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REVIEW ARTICLE

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# Evolving strategies in the surgical management of rheumatic heart disease in low-resource settings: A Nigerian perspective

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**ABSTRACT**

Rheumatic heart disease (RHD) remains a significant public health burden in Nigeria and other low- and middle-income countries (LMICs) despite being virtually eliminated in high-income countries. The disease usually affects adolescents and young adults, who usually present with advanced lesions. Surgical management in this region is complicated by the prohibitive cost of cardiac surgery, delayed presentations, and limited access to specialized care. This review highlights the evolving surgical strategies for managing RHD in Nigeria. It discusses the burden and epidemiology of RHD, challenges in surgical care, traditional surgical methods, and emerging strategies to improve access and outcomes. It also presents the progress made in building local capacity, reducing reliance on international missions, and formulating sustainable approaches tailored to low-resource settings.

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## Introduction

Rheumatic heart disease (RHD) is a public health concern in sub-Saharan Africa but has been virtually eliminated in most of the developed world [1–3]. RHD is a sequela of rheumatic fever occurring following untreated or poorly treated pharyngitis arising from Group A beta-haemolytic streptococci (GAS) [1,4–6].

RHD remains a massive burden in resource-limited settings like sub-Saharan Africa, where the majority of mortalities occur as a result of the disease [4,7]. According to the hospital-based sub-Saharan Africa survey of heart failure, RHD is the second leading cause of acute heart failure-related hospitalizations, with an in-patient mortality of 4.2%, a 6-month mortality of 17.8%, and an estimated 82% overall mortality occurring in these countries as a result of RHD in 2015 [4]. Worldwide, RHD accounts for an estimated 306,000 deaths annually, with a large number occurring in Oceania, South Asia, and Sub-Saharan Africa [6].

In Nigeria, the most populous nation in sub-Saharan Africa, RHD is also endemic, with prevalence rates ranging from 2.1 per 1,000 (in the southern part of the country) to 21.6 per 1,000 (in the northern part of the country) [8–10]. Severe valvular disease has been found in more than 50% of patients with RHD in sub-Saharan Africa, including Nigeria [7]. The typical presentation patterns of valvular heart disease as a result of RHD in Nigeria are similar to those documented in other tropical/subtropical regions [10]. A history of rheumatic fever is present in only about 26% of patients [10]. Patients typically present with congestive heart failure, which is the most common indication for hospital admission, along with acute rheumatic fever, superimposed chest infection, and cerebrovascular events [10]. The pattern of valve involvement is from mitral regurgitation (35%) and mixed mitral valve disease to mitral stenosis. Other less common patterns include tricuspid regurgitation, aortic regurgitation, and aortic stenosis [8–10].

RHD remains the most common indication for cardiac surgical intervention in adolescents and young adults in low- and middle-income countries (LMICs), surpassing congenital heart diseases fourfold [4]. In these regions where RHD is most prevalent, there are many limitations in getting surgical

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care because of limited access to trained personnel and the prohibitive cost of cardiac surgery, largely because of out-of-pocket health coverage models in these already resource-poor settings [2,4]. These reasons contribute to late presentation and presentation with severe disease that may make percutaneous procedures and valve repairs almost always not feasible [4,8].

## Methodology

A comprehensive literature review was conducted to evaluate evolving strategies in the surgical management of RHD in low-resource settings, with a particular focus on the Nigerian and sub-Saharan African experience. Data were obtained from published articles, institutional reports, and relevant grey literature addressing the epidemiology, surgical challenges, and progress in RHD care.

Electronic searches were performed in PubMed and Google Scholar databases, covering publications from 1962 to 2025. Search terms included combinations of *"rheumatic heart disease," "valve surgery," "low-resource settings," "sub-Saharan Africa," "Nigeria," "cardiac surgery capacity,"* and *"health system challenges."* Studies were selected based on their relevance to surgical practice, disease burden, and healthcare delivery constraints within LMICs. Priority was given to articles providing quantitative data on RHD prevalence, clinical outcomes, and institutional or national strategies aimed at improving access to cardiac surgical care. Reference lists of key papers were also screened to identify additional sources.

