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Chapter

Establishing Sustainable Pediatric Cardiac Surgery Program in Nigeria: Challenges and Prospects

Ikechukwu Andrew Nwafor, Josephat Maduabuchi Chinawa, John Chukwuemeka Eze and Fidelis Anayo Onyekwulu

Abstract

Unlike in the Western world, the delivery of cardiovascular services to children and adults born with congenital heart defects (CHDs) in Nigeria is grossly inadequate. There are problems all through the ages of these unfortunate patients. Accurate statistical data of CHD in Nigeria is lacking, but it is comparable to 8 per 1000 live births as seen in other countries. The burden is presently being ameliorated by medical tourisms and foreign cardiac surgery missions, but such services are still inadequate. There is a need for the government to share resources between this noncommunicable (CHD) and communicable diseases. When this is done with assistance of international partners and humanitarian organizations, a sustainable pediatric cardiac surgery program will be established that will definitely enhance the care of these patients at childhood, adolescent, and adult stages of their lives.

Keywords: pediatric, surgery, program, congenital, sustainable, medical tourism

1. Introduction

Unlike in developed countries, the delivery of cardiovascular services to children born with congenital heart defects in Nigeria is inadequate. There are problems at both pediatric and adult ages with high morbidity and mortality on account of inadequate surgical care. The country initially lacked both manpower and infrastructure so that many souls of congenital pediatric patients departed their bodies with their pathologies undiagnosed and untreated. Pioneers of cardiac surgery in Nigeria were not decisive of separate pediatric cardiac program while they engaged the government. Presently, with many trained personnel, there is a need for structured pediatric cardiac team with requisite infrastructure to work. This will bring the desired success.

2. Historical aspects

In Nigeria, a foreign cardiac team with a local team performed the first open heart surgery in our institution, University of Nigeria Teaching Hospital (UNTH),

Enugu, in 1974. UNTH is the teaching hospital for the Federal Government of Nigeria and is affiliated to University of Nigeria, Nsukka. Foreign cardiac team was led by a British-Egyptian Surgeon, Sir (Dr) Magdi Yacoub, and indigenous team was led by late Professor Fabian Udekwu. This singular act added to many others attracted the attention of the Federal Military Government of Nigeria, which designated it the National Cardiothoracic Center of Excellence (NCTCE) in 1984.

Adult cardiac surgery was the main focus of the program. The hospital stood by her deeds and was able to establish itself, as the leader in open heart surgery not only in Nigeria but also in West African subregion [1]. Afterward, the center's activities decreased due to poor military governance and corruption. The near total neglect of healthcare system (HCS) in the country led to the collapse of the center due to brain drain and inadequate facilities such that between 1974 and 2000, only a total of 102 open heart operations were carried out, mainly by local team [1].

With return to civilian rule in Nigeria in 1999, efforts were made to improve the center through Foreign Cardiac Mission Model. The first mission was by International Children Heart Foundation (ICHF) in 2003 under the sponsorship of Kanu Heart Foundation. Incidentally, that mission was the first pediatric mission, and William Novick (International Cardiac Foundation) was the lead surgeon. The team visited once and performed mainly pediatric cases for the first time at the center. Other international cardiac missions started visiting 10 years later and became regular with more frequent visits every year [2]. Options considered toward sustenance of pediatric cardiac surgery were staff training and equipment procurement. One way to achieve the desired training in emerging country like ours is by regular and frequent visits to centers such as NCTCE by foreign cardiac teams and performing the surgery alongside the local team (cardiac mission model) [3–5]. Other options include sending the local team to established centers, for example, India for hands-on training for a period not less than 2 years. Furthermore, members of the local team individually went for training abroad on their personal arrangement at different times and in different established centers.

The cardiac mission model would not even have been possible without the aids from some agencies of the Federal Government of Nigeria, Nigerians in Diaspora, public spirited individuals, and foreign organizations as shown in **Table 1**. Most of the countries in West African subregion are very poor, and a study by Edwin F et al. showed that no existing cardiac center in the subregion came into being without huge governmental support [6].

Good things that go for foreign mission team include high technical skill and team work in contrast to what is obtainable on the ground. Treating patients locally in this method is cheaper and serves as workshop and training session for different categories of workers at minimal cost to the institution. However, model of cardiac missions is not a sustainable one because a lot of effort and expenditure are allocated toward surgery on a few patients [7].

