus area of the Symposium. Historically, in Rwanda, the diagnosis of cardiac conditions requiring surgical interventions required patients to travel abroad for surgery, posing significant cost and logistical implications to both the Government of Rwanda and the patient. According to Medical Referral Board (MRB) reports, there are 3 main reasons Rwandans would travel overseas for medical care, namely cardiovascular diseases, organ transplant needs, and oncology care components that were not previously available locally. The development of a cardiothoracic program that runs on a full-time basis has enabled a well-concerted connection between the bedside findings in remote hospitals in Rwanda and the expanded highly specialized

cardiac services offered at KFH. This also supports more equitable access to care for the whole population, who can now get these surgical services without traveling abroad.

Health Workforce Development: As is often the case for many countries in the sub-Saharan region, Rwanda also faces a shortage of staff, whereby the health workforce density is at one skilled health professional per 1,000 population [7]. In that regard, the distribution of services is being strengthened to enable equitable access to specialized health care across the whole country. In line with the current reforms, including the 4x4 strategy of the Government of Rwanda, which aims to quadruple the health workforce of Rwanda in the next 4 years, cardiac-related programs are listed among the most pressing priority programs [8]. This strategic vision of the country is gradually moving away from the classical short medical missions that focus only on clinical service delivery. Rather, these programs are moving towards a training focus and establishing degree-granting academic programs so that the sustainability of the services provided is embraced. This model also leverages the existing partnerships but through a training lens, whereby they contribute to the teaching of these established academic programs. Several programs have started to enroll trainees, primarily through the University of Rwanda, including fellowship programs in adult cardiology, pediatric cardiology, and cardiothoracic surgery.

Partnerships and Stakeholder Collaboration: In Rwanda, before the initiation of uninterrupted full-time cardiac surgery services, five main medical mission partners were engaged, with an average of 12 trips annually. Some missions have existed for more than 15 years. While these collaborations had led to several patients receiving care, there was limited output in terms of a trained workforce with academically grade-able qualifications. The shift in this approach to send trainees abroad for their full training has been initiated to the enrolment in locally based programs, especially for the postgraduate programs that are mainly bedside based. The current volume of cardiac patients creates a unique opportunity to transmit the skills to junior colleagues from the full-time cardiac surgeons in Rwanda, who are also affiliated faculty at the University of Rwanda.

Early Diagnosis and Post-Operative Follow-Up Strategies:

Rheumatic and congenital heart diseases are among the causes of heart failure and death in children and young adults [9]. Over the last 10 years, Rwanda has reinforced screening of heart diseases, including congenital rheumatic heart disease, for early treatment, including open heart surgery for advanced cases eligible [10]. Cases screened by trained clinicians at the district and provincial hospitals are referred to KFH, where cardiac surgeries are conducted. The goal of the pre-operative screening procedure is to ascertain whether the patient is surgically eligible and how urgently surgery is required. The patient stays one to two weeks after surgery at KFH to receive early postoperative care and monitoring. Following their discharge, patients receive follow-up care every month for three months at the NCD clinic or teaching hospital nearest to their place of residency.

Long-term follow-up is conducted at the referral hospital or the NCD clinic in the patient's district after three months. Patients who are operated upon outside of Rwanda are given identical postoperative care [10]. Results for RHD patients tracked after surgery in rural Rwandan hospitals were largely positive. It is safe to decentralize the follow-up of patients with RHD to nurse-led specialty NCD clinics following heart surgery if they receive the necessary training and supervision [10,11]. The integrated NCD clinic operations suite includes monitoring postoperative cardiac patients, and NCD nurses screen and treat other chronic NCDs such as hypertension, diabetes, heart failure, and chronic respiratory disorders [12].

DISCUSSION

Historically, research focused on infectious diseases, and the shift toward NCDs in line with national health sector research policy has been emphasized. Particularly, the research agenda targeting interventions that reduce the CVD burden in Lower- and Middle-Income Countries (LMICs), including Rwanda, should be prioritized [13,14]. Rwanda's CVD research agenda aims to enhance screening programs and deepen the understanding of the burden, trends, and determinants of CVDs among the population of all age groups. It will also be designed to assess and evaluate the cost-effectiveness of the preventive

programs and management programs. Moving forward, both primary data from the surgical camps and outreaches and secondary data from across the health facilities registers will be corrected, analyzed, and published to raise awareness of CVDs and inform medical practice.

The conference further highlighted the importance of leveraging health technologies and incorporating data science and artificial intelligence into CVD's diagnostics practice [15]. Through the partnerships between the Ministry of Health, IRCAD Africa, universities, independent researchers, and other research bodies, it is essential to ensure continuous research mentorship and uninterrupted funding and engagement opportunities. These efforts will help to generate high-quality evidence that will inform national policies and improve patient outcomes.

As cardiac surgery is running daily, data must be kept and stored in a way that will benefit both patients, the government, and partners. This data is needed to inform high-level decisions that impact the population and evaluate cardiac surgery services as well. Worth noting more funding is available when data is presented to the teams. From there, it is easy to determine what kind of approaches, data, and support are needed. Data also indicates the progress that has been achieved; hence, having a national registry would help a lot [16].