The collected data were synthesized under key segments—epidemiology, resource limitations, traditional surgical practices, and emerging strategies—to provide an integrative understanding of RHD management in Nigeria and comparable low-resource environments.

## Challenges in Surgical Management

### *Human resource limitations*

Nigeria faces a significant shortage of trained cardiac surgeons, anesthetists, perfusionists, and critical care nurses. Few centres have the requisite personnel to perform open-heart surgery consistently, resulting in dependence on foreign cardiac missions [11,12]. In 2006, the World Health Organization's (WHO) health report identified a lack of human resources as the greatest challenge to providing surgical care in developing countries [13]. The deficiency of trained cardiac surgeons, cardiologists (both adult and pediatric), cardiac anaesthesiologists, intensivists, and perfusionists is the most crucial obstacle and rate-limiting step to providing adequate open-heart surgery in Nigeria [11,13]. Nigeria, with a population of more than 180 million people, has less than 100 trained cardiothoracic surgeons, and only about 6 perform regular open-heart surgery [14].

The average cardiothoracic surgery trainee in West Africa spends about 6 years in training but obtains much less hands-on experience than his European counterpart and may need to travel out of the region for additional surgical skill training [12]. This discourages intending trainees and is probably why the number of cardiothoracic surgeons in the region, including Nigeria, is still abysmal. Also, because of this poor exposure to cardiac surgery during training, most cardiothoracic surgeons in the region are limited to performing regular thoracic surgical procedures, with only a limited number going into cardiac surgery [12]. The limited number of accredited training institutions in the region and the lack of simulation-based training, which can potentially increase the surgical skills of trainees without any risk to patients, are other factors identified as hampering the workforce problems involved in cardiac surgery in Nigeria [15]. There have been several models employed in Nigeria to establish a sustained cardiac program. These strategies include regular foreign missions, short-term training of individual members of the cardiac team in (foreign) high-volume centres, employment of foreign surgeons, and incentives to entice Nigerian surgeons living in the diaspora to return and establish a cardiac centre (like our neighbours in Ghana) [12,16].

### *Infrastructure deficits*

Many hospitals in the region lack the majority of the facilities used for open-heart surgery or have them in suboptimal conditions, limiting the ability to provide comprehensive cardiac care. The first open-heart surgery in Nigeria was performed in 1974 at the University of Nigeria Teaching Hospital, Nsukka, by a fly-in mission led by Sir Magdi Yacoub [11]. Since then, there have been several missions in that hospital and several other hospitals across the country, with only a few hospitals (about 6 centres) being able to operate independently [12,14]. This is grossly inadequate for a country with a population of over 200 million people.

The missions have served as trial runs for the infrastructure and coordination of interdisciplinary skills required for cardiac surgery [11]. According to the Nigeria Open-Heart Surgery Registry, about 16 centres performed open-heart surgery in 2024, with only 6 operating independently of a visiting team (both local and foreign), signifying a growing number of centres with the required infrastructure [14]. These equipment are, however, outdated and may not be sufficient to cater to the needs of over 200 million people in Nigeria [15].

### *Financial constraints*

Globally, some of the essential drivers and predisposing factors for RHD are poverty and social disadvantage [10]. These factors drive overcrowding, poor ventilation, malnutrition, poor sanitation and hygiene, and the poor health-seeking behavior seen in Nigeria and other LMICs [8–10]. RHD exerts a multi-level economic impact, which can affect households and healthcare systems [4]. These costs can have devastating consequences for households in LMICs where the disease is endemic, leading to disruptions in income from time spent away from work either as a patient or caregiver [4]. It can cause them to be stuck in a "poverty trap," further worsening health-seeking behavior and reducing access to good health care [4]. The number of children and young adults from socioeconomically disadvantaged backgrounds exposed to rheumatic fever and complications of RHD in Nigeria is enormous, and is likely going to increase because of worsening economic conditions [13]. The average cost of valve replacement surgery for RHD in Nigeria is $6,000 in a country where the minimum monthly wage is less than $50 [14]. This is a serious challenge for patients in Nigeria, where healthcare insurance schemes are underdeveloped or virtually absent, and the primary source of healthcare expenditure is out-of-pocket [4,11].