The adoption of cardiac mission model by developing countries such as Nigeria as a way of helping indigent patients with both congenital and acquired heart diseases is good. However, that method is like giving someone a fish anytime he demands it. The best way is to incorporate teaching the person how to fish, that is, developing and equipping local team. It is only in this way will establishing pediatric cardiac center across the low- and middle-income countries become sustainable.

Pediatric cardiology and pediatric cardiac surgery practices in Nigeria are taxing [8, 9]. Getting all the requirements to cater for the surgical needs of a very

S/N	Name of organization	Local or foreign	Aid provided
1	Federal Ministry of Health (FMOH)	Local	Payment of salaries and allowances of local team members. Provided infrastructure
2	UNTH	Local	When UNTH moved to new site, a ward was restructured for cardiac surgery and ICU. Sponsorship for both foreign and local training of local team. Also, provided air tickets, local transportation, feeding and security for foreign cardiac teams as well as sourcing for disposables.
3	TET fund (University of Nigeria)	Local	Equipment (Cath Lab, six ventilators, two theater tables, two theater lights, eight ICU beds, six monitors, etc.)
4	Kanu Heart foundation (KHF)	Local	Sponsorship of International Children Heart Foundation (ICHF) visit in 2003. Brought equipment and disposables
5	Enugu State Government	Local	Logistics for foreign team and fees for some patients
6	Innova Hospital, Hyderabad, India in 2009	Foreign	UNTH sent two cardiac anesthetists, two cardiothoracic surgeons, two medical laboratory scientists for perfusion, two pediatric cardiologists, three nurses, two physiotherapists, and a technician for training as staff build up to her restart of open-heart surgery in 2013. It was tuition-free
7	VOOM Foundation from 2013	Diaspora (USA)	Foreign team, equipment, and disposables severally
8	Save-a-Heart Nigeria started with VOOM but separated later.	Diaspora (UK)	Foreign team, equipment, and disposables severally
9	Rotary Club of Nigeria	Local	Payment of surgical fees for some patients
10	Opublic of Italy	Foreign	Free pediatric cardiac surgery with disposables severally
11	Novic Cardiac Alliance of USA with VOOM Foundation	Foreign	Foreign team, equipment, and disposables
12	Cardiostat of USA with VOOM Foundation	Foreign	Foreign team, equipment, and disposables
13	Public spirited individuals, businesses	Local	Payment of surgical fees and blood donation
14	Bigard Seminary, Enugu (Seminarians were donors)	Local	Free blood donation severally
15	Santarina of India	Foreign	
16	UNEC medical students		Free blood donations

Table 1.
Some collaborations took place both locally or outside your country in helping capacity building but help will also be needed in some aspect.

large number of children with congenital heart defects with its attendant financial constraints, poor funding from the government is really a huge task.

Pediatric cardiology and pediatric cardiac surgery training in Nigeria involve the management of different cardiac diseases in children. This covers children with both congenital and acquired heart disease [10]. This also includes arrhythmias and coronary heart diseases. Besides, interventional cardiology practice is really at the primordial phase with less than three teaching hospitals providing the skills and competences all over the country [10].

Even the foreign missions that come occasionally could not provide the necessary skills of all the surgical intervention as they spend few days and may not inculcate such skills to the local surgeons within few days of stay.

Infrastructure problems, non-availability of high technology: The equipment used for heart surgery in Nigeria is imported from other countries. Virtually all the drugs are also imported. Prostheses and other consumables are imported, and their cost is quoted in US Dollars or Naira equivalent. With the heavy devaluation of Nigerian currency, many of these items are lacking or beyond reach. Therefore, the team has to improvise, but this state of affairs leads to poor outcome.

Human resources, team members: The practice is a team work, and the team members include pediatric cardiac surgeons, pediatric cardiologists, pediatric cardiac anesthetists, cardiac interventional radiologists, clinical perfusionists, medical laboratory scientists, and pharmacists. Other members are physiotherapists, perioperative nurses, cardiothoracic nurses, intensive care unit nurses, and equipment technicians. Human resources are not adequate locally trained and pediatric cardiac surgeons are not sufficiently skilled to handle complex congenital cardiac defects.

Training/skill acquisition: Every member in this team requires some skill to fit into the team, but our local training program leaves room for vital overseas exposure. Currently, there is neither perfusion school nor equipment training center in Nigeria that will produce manpower that will operate high-tech equipment or trouble shoot malfunction, respectively. Surgical management of heart disease is not a trial-and-error program. Every member of the team is expected to be proficient in his/her area. If mistake is made, the patient suffers. Only correct actions at every stage of the management will produce good outcome. There is need for further training or continuing education, research, workshop, seminar, and recertification. In the absence of these, the workers will become outdated. No member of the team should grow weary of this exercise, and this is where a leader with vision is needed.

