

South-to-south collaboration to strengthen the health workforce: the case of paediatric cardiac surgery in Rwanda

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ABSTRACT

Paediatric cardiovascular diseases have been referred to as diseases of injustice as access to care is inequitable globally. For example, Africa only has 78 cardiac centres, with 22 located in Sub-Saharan Africa. Most of these centres rely on visiting surgical teams to provide clinical care. While visiting surgical teams provide essential care, building a sustainable and locally run cardiac workforce in Africa is critical to addressing these inequities in access to care. This paper considers the role of south-to-south partnerships in building sustainable surgical programmes using Rwanda's paediatric cardiac surgery programme as an example.

SUMMARY BOX

- ⇒ With 22 cardiac centres in Sub-Saharan Africa and 78 across the continent, many centres rely heavily on visiting surgical teams to provide clinical care, posing challenges to programme sustainability.
- ⇒ Rwanda has made significant progress towards establishing a fully sustainable paediatric cardiac surgery programme, transitioning away from reliance on visiting teams towards local capacity building.
- ⇒ South-to-south partnerships have the potential to build sustainable programmes by strengthening equitable access to surgery, health workforce development and mentorship programmes.

BACKGROUND

Despite 80% of deaths from cardiovascular diseases occurring in low-income and middle-income countries (LMICs), these countries have the biggest gap in terms of availability of cardiac surgical care, with Africa having only one cardiothoracic surgeon per four million people.¹ The persistence of inequities in access to paediatric cardiovascular care is a fundamental injustice. For example, while 97% of rheumatic heart diseases occur in LMICs, only 11% of the population can access surgical care.¹ The same applies to congenital heart disease (CHD), where one-third of untreated children die within a month.¹ In LMICs, the lack of availability of echocardiography and CHD surgery results in children dying from CHD, whereas those in higher-resourced settings have ready access to care.²

Building a sustainable, qualified cardiac workforce in Sub-Saharan Africa is critical to addressing the significant inequities across the region. There are 78 cardiac centres or units on the continent, with 22 located in Sub-Saharan Africa.² However, most of

these centres, including the one in Rwanda, have relied heavily on visiting surgical teams coming for a few weeks per year. Historically, surgical care across the continent has undergone a gradual shift away from colonial legacies, where surgical care was largely managed by a surgeon from the colonising country, with local surgeons being required to have their training validated in Western countries for legitimacy.³ Few countries have made the transition to having fully locally run programmes. When globally distributed, Africa still only has 2.7% of the world's cardiothoracic surgeons.⁴ The workforce gap is further exacerbated in paediatric cardiac surgery, with only 1.99 paediatric cardiac surgeons per million in the region when adjusted for the paediatric population.¹ The only way these inequities can be addressed is for countries and institutions in the region to implement rigorous health workforce development plans with expert partners that engage international experts while transitioning to a locally managed and sustainable training model. This is further strengthened through strong government support and



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mobilisation of resources to build the programme.⁴ Additionally, this must consider all cadres of professionals required to sustainably run the programme, including medical doctors, nurses, allied health professionals, biomedical engineers and administration.

HEALTH WORKFORCE DEVELOPMENT IN RWANDA

The Government of Rwanda significantly invests into building its health workforce in alignment with the national 'four by four' strategy, aiming to quadruple the health workforce over an average of 4 years.^{5,6} Specifically, this strategy aims to move Rwanda closer to the WHO's health workforce targets by establishing and strengthening training programmes, recapturing local faculty and leveraging partnerships, and improving the existing capacity of training institutions.^{6,7} One way this will be achieved is through increasing residency and fellowship intake capacity, including in general surgery and cardiothoracic surgery, from an overall average of 72 per year in 2020–2022 to a minimum of 208 per year. This adjusted enrolment rate will lead to over 1000 enrollees by 2028.⁸

In terms of cardiovascular care, which is one of Rwanda's national priorities, there are currently two Rwandan paediatric cardiologists and one adult cardiothoracic surgeon practising in the country.⁵ The country currently does not have any Rwandan paediatric cardiac surgeon. Workforce projections over the next 4 years were developed with the aim of having one complete local team trained to run the programme, including 5 paediatric cardiologists, 1 paediatric cardiac surgeon, 4 adult cardiac surgeons, 5 paediatric critical care specialists and 10 perfusionists. While this is not sufficient to address the burden of disease, the long-term plan is to continue scaling up the workforce to meet this burden over the coming 10 years.