Although the National Health Insurance Scheme (NHIS) was launched to improve healthcare access and financial protection, its implementation has faced several barriers. Eze *et al.* identified persistent challenges, including low enrollment—only about 5% of Nigerians were enrolled after 15 years of its introduction—reflecting systemic inefficiencies and weak institutional performance. Contributing factors include inequitable resource allocation, poor service quality, decaying health infrastructure, suboptimal management of human resources, and fragile referral systems. The limited physician workforce further compounds these problems; as of 2019, Nigeria had only about 24,640 doctors, far below the WHO recommendation of one doctor per 600 people. These limitations have significantly hindered the effective implementation of NHIS and restricted its capacity to provide financial coverage for complex interventions such as cardiac surgery [17].

### *Late presentation*

Patients often present with late disease, reducing the possibility of minimally invasive procedures (balloon valvuloplasty) and surgical valve repair, and also increasing surgical risk [1,8]. Inadequate awareness, poor access to healthcare, and misdiagnosis at peripheral centers contribute to these delays. The paucity of adequate knowledge of RHD has been identified as a factor that contributes to delayed seeking of medical care, which increases the risk of developing chronic RHD. Chronic RHD is seen in more than half of the patients presenting with RHD in sub-Saharan Africa [1,7,10]. These patients present with definite evidence of valvular regurgitation or stenosis and at least two other abnormalities, like restricted leaflet mobility, focal or generalized valvular thickening, or subvalvular thickening of the affected valve [8]. The standard treatment for severe RHD is valve replacement or repair, but it is more challenging to effectively repair such valves. Therefore, the majority will have valve replacement without any attempt at repair [8]. Valve repair, though preferable in younger patients, is rarely feasible due to the advanced nature of lesions at presentation. Another reason why most surgeons in this environment will opt for valve replacement, and even at that with a more durable valve, is the fact that should the patient require reoperation as a result of failed repair or as a result of bioprosthetic valve replacement, the financial implications will be insurmountable for most families in the region [16,18].

## Traditional Surgical Approaches

The American College of Cardiology (ACC)/American Heart Association (AHA) and the European Society of Cardiology (ESC)/European Association of Cardiothoracic Surgeons (EACTS) provide guidelines that generally guide the management of valvular heart disease, including the surgical management of valvular heart disease caused by RHD [19,20]. These two guidelines, last updated in 2020 and 2021, respectively, are concordant with

some differences that are generally considered minor [19].

Generally, the standard treatment for severe RHD, as outlined in the previously mentioned guidelines, is valve repair or replacement, typically with mechanical valves or bioprosthetic valves. Different characteristics of these replacement valves inform the selection of prosthetic valves [21–23]. Mechanical prosthetic valves are durable, lasting for decades, whereas a third of homograft valves deteriorate within 10–15 years following insertion [24]. The premature valve failure seen in heterograft valves is frequent in those less than 40 years of age because of a higher immunologic reaction, and these individuals are also more active; therefore, cardiac activity and the wear and tear on the valve are higher [24–26]. Mechanical valves require the patient to be on anticoagulation for life [24]. Bioprosthetic valves have a low thrombogenic profile and, thus, do not require long-term anticoagulation [24]. Anticoagulation is encouraged exclusively during the first three months following implantation of a bioprosthetic valve [20]. Another characteristic of the various valves is their hemodynamic profile. The heterograft bioprosthetic valve has the smallest effective orifice, while the allograft bioprosthesis has the largest orifice size, with dimensions that approximate the native valve orifice size [24].

Valve repair, although a viable option, is not routinely performed by surgeons in the region because of the eventual progression of rheumatic cardiac pathology and subsequent repair failure [27]. Second, because of limitations in health financing, a significant financial burden is placed on the family by the need to reoperate a failed valve repair [27].