Pediatric cardiac surgery program requires enormous resources and commitment to establish. Training of cardiac anesthetist like every other personnel in the team requires enormous funds. This is because the training is done abroad [11].

Training and retraining are also necessary in order to prevent attrition. Attrition therefore constitutes a big problem as the volume of cardiac surgery carried out in Nigeria is very small compared with the burden of pediatric cardiac disease in the country. Training or upgrading the education of the pediatric cardiac team, massive training of core personnel for pediatric cardiac surgery and pediatric cardiologist will enable the work to be self-sustaining as their services will be patronized by both locals and foreigners. Funds will be generated as is done in other heart centers in India, America, etc.

There are three main methods of acquiring training. It could be by an institution sending a team to undergo training in another institution. The second option involves

inviting experts to come and train the local personnel on the job while the third option is for individuals to scout for training positions anywhere by themselves.

Another good alternative is to engage a cardiac team from a good cardiac center to work with the locals on continuous basis until skill transfer is achieved. This will be cost-effective, and more patients will receive care while skill acquisition will take place smoothly [11].

Financing of equipment/supply of equipment. Equipment is usually procured through tenders by government, but one noticeable problem is the dumping of unserviceable and outdated equipment at the hospital, by fraudulent contractors and their collaborators. The end user more often than not is not in the picture although the pediatric cardiac surgery is equipment-driven. Many of the equipment in use now are computer-based, but computer illiteracy is pervasive, resulting in poor handling and subsequent breakdown of these sophisticated and expensive machines.

Monitoring in cardiac anesthesia is pivotal to the success of cardiac surgery [12]. Monitoring equipment is expensive, and for a country such as Nigeria, acquisition of these equipment is difficult to come by. This equipment ranges from anesthesia work station, ultrasound, transesophageal echocardiography, multiparameter monitor, cardiac output monitor, I-Stat machine for point of care test in the operation theater, and intensive care unit. Other equipment include syringe pump, infusion pumps, blood warmer, etc.

Disposables/consumables are equally as important as non-availability of central venous catheters, arterial cannula, transducers; pressure tubing, etc., can prevent successful surgery. These consumables can be secured by the hospital management if she is committed to the sustainability of the program. Non-availability of drugs is also an impediment to cardiac surgery in Nigeria as some of the required drugs are not approved by the National Food and Drug Administration agency (NAFDAC). Some opioids and inotropes are not readily available, and this makes patient management difficult.

Procurements through competitive bidding: The prices are usually overinflated owing to the fact that contractors are owed for a period between 1 and 2 years. This adds to the high cost of pediatric cardiac surgery in Nigeria. Some cardiac missions such as Cardiostart International, William Novick cardiac Alliance, VOOMF, Save-a-heart Nigeria, ICHF/Kanu Heart foundation brought consumables during visits. These are, however, not usually enough.

3. Challenges accruing from establishing pediatric cardiac surgery

NCTCE has some challenges emanating from poor funding, incomplete treatment of patients, and late presentation by patients as well as poor equipment maintenance. It is thought that successful creation of Nigeria Cardiac Foundation where every Nigerian contributes 0.20–0.25% monthly salary will impact significantly in funding cardiac surgery. Another alternative is to incorporate pediatric cardiac surgery into National Health Insurance (NHIS). This will also address the challenges of late presentation. As can be seen, the Cardiac Surgery Intersociety Alliance (CSIA) or any other body can assist our center in providing appropriate training for pediatric cardiac surgeons, anesthetists, perfusionists, nurses, etc., among other helps that are needed. Donation of consumables and equipment will be of immense benefit to the program. CSIA model is what NCTCE needs at this time in addition to what others may offer.

4. Why the initial efforts were unsustainable?

These initial efforts were not sustained owing to the following factors: poor funding and total neglect of health sector, brain drain syndrome, reliance on medical tourism, and competing double burden of diseases as well as corruption, nepotism. Other issues were poor social infrastructures such as public power and water supply, poor remuneration of health workers with incessant strike actions, and insecurity in the land and inter-professional conflicts [1].