Substantial investments were dedicated to the recruitment of expatriate faculty, ensuring the inclusion of at least one full-time specialist in each focal domain, including specialised nurses, perfusionists, paediatric intensivists, paediatric cardiologists and a paediatric cardiac surgeon. In 2021, the University of Rwanda inaugurated subspecialty fellowship programmes, marking a noteworthy milestone. These programmes, encompassing adult cardiology and paediatric cardiology, attracted two cohorts of fellows each, currently immersed in a comprehensive training at tertiary-level teaching hospitals within Rwanda⁹ and further enriched by external rotations abroad in India, Vietnam, France and the USA.

King Faisal Hospital Rwanda (KFH), situated in Kigali, Rwanda, is a quaternary-level teaching hospital currently expanding its capacity from 160 to over 600 beds. The hospital is also in the process of establishing its own medical college. Notably, KFH houses Rwanda's sole catheterisation laboratory and operates the exclusive paediatric cardiac surgery programme in the country. In the past, the hospital depended on international surgical teams from Australia, Belgium, Canada, Israel and the

USA for paediatric cardiac surgical care, operating on a mission basis and without a clear training model for the local team. However, there is a need to transition from this reliance to a fully sustainable and locally run programme that engages these partnerships while prioritising training. The transition emphasises south-to-south collaboration and the shift in engagement of the international visiting teams. These efforts are done in collaboration with the KFH Foundation, with a mandate to work together with KFH to mobilise resources to support initiatives in specialised clinical care, education and research.

SOUTH-TO-SOUTH COLLABORATION

To build a locally run and sustainable programme in the coming 5 years, KFH leadership is prioritising south-to-south partnerships and reimagining the scope of international visiting teams to further increase access to paediatric cardiac care in Rwanda. Therefore, KFH, in partnership with the KFH Foundation, onboarded a rotating cardiac surgery team to rotate every 6 months from the Children's Heart Center and St Paul's Hospital Millennium Medical College, both in Addis Ababa, Ethiopia. The Ethiopian centre has two fully trained teams. The institution benefits from the partnership because while one of the teams rotating in Rwanda gains access to a high case load and continuous exposure in a familiar setting, the programme uninterruptedly operates locally in Ethiopia with the second trained team. This is made possible by close collaboration with the Ethiopian institution, specifically by recruiting from a pool of trained cardiac surgery professionals in a way that does not compromise their clinical service delivery and who are willing to contribute to health workforce development in another country before returning to Ethiopia. This also has mutual financial benefits, where the hosting institution in Rwanda pays the salaries of the visiting Ethiopian team. This interdisciplinary team includes a cardiac intensivist, cardiac anaesthesiologist, paediatric cardiologist, perfusionists, cardiac critical care nurses and cardiac operating theatre nurses. Furthermore, a full-time paediatric cardiac surgeon was hired in June 2022 to lead the programme.

Other south-to-south partnerships are also being leveraged with high-volume training sites, primarily in Kenya, Tanzania, India and Ethiopia. This allows for trainees to have hands-on exposure in settings with similar disease profiles, making them better prepared to return to Rwanda and further develop the local programme. In the case of KFH, the benefits of south-to-south collaboration have resulted in a win-win situation for the institutions involved. Four overarching benefits of this model that are evident at KFH include a contextual understanding, mentorship with local interest, strengthening equitable surgical access and moving towards programmatic sustainability. [Table 1](#) outlines the benefits of the partnership and the way forward as the team in Rwanda transitions to being fully trained and self-reliant.