Nwafor *et al.* reported that complications related to prosthetic valve replacement significantly reduce life expectancy, particularly among children and young adults, irrespective of the initial valvular pathology. Reported mean survival rates after mitral valve replacement range from 63% to 66% at 10 to 15 years of follow-up. The rate of reoperation in young patients is high due to somatic growth, prosthetic valve thrombosis, and challenges with consistent anticoagulation monitoring [8]. Salami *et al.* reported on 13 patients who underwent surgery in Ibadan. The study noted prolonged hospitalization among patients on warfarin to achieve target International Normalized Ratio (INR) and stabilization before discharge. Postoperative complications included paravalvular leak in two patients who had valve replacement and one case of sternal wound infection [28]. Despite these challenges, increasing experience, improved postoperative care, and the gradual establishment of follow-up protocols continue to enhance outcomes for RHD patients undergoing surgical intervention in Nigeria.

## Evolving Strategies in Nigeria

### *Increasing local surgical capacity*

Building local capacity in terms of training, skills transfer, and infrastructure development is one of the most important ways of improving overall cardiac surgery care, including RHD, which is the most common acquired heart disease requiring surgical intervention in the region [14]. The Association of Cardiovascular and Thoracic Surgeons of Nigeria (ACTSON) began collaborating with North African institutions (Morocco and Algeria) to train cardiothoracic surgeons in 2021, and so far, about four trainees have benefitted from the programme. Efforts are also underway to improve training through collaborations between local centres that routinely perform cardiac surgery (volumes of individual centres may be termed low). In September 2023, the West African College of Surgeons approved a joint full accreditation, which was granted to three centres in the country, i.e., Lagos State University Teaching Hospital, Obafemi Awolowo University Teaching Hospital, and Tristate Healthcare System (LOT Group), to train nine residents between them. This is a landmark achievement and will go a long way in improving local surgical capacity and translating to an improvement in cardiac surgery, including RHD. Hospitals like Usmanu Danfodiyo University Teaching Hospital (UDUTH) in Sokoto have transitioned from relying on foreign missions for cardiac surgery to increasingly local-led surgical programmes.

Expanding exposure and enhancing structured training of local cardiac teams are essential to further reduce dependence on visiting foreign missions. Strengthening in-country human resources enables continuity of care, lowers operational costs, and ultimately improves access to life-saving cardiac surgery for patients with RHD. This transition also ensures that surgical interventions are more sustainable, culturally contextualized, and available year-round. According to the Nigerian Open Heart Surgery Registry, reliance on visiting teams has progressively decreased from 100% between 2004 and 2006 to only 37.1% in 2024, with 62.9% of surgeries now being performed by local teams [14] (see Fig. 1 below). This steady shift underscores the

impact of deliberate investments in training, mentorship, and institutional collaboration on the evolution of Nigeria's cardiac surgery landscape.

### *Cost reduction strategies*

RHD remains an underfunded disease relative to the burden it exerts. Diseases like malaria and TB receive about half of global funding, whereas all cardiovascular diseases receive only a fraction (2%) [29]. To achieve any significant progress in the surgical management of RHD and other acquired and congenital heart diseases in the African sub-Saharan region, economic growth and healthcare advancements are necessary [30]. There is a vast contrast in healthcare advancement between North African and Sub-Saharan African countries. This is made evident by the volume of cardiac surgical procedures performed in North African and Southern African countries (countries where there is significantly more economic growth and advancement) when compared to the volume seen in West African countries, a region plagued with low economic growth and advancement [30]. The regions with a significantly higher level of economic and healthcare development have a higher volume because surgery is made accessible to the populace by strategies like government insurance (Egypt and South Africa) and established government institutions that are dedicated to cardiac care at no cost to the citizens (seen in parts of Egypt and Sudan) [30]. In most sub-Saharan African countries, like Nigeria, there is a dearth of insurance schemes, and even in countries where they are present, the informal sector is rarely included, and patients have to pay for most services out of pocket [17,31]. An alternative is reliance on non-governmental philanthropic organizations and donor support groups (like those seen in Ghana, i.e., the Ghana Heart Foundation), which can only cater to a limited number of patients requiring surgery for RHD.