Rwanda Biomedical Centre and KFH have started using the cardiac registry and research electronic data capture (REDCap) database to collect, store, analyze, and disseminate data related to screening, treatment, and other national indicators for cardiac diseases. This is a reliable and convenient way to keep data safe. REDCap-based data collection and data-analysis workflow has been found to provide a remote and secure method to collaborate, reduce technical difficulties, and allow role-based access control [17–19]. All data metrics regarding patients (adult cardiac, pediatric cardiac, and thoracic) are being added to the system. As a part of the validation process, prior to installing their REDCap, RBC first consulted cardiologists and cardiac surgeons to provide their comments before it was put in place.

It has been demonstrated that an in-house cardiac surgery program facilitates more long-term sustainability than full reliance on surgical missions. Surgical missions come for a week and leave; nurses and surgeons who were working in

the cardiac unit go back to other departments and receive cardiac patients again in the following mission. This approach was used in different African countries where there were a small number of cardiac surgeons [20,21]. Nevertheless, this really reduces local health workers' exposure, and it doesn't create consistency in their work or patient care. Observations that the cardiac mission approach is also not sustainable and its association with high expenditure have been reported [22,23]. Alongside this, the in-house team conducted a comprehensive needs assessment to strengthen the infrastructure and systems needed alongside the locally run program. Specifically, they identified any required equipment, materials, and consumables and engaged with our pharmacy and procurement teams to bring them. Whereas previously visiting teams would bring their own consumables, now the local team is advocating for long-term systemic shifts to make the program sustainable locally.

CONCLUSION

The 2024 National Cardiothoracic Surgery Symposium highlighted the progress and challenges in establishing a sustainable cardiothoracic surgery program in Rwanda. The discussions resulting from the symposium may be used to strengthen the national program further and as a model for other programs under development. Through interdisciplinary collaboration, Rwanda aims to bridge knowledge gaps in cardiovascular diseases, improve patient care, and develop a robust research agenda to tackle cardiovascular diseases.

REFERENCES

- Gaidai, O.; Cao, Y.; Loginov, S. Global Cardiovascular Diseases Death Rate Prediction. *Curr. Probl. Cardiol.* 2023, 48, 101622, doi:10.1016/j.cpcardiol.2023.101622.
- Cardiovascular Diseases (CVDs) Available online: [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)) (accessed on 28 June 2024).
- Ahadzi, D.; Gaye, B.; Commodore-Mensah, Y. Advancing the Cardiovascular Workforce in Africa to Tackle the Epidemic of Cardiovascular Disease: The Time Is Now. *Glob. Heart* 18, 20, doi:10.5334/gh.1197.
- National Strategy and Costed Action Plan for the Prevention and Control of Non-Communicable Diseases in Rwanda: July 2020-June 2025 | ICCP Portal Available online: <https://iccp-portal.org/national-strategy-and-costed-action-plan-prevention-and-control-non-communicable-diseases-rwanda> (accessed on 13 August 2024).
- Swain, J.D.; Sinnott, C.; Breakey, S.; Charles, R.H.; Mody, G.; Nyiramanzi, N.; Patton-Bolman, C.; Come, P.; Ganza, G.; Rusingiza, E.; et al. Ten-Year Clinical Experience of Humanitarian Cardiothoracic Surgery in Rwanda: Building a Platform for Ultimate Sustainability in a Resource-Limited Setting. *J. Thorac. Cardiovasc. Surg.* 2018, 155, 2541–2550, doi:10.1016/j.jtcvs.2017.11.106.
- Gardner, T.J. Open Heart Surgery in Rwanda: A Legacy of Surgeon Leadership and Vision. *J. Thorac. Cardiovasc. Surg.* 2018, 155, 2551–2552, doi:10.1016/j.jtcvs.2017.12.052.
- Ahmat, A.; Okoroafor, S.C.; Kazanga, I.; Asamani, J.A.; Millogo, J.J.S.; Illou, M.M.A.; Mwinga, K.; Nyoni, J. The Health Workforce Status in the WHO African Region: Findings of a Cross-Sectional Study. *BMJ Glob. Health* 2022, 7, e008317, doi:10.1136/bmjgh-2021-008317.
- The 4x4 Reform: A Path to Quality Health Care in Rwanda Available online: <https://www.moh.gov.rw/news-detail/the-4x4-reform-a-path-to-quality-health-care-in-rwanda> (accessed on 29 March 2024).
- Fahed, A.C.; Roberts, A.E.; Mital, S.; Lakdawala, N.K. Heart Failure in Congenital Heart Disease: A Confluence of Acquired and Congenital. *Heart Fail. Clin.* 2014, 10, 10.1016/j.hfc.2013.09.017, doi:10.1016/j.hfc.2013.09.017.
- Ntaganda, E.; Rusingiza, E.; Rukundo, G.; Ng'ang'a, L.; Hedt-Gauthier, B.; El-Khatib, Z.; Kwan, G.F.; Gapira, G.; Worrall, N.K.; Swain, J.; et al. Postoperative Rheumatic Heart Disease Follow-Up: Creating a National Registry and First Results from Rwanda. *Ann. Glob. Health* 86, 115, doi:10.5334/aogh.2719.
- Rusingiza, E.K.; El-Khatib, Z.; Hedt-Gauthier, B.; Ngoga, G.; Dusabeyezu, S.; Tapela, N.; Mutumbira, C.; Mutabazi, F.; Harelimana, E.; Mucumbitsi, J.; et al. Outcomes for Patients with Rheumatic Heart Disease after Cardiac Surgery Followed at Rural District Hospitals in Rwanda. *Heart* 2018, 104, 1707–1713, doi:10.1136/heartjnl-2017-312644.
- Niyonsenga, S.P.; Park, P.H.; Ngoga, G.; Ntaganda, E.; Kateera, F.; Gupta, N.; Rwagasore, E.; Rwunganira, S.; Munyarugo, A.; Mutumbira, C.; et al. Implementation Outcomes of National