Table 1 South-to-south partnership benefits

Involvement	Benefits	Way forward
Staff	Salary support for the Ethiopian team from Rwandan institutions, resulting in cost savings for the Ethiopian institution.	Phase-out of the Ethiopian rotations as the Rwandan team becomes self-reliant and fully trained.
Clinical exposure	Hands-on exposure and high case volume for both Ethiopian and Rwandan teams.	Increased complexity of surgical cases as the team becomes trained (see figure 1).
Education and mentorship	Improved mentorship structures for the Rwandan team in a contextually relevant way. Teaching experience to the trained Ethiopian team.	Phase-out of the Ethiopian rotations as the Rwandan team becomes self-reliant and fully trained, where the trained Rwandan team would become the trainers.
Access to care	More equitable access to care for patients who would otherwise travel abroad for treatment.	Fully sustainable programme in Rwanda where no patients would have to be transferred abroad.
Service delivery	Strengthening of all clinical services (eg, blood bank, intensive care unit, resuscitation team, supply chain and procurement systems, biomedical engineering).	Continued clinical service delivery strengthening.

South-to-south partnerships bring teams with a strong understanding of the local environment, making integration into the system a smoother process. The rotating Ethiopian team understands the context, including disease demography and disease presentations typical for African patients. For example, they come with ample experience in managing late-presenting CHD cases. They are also experienced in the management of congenital and acquired heart disease in the absence of advanced diagnostic and therapeutic tools. They also have exposure to rheumatic heart disease, which is the most common acquired heart disease seen in developing countries and rarely seen in the West.

This model also allows for strengthened mentorship, addressing the challenge of limited training and hands-on patient access for African health professionals in Western hospitals, which only allow for direct patient contact after incountry training or certification. This model allows local professionals to function as trainees in their own contexts and hospitals. With paediatric cardiac care in the country, junior members of the team or prospective residents or fellows can observe and be inspired by activities to which they previously had no exposure.

Regarding equitable access to care, the programme provides an alternative to overseas surgery, which is less convenient and more costly. Prior to the establishment of this programme, Rwanda referred paediatric cardiac patients abroad through the national medical referral board if patient care could not be coordinated with the visiting surgical team schedules. This posed logistical and financial challenges both to the Government of Rwanda and to the patients. Having the programme hosted in Rwanda allows for increased and more equitable access to care, as well as significant cost savings to both the families and the government.

Finally, this partnership model promotes longer-term programme sustainability in Rwanda. The nature of

the programme raises the level of all clinical services, including the blood bank, intensive care unit (ICU), resuscitation team, supply chain and procurement systems, and biomedical engineering, among others. Building a cardiac team that is committed to sustaining a programme ultimately creates a team that continues to serve the local and regional community. Having a strong cardiovascular service in the hospital raises the quality of care at the hospital.

PROGRESS TO DATE

Since its inception in October 2022 and over the first year of the programme, the team has performed over 170 paediatric cardiac surgeries. Of these, 77% were performed by the local team without reliance on international collaborators, with two deaths, or a 1.5% mortality rate. This is a significant milestone compared with the 18 paediatric cardiac procedures that were performed the year before relying on visiting teams, with the rest being referred abroad. When compared with the expected mortality rate of 2% per the Society of Thoracic Surgeons' database, the mortality rate of 1.5% is well within acceptable.¹⁰ While mortality is a robust indicator for evaluating the quality of the programme, morbidities and complications are serving as additional indicators of the programme going forward.¹¹

Under this south-to-south collaboration, the team established a progression of clinical case complexity to ensure that local professionals are being trained and strengthened in a progressive way. This is outlined in [figure 1](#), which highlights both the increasing complexity (eg, procedures and patient age) and frequency of procedures to build the team's capacity over time and further reduce their reliance on visiting teams. The inverted triangle demonstrates the greatest volume of