4.1 Poor funding and neglect of health sector

Low government health spending over the last two decades has limited the expansion of highly cost-effective interventions, stunted health outcomes and exposing large shares of the population to catastrophic health expenditures. Nigeria spends less on health than nearly every country in the world. In 2016, government health spending was 0.6% as a share of GDP or just \$US11 per capita. As a result, Nigeria significantly underperforms on key health outcomes. Maternal mortality at 576 deaths per 100,000 live births is one of the highest in the world (2.6 times the global average); one in eight children dies before reaching their fifth birthday; and 25% of households spend more than 10% of their household consumption on health [13].

4.2 Brain drain syndrome

The migration of health professionals from Nigeria to high-income countries—medical brain drain, deserves critical attention due to its adverse effects on the healthcare system (HCS) for developing nations, which indirectly impacts population health outcomes and creates greater inequity among vulnerable populations. This international migration of medical doctors (MDs) has created a great challenge for public health systems; it worsens already weak healthcare systems, which widens the health inequalities gap worldwide. Globally, Nigeria ranks among the worst countries in regard to maternal health outcomes. Although it represents 2% of the global population, it disproportionately contributes to nearly 10% of global maternal deaths [14]. With the current new world order, where the world is a global village, it is very easy and fashionable for members of the team to migrate and work in other parts of the world. With the skill, training, exposure, vigor, endurance, and other qualities, the tested professional can easily leave the service and country and comfortably settle and earn hard currency. The attraction to brain drain is always there for members of this team, and this has adversely affected the growth of pediatric cardiac surgery and other programs in UNTH, in particular, and Nigeria in general. Unless something urgent is done, this trend will continue, and Nigeria will be the loser.

5. Political issues with changing governments

Political instability in the country and frequent widespread violence combine to limit the number of foreign agencies that participate in the surgical management of heart disease in Nigeria. Some of these charities have personnel and equipment. Some foreign physicians want experience in treating types of heart disease that are

no longer common in their countries. However, even charitable organizations cannot take their safety for granted. Furthermore, political decisions that affect the treatment of heart disease vary with each political leader, and these leaders change very often. Their successors do not maintain continuity. Some emphasize primary health care to the detriment of the treatment of heart disease.

Intensive labor: The practice is labor-intensive at no incentive. Safety of patients guides the staff activity rather than welfare of the worker. More often than not, the treatment of patient usually exceeds expected period of time. This can easily lead to frustration if the involved personnel have not prepared for any extra time on duty post. Majority of the staff are based in the intensive care unit with the attendant stress.

High cost of treatment/low sponsorship: As a result of heavy outlay in the provision of surgical treatment, patients are made to pay higher than an average patient in the hospital. Many of these patients are indigent and therefore cannot afford the bill. Moreover, there is no universal health insurance coverage for the citizens, which would have sponsored patients for this kind of treatment. We have a situation where the government has succeeded in providing infrastructure, but the patient cannot benefit from the available services. When compared with the cost of treatment abroad, it is still far cheaper to provide this locally.

Inter-professional conflict: It is an established fact that our healthcare field has been experiencing inter-professional conflicts. The surgical team managing the heart disease is inclusive. These conflicts rob the patients the united attention that would have helped in overcoming their predicament. Some members of the team keep to the legality of the duty but are morally bankrupt, and this causes problem. Other causes of problem are pride, envy, jealousy, inferiority/superiority complex, and cheating.

Others: Public utilities such as water and electric power are not readily available, and they are very essential in this business. Hospital resorts to alternative source of power outside the national grid, and this is more expensive, thereby increasing the cost of treatment. Non-payment of salary as and when due and stagnation in service add to the challenges in the management of their patients.

6. Burden

It is important to note that lack of facilities for sustainable pediatric cardiac services and pediatric cardiology practice in Nigeria results in preventable deaths and suffering. Regrettably, about 15 million children are noted to have died and had some morbidities from potentially treatable cardiac diseases [15].

The practice of pediatric cardiac surgery had been ignored for long, as this has now evoked major concern to governmental and nongovernmental organizations and cardiovascular specialists [1]. In some areas in West African province, it is noted that only 20% of the parents of children who are less than 15 years and who needed pediatric surgical intervention are able to finance the operation within 12 months of diagnosis [1, 16].

Early diagnosis and treatment are very necessary to enhance the survival of children with cardiac disease [1]. This can be achieved by the provision of affordable human resources, diagnostic and surgical as well as other interventional facilities at each level of care in the country.