- Decentralization of Integrated Outpatient Services for Severe Non-communicable Diseases to District Hospitals in Rwanda. *Trop. Med. Int. Health* 2021, 26, 953–961, doi:10.1111/tmi.13593.
13. Qureshi, N.Q.; Mufarrih, S.H.; Bloomfield, G.S.; Tariq, W.; Almas, A.; Mokdad, A.H.; Bartlett, J.; Nisar, I.; Siddiqi, S.; Bhutta, Z.; et al. Disparities in Cardiovascular Research Output and Disease Outcomes among High-, Middle- and Low-Income Countries – An Analysis of Global Cardiovascular Publications over the Last Decade (2008–2017). *Glob. Heart* 16, 4, doi:10.5334/gh.815.
14. Pena, M.S.B.; Bloomfield, G.S. Cardiovascular Disease Research and the Development Agenda in Low- and Middle-Income Countries. *Glob. Heart* 2015, 10, 71–73, doi:10.1016/j.gh.2014.12.006.
15. Yan, Y.; Zhang, J.-W.; Zang, G.-Y.; Pu, J. The Primary Use of Artificial Intelligence in Cardiovascular Diseases: What Kind of Potential Role Does Artificial Intelligence Play in Future Medicine? *J. Geriatr. Cardiol. JGC* 2019, 16, 585–591, doi:10.11909/j.issn.1671-5411.2019.08.010.
16. Meltzer, S.N.; Weintraub, W.S. The Role of National Registries in Improving Quality of Care and Outcomes for Cardiovascular Disease. *Methodist DeBakey Cardiovasc. J.* 2020, 16, 205–211, doi:10.14797/mdcj-16-3-205.
17. Senger, R.; Santarem, M.D.; Goldmeier, S. Clinical Registry of Cardiovascular Surgeries in a University Hospital. *Rev. Assoc. Médica Bras.* 2019, 65, 16–23, doi:10.1590/1806-9282.65.1.16.
18. Santos, S. dos; Santarém, M.D.; Rodrigues, C.G.; Moraes, M.A.P. de Implementation of a Management Registry for Storing Clinical Data in a Research Centre. *J. Int. Soc. Telemed. EHealth* 2017, 5, (GKR);e48:(1-3).
19. Rovera, G.; Fariselli, P.; Deandreis, D. Development of a REDCap-Based Workflow for High-Volume Relational Data Analysis on Real-Time Data in a Medical Department Using Open Source Software. *Comput. Methods Programs Biomed.* 2022, 226, 107111, doi:10.1016/j.cmpb.2022.107111.
20. Ejigu, Y.M.; Amare, H. Pediatric Cardiac Surgery in Ethiopia: A Single Center Experience in a Developing Country. *Ethiop. J. Health Sci.* 2023, 33, doi:10.4314/ejhs.v33i1.10.
21. Falase, B.; Olufemi, S.; Ikotun, F.; Daniel, F.; Idowu, A.; Khodaverdian, R.; Farkas, E. Making the Transition From Cardiac Missions to Autonomous Heart Surgery at a Nigerian Teaching Hospital: Challenges and Lessons Learned. *Semin. Thorac. Cardiovasc. Surg.* 2023, doi:10.1053/j.semtcvs.2023.05.002.
22. Woldmichael, K.G.; Aklilu, T.M. Mission-Based Cardiac Surgery and Catheter Treatment of Coarctation of Aorta in the Young and Older Children: A Facility Based Review of Cases in Addis Ababa. *Pan Afr. Med. J.* 2019, 34, doi:10.11604/pamj.2019.34.160.19406.
23. Nwafor, I.A.; Vickram, A.; Osenmabor, K.O. Surgical ‘Safari’ vs. Educational Program: Experience with International Cardiac Surgery Missions in Nigeria. *Braz. J. Cardiovasc. Surg.* 2020, 35, 918–926, doi:10.21470/1678-9741-2020-0155.