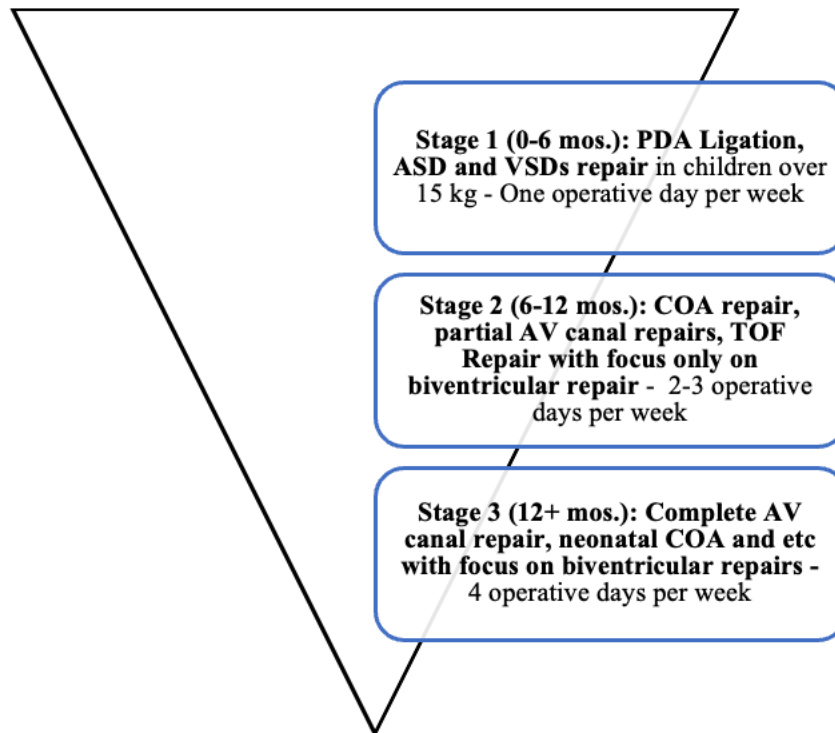


Figure 1 Clinical case training progression. ASD, atrial septal defect; AV, atrioventricular; COA, coarctation of the aorta; PDA, patent ductus arteriosus; TOF, tetralogy of Fallot; VSD, ventricular septal defect.

straightforward procedures in stage 1, which then build to more complex and rare procedures through stage 3.

The team started with simple cases, such as patent ductus arteriosus ligations, atrial septal defect repairs and ventricular septal defect repair in children weighing over 15 kg. After 6 months, they advanced to more complex cases, such as ventricular septal defects in younger and smaller patients, coarctation repairs and tetralogy of Fallot repair, with surgical days two to three times per week. Notable procedures include three cases of arterial switch performed for the first time in Rwanda, as well as other neonatal procedures for aortopulmonary window, pulmonary atresia with intact ventricular septum requiring surgical creation of a forward flow at a neonatal age, and four neonatal coarctation repairs, with the youngest patient being a 4-day-old neonate.

A substantial cohort of 36 health professionals are undergoing training, while the Ethiopian team continues to collaborate with the Rwandan team at KFH. These 36 trainees include 3 individuals specialising in cardiac surgery, 16 critical care nurses, 4 operating theatre nurses, 5 perfusionists, 5 intensivists and 3 cardiac anaesthesiologists. Locally, there are two paediatric cardiology fellows and six adult cardiology fellows expected to complete their training within the next 2–3 years. Additionally, various other health professionals, such as biomedical engineers, nutritionists, physiotherapists and

administrators, have received specialised cardiac exposure training, primarily in Israel, Tanzania, Kenya, Ethiopia and India.

Alongside the strengthening of south-to-south partnerships, KFH still engages regularly with visiting surgical teams. However, the objective of their engagement is shifting towards capacity and systems building. Maintaining its long-term cooperation with these teams, KFH continues to host open heart and catheterisation trips to treat the sickest with the leadership of the local team. The goal of this model is to broaden the case variety and complexity of patients treated in Rwanda and for the programme to be led by the local team. International engagements are designed to promote self-sustainability with clear long-term and short-term objectives.

CHALLENGES

Significant progress has been made towards strengthening the hospital's infrastructure to accommodate this programme, including establishing a dedicated cardiac ICU and strengthening the operating theatre infrastructure. However, there is still a lack of dedicated paediatric cardiac ICU and perioperative care environment. Supply chain and stock availability are also a challenge, with local suppliers not having the required surgical supplies, leaving the programme to rely on the visiting teams to bring them. Furthermore, ensuring that screenings,

referrals and procedures are covered by insurance schemes is a challenge, and KFH is in ongoing discussions with insurance companies to advocate for increased access to the service.