7. Challenges incurred in establishing pediatric cardiology practice

The practice of pediatric cardiology and pediatric cardiac services in Nigeria is faced with several challenges. The cost of pediatric cardiac services is very exorbitant and unaffordable for most developing nations. Nigeria gives priority to other disease burdens other than cardiac disease during budget allocations. The current COVID-19 pandemic, HIV/AIDS pandemic, poor health infrastructure and referral systems, malaria, pneumonias, and malnutrition have made the situation worse and dampen the importance of pediatric cardiac service.

The population of children with uncorrected congenital heart disease in Nigeria in particular and Africa in general is considerable. This is due to the fact that most pediatric services are centered on diagnosis and management of infectious diseases, shortage of trained personnel who diagnose congenital heart defects, resulting in late diagnosis and referral. Besides, the number of facilities for pediatric cardiac surgery is meager with attendant paucity of pediatric cardiac surgeons [16].

In Africa, pediatric cardiac surgery is usually performed in adults than in younger children, due to lack of manpower [17, 18]. The country no longer completely lacks facility and skills in carrying out stage procedures for cyanotic congenital cardiac disease or palliative surgery such as pulmonary artery banding or systemic-pulmonary shunt as earlier reported [19].

The challenges encountered in the establishment of pediatric surgery for cardiovascular diseases in African could be resolved through capacity building and inculcating expertise in the diagnosis and management of congenital heart diseases; training and retraining of local pediatric cardiologist and pediatric cardiac surgeon in the management of cardiac disease tailored to our sociocultural background; getting state-of-the-art equipment and facilities that will enhance the management of cardiovascular diseases in children; public enlightenment and campaign on preventive measures on emerging and reemerging cardiac disease, creating endowment funds and financial support where there will be community participation; making policies that establish pediatric cardiac training in Nigeria that will be sustainable and achievable; reinforcement of skills in terms of professional competences, exchange program, knowledge, innovative surgical techniques, new technologies, equipment, and human resources; granting financial aid to take care of the poorest of the poor by public, governmental, or private initiatives; establishment of number of centers of excellence dedicated to training, retraining, research, and clinical care in pediatric heart surgery in sub-Saharan Africa; developing international cooperation through foundations and nongovernmental organizations, and through banking firms and grants; and seeking the support of pharmaceutical industries and medical equipment [20–22].

8. Prospects

In short, we want to outline and describe what it took to overcome some of the obstacles we faced in developing or expanding pediatric cardiac care.

8.1 Successes achieved

After the ICHF/KHF mission in our center in 2003, pediatric cardiology and surgery activities in our center dwindled owing to dilapidated equipment, poor workers' remuneration, and brain drain as well as poor leadership, coupled with government directive

to move UNTH to the permanent site without any building for pediatric cardiac surgery activities. In 2007, UNTH moved to the permanent site and then came a change in the leadership of NCTCE. Through continuous appropriate dialog and advocacy, NCTCE benefitted from TETFUND program. With advice from Prof. Tom Pezzella of ICHF, USA, a training center was found in India (ICHH, Hyderabad India), with institutional collaboration. With this development, pediatric cardiac anesthetists and intensivists, technicians, ICU and perioperative nurses including pediatric cardiologists got training within periods ranging from 6 months to 2 years.

There was the arrangement for pediatric cardiac surgeons to do 1 year training at the Indian center with the Indian team coming to our center to see a smooth takeoff of sustainable pediatric cardiac surgery program. However, that arrangement did not materialize because cardiac mission model was adopted. This cardiac mission model started in February 2013 and ended in October 2019. During the period, William Global Cardiac Alliance, Vincent Ohaju Memorial Foundation, Save-A-Heart-Nigeria, Cardiostart International, O'Pobic, Santarina all visited our center and performed operations in 113 in pediatric patients over 7 year period [23, 24].

Currently, our cardiologists can adequately handle all echocardiographic investigations. In addition, our adult cardiologists are able to handle all forms of cardiac pacemaker insertions, coronary angiography, and some coronary artery stenting and angioplasties. Our cardiothoracic surgeons with anesthesiologists and other theater staff can handle all non-open heart surgical procedures and some open-heart surgical procedures such as repair of atrial septal defects (ASD), repair of some ventricular septal defects (VSD), excision of some types of intracardiac tumors, and replacement of the mitral valve. We are still not able to do intracardiac repair for the blue babies in addition to some other types of congenital cardiac anomalies as well as some types of valve repair/replacement and coronary artery bypass procedures.

The COVID-19 pandemic has slowed the engagement of a resident foreign pediatric cardiac surgeon (GhanianModerl-ref) at NCTCE by the present UNTH/NCTCE management to equip the local surgeon with adequate skills that will make the program very sustainable.

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