In Nigeria, ACTSON has been advocating for the inclusion of cardiac surgery in the NHIS, and although discussions are still ongoing with the relevant stakeholders, there is still a long way to go. Another strategy is the attainment of the WHO universal health coverage, which requires legislative measures and policy changes in order to ensure all individuals have access to high-quality healthcare

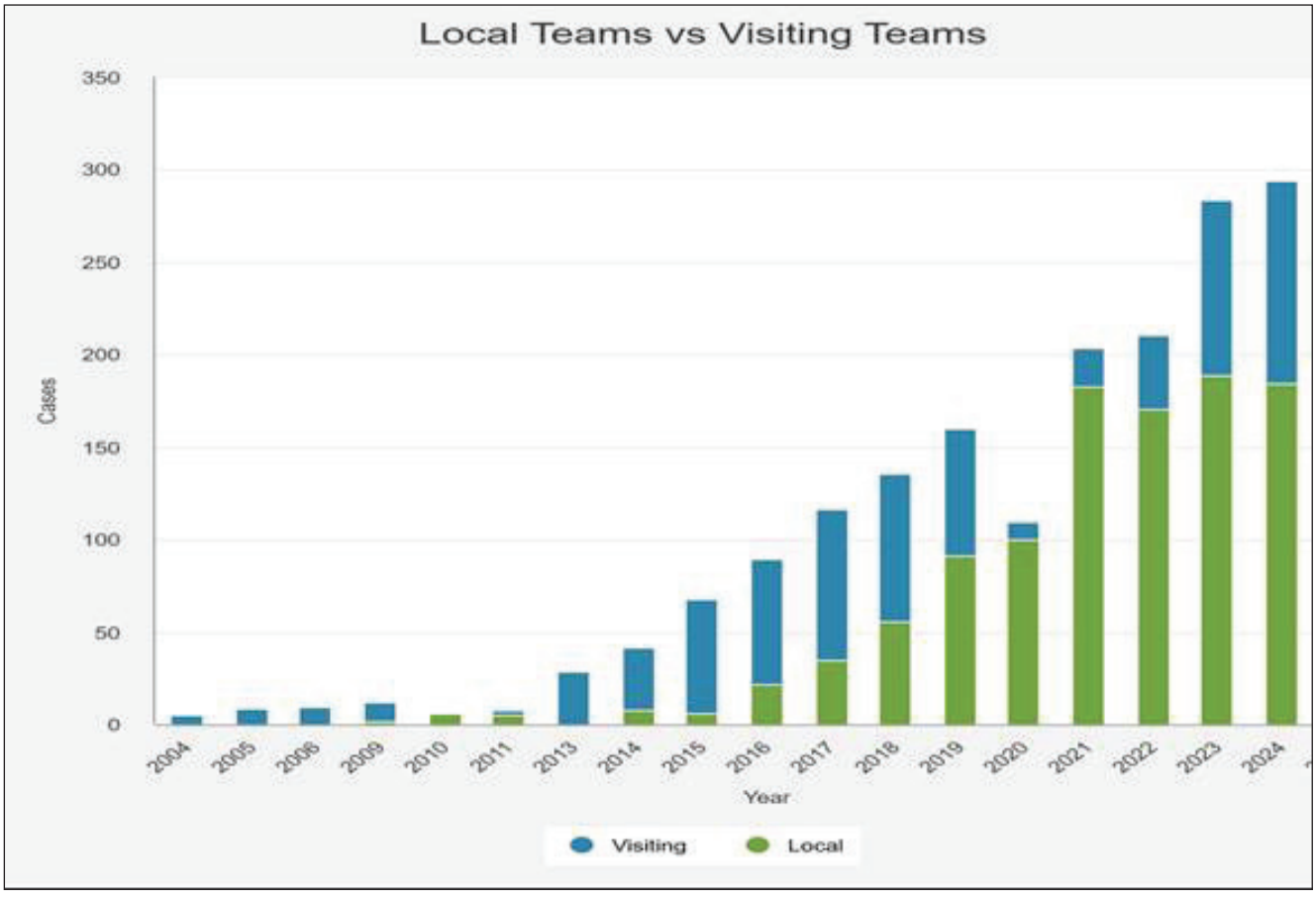


**Figure 1.** Local versus Visiting-team led surgeries in Nigeria from 2004 to 2024 (Nigeria Open-Heart Surgery Registry).

wherever and whenever they need it without financial hardships [17,30,31]. Other strategies directed at encouraging economic growth and fiscal prudence will also go a long way in improving the overall healthcare delivery system in the region and improving cardiac surgery [30,31].