WAY FORWARD

KFH aims to have a sustainable paediatric cardiac surgery programme run entirely by Rwandan professionals over the coming 5 years. As the programme matures, the expectation will be twofold: deliver a consistently high level of clinical service delivery and teach the local staff to be independent in the coming 5 years. Once the trained Rwandan workforce returns or completes their fellowships, the visiting team plans to support them for a year and then transition out. The reciprocal benefit for Ethiopia is that these professionals are exposed to consistent cardiac surgical care in another setting as mentors, without compromising the service in Ethiopia.

Priorities for the way forward include scaling up training and the scope of clinical care, establishing and implementing locally run training programmes and strengthening research output. In addition to strengthening clinical and research activities, emphasis is made on safety and quality infrastructure. Specifically, this includes establishing a national registry and strengthening the culture towards meaningful quality improvement activities in the hospital and across the health system.

Duplicating the same model, efforts are also underway to strengthen and scale up the adult cardiothoracic programme alongside the paediatric programme to address the full spectrum of cardiovascular clinical care. As general surgeons and other health professionals are undergoing subspecialty surgical training abroad in both adult and paediatrics, the team based in Rwanda is working with international partners to develop and implement specialised cardiac training programmes that are facilitated and accredited locally. This includes fellowships in adult and paediatric critical care and cardiothoracic surgery. Ultimately, the aim is for the Rwandan professionals undergoing training to become the future faculty of these locally run programmes to ensure programme sustainability.

Finally, efforts are underway to develop an accompanying research programme to conduct and publish more research on paediatric cardiac surgical care in Rwanda and the region. One study found that while 53% of African countries, including Rwanda, contribute to cardiac surgery publications, only 3% of these surgical papers are specifically about cardiac surgery.¹² This will allow for the programme to continue to grow through evidence-based interventions. Through this south-to-south collaboration

and training model, and as the first paediatric cardiac surgery programme of its kind in the region, Rwanda is well positioned to have a sustainable and fully locally run cardiac surgery programme within the coming 5 years. Once the programme is run locally, efforts will be underway to establish a wider network of paediatric cardiac surgery service and training, with the aim that the Rwandan workforce can become the future mentors to programmes across the region to further expand on this south-to-south model.

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REFERENCES

- Vervoort D, Meuris B, Meyns B, *et al*. Global cardiac surgery: Access to cardiac surgical care around the world. *J Thorac Cardiovasc Surg* 2020;159:987–96.
- Ejigu YM, Amare H. Pediatric Cardiac Surgery in Ethiopia: A Single Center Experience in a Developing Country. *Ethiop J Health Sci* 2023;33:73–80.
- Thango N, Klein AL, Cheserem B, *et al*. The Impact of Colonialism on Surgical Training Structures In Africa Part 2: Surveying Current and Past Trainees. *World Neurosurg* 2024;185:e299–303.
- Yankah C, Fynn-Thompson F, Antunes M, *et al*. Cardiac surgery capacity in sub-saharan Africa: quo vadis? *Thorac Cardiovasc Surg* 2014;62:393–401.
- Ministry of Health. FY 2023/2024 forward-looking joint health sector review report. Kigali, Rwanda Ministry of Health; 2023.
- Ministry of Health. 4X4 reform: executive summary. Kigali, Rwanda, 2024.
- World Health Organization. Global strategy on human resources for health: workforce 2030. World Health Organization; 2016.
- Ministry of Health. 4x4 reform. kigali, rwanda. Kigali, Rwanda Ministry of Health; 2024.
- Ministry of Health. National strategy for health professions development 2020–2030. Kigali, Rwanda, 2020.
- The Society of Thoracic Surgeons. Congenital heart surgery public reporting: the society of thoracic surgeons. 2020. Available: <https://publicreporting.sts.org/index.php/chsd-exp>
- Murni IK, Djer MM, Yanuarso PB, *et al*. Outcome of pediatric cardiac surgery and predictors of major complication in a developing country. *Ann Pediatr Cardiol* 2019;12:38–44.
- Lin Y, Till BM, Yi S, *et al*. Cardiac surgery publications in Africa over the last 20 years: A literature review. *S Afr J Sci* 2020;116:31–6.