### *Early detection and prophylaxis*

Improved early echocardiographic screening, vaccination against GAS, and early detection of rheumatic fever help prevent the progression of rheumatic fever and identify patients earlier, allowing for better surgical outcomes. Preventive interventions are essential components of healthcare and have been consistently shown to improve outcomes [32]. This is particularly important in LMICs, where access to cardiac surgery is complex and relatively more expensive [32,33]. These strategies include investments in vaccines that prevent RHD, timely detection of GAS pharyngitis, and proper antibiotic treatment of GAS pharyngitis and acute rheumatic fever. Others include screening programs for RHD and management of postoperative recurrences and complications [32].

Guidelines for prevention and treatment of RHD were proposed by the WHO more than 6 decades ago [34]. The World Heart Federation has also set a 2025 RHD reduction target, with some LMICs already implementing some policies to implement this [33]. One such strategy is improving housing and hygiene education in the prevention of rheumatic fever, which has been shown to be a feasible measure in the prevention of RHD [33,34].

Primary healthcare improvements, which have also been emphasised by the WHO and include investments in a healthcare workforce trained in the prevention, diagnosis, and management of GAS pharyngitis, have also shown promise [34]. Early diagnosis for the prevention of RF recurrence has triggered an increasing number of echocardiography-based studies, which have been found to be effective in screening high-prevalence regions. The current criteria are based on both morphologic and functional changes seen in heart valves [36].

Antibiotic treatment of GAS has been found to reduce the attack rate of acute RF by up to 80% [36]. A single intramuscular injection of benzathine penicillin or a 10-day course of oral penicillin has been shown to eradicate GAS pharyngitis, thereby reducing the risk of RF in the first place [37,38]. A safe and effective vaccine against acute RF would be vital in the prevention of RHD. This has, however, been delayed by the diverse nature of GAS strains, cross-reactivity between streptococcal species and host proteins, and lack of animal models for studying the pathogenesis of RHD [34,36,38].

## Future Directions and Recommendations

Sustaining and scaling cardiac surgery in Nigeria requires a multifaceted approach tailored to the realities of the local context. There is a strong need for the inclusion of valve surgeries in the NHIS. This would help reduce the out-of-pocket expenditure that currently limits access to care for most patients with RHD. Continuous investment in the training and retention of cardiac professionals, including cardiothoracic surgeons, anaesthesiologists, perfusionists, and specialised nurses, is also critical.

Strengthening referral systems and improving public awareness about the importance of early diagnosis and treatment of streptococcal infections and rheumatic fever would potentially reduce late presentations. Establishing regional centres of excellence for cardiac care, supported by coordinated national policies, can enhance access to quality surgical treatments and improve outcomes.

Finally, promoting preventive strategies such as early treatment of streptococcal pharyngitis, implementation of echocardiographic screening programs, and investments in vaccine development against GAS pharyngitis should be prioritized as sustainable, long-term measures to reduce the burden of RHD in the country.

## Conclusion

RHD remains a persistent and devastating cause of morbidity and mortality in Nigeria and other low-resource settings, disproportionately affecting young and economically active individuals. Although significant challenges persist—including delayed presentation, inadequate manpower, infrastructural limitations, and prohibitive costs—the steady evolution of cardiac surgical capacity in Nigeria demonstrates meaningful progress. The gradual transition from dependence on visiting foreign missions to increasingly autonomous local surgical teams, supported by structured training programs and regional collaborations, has the potential to redefined the outlook for patients requiring surgical intervention.

Strengthening human resource development, promoting institutional partnerships, and advocating for the inclusion of cardiac surgery within national health insurance frameworks are crucial to ensuring sustainable progress. Efforts to

improve early detection, streamline referral systems, and enhance postoperative care are equally vital. The Nigerian experience highlights that even in resource-constrained environments, targeted investments in training can translate into measurable improvements in access to RHD surgery. Continued commitment to these strategies will be instrumental in achieving equitable and durable cardiac care across sub-Saharan Africa.

## Conflict of interest

The author has no conflict of interest to declare.

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