Cardiothoracic Surgery Training in Africa: History and Developments


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Cardiothoracic Surgery Training in Africa: History and Developments


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Central Picture Legend: Map depicting countries of Africa with established cardiothoracic surgery centers and training programs
Despite the growing burden of cardiovascular diseases in the Africa, there is still a lack of specialized institutions with cardiothoracic surgical centers and training programs in the entire region.

Even some African countries that have a proud history of established cardiothoracic surgical training programs are not well known globally. In these African countries with established cardiothoracic surgical programs, the number of procedures is limited with long wait list due to insufficient local expertise, lack of financial resources and inadequate health infrastructure.

Glossary of Abbreviations

- rheumatic heart disease (RHD)
- congenital heart disease (CHD)
- Low-middle income countries (LMICs)
- African Network for Medical Excellence (ANME)
- Cardiac Surgery Intersociety Alliance (CSIA)

ABSTRACT

Cardiovascular disease is the leading cause of death globally, responsible for 17.5 million deaths each year, 80% of which occur in low and middle-income countries including countries in Africa. Cardiotoracic surgery, with its heavy financial outlay is unavailable in many African countries. A lot of African health care givers are under the erroneous impression that the cardiovascular
surgical landscape of Africa is blank. Even in African countries with established cardiothoracic surgery capacity and training programs, they still face several challenges across multiple levels that includes persistent low filling rate of residency programs, insufficient local expertise, lack of financial resources, inadequate health infrastructure and skewed health insurance reimbursement system. Hence, there is still a growing burden of surgically correctable cardiovascular disease in these countries. This review highlights the cardiothoracic surgery practice in Africa and the different training programs in the region.

**KEYWORDS:** Cardiothoracic surgery, training, Africa

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**INTRODUCTION**

Africa’s over 1.4 billion people currently make up 18.2% of the world population (1). The continent has a land area of 29,648,481 km²; and, from an economic and developmental standpoint, is split by the Sahara Desert into two distinct regions, a better developed Northern Africa and a developing sub-Saharan Africa. The continent possesses an average of 135.19 hospital beds per 100,000 (2).

Modern cardiothoracic surgery practice in North and sub-Saharan regions of Africa took off in the 1950s and 1960s (3). These early years witnessed considerable progress as it presented the world with its first human-to-human heart transplant performed at the University of Cape Town, South Africa (4). The years following the nascent periods failed to keep up with the pace of progress set in some countries in the continent. Although the sub-specialty continues to widen within the African continent, not all nation states possess facilities, trained personnel and economic means to
establish and maintain a viable cardiothoracic surgery practice (3). In response to this situation, diverse models and initiatives are used by surgeons to sustain the practice of cardiothoracic surgery in Africa, particularly in resource-constraint settings. In this article, we describe the cardiothoracic surgery practice in Africa and analyze its different training programs in this region. We also share our perspective on the future of cardiothoracic surgery in Africa.

**Healthcare and Cardiothoracic Surgery in Africa**

Africa has a significant proportion of the global burden of cardiovascular diseases, ranging from chronic heart conditions to congenital defects of the cardiovascular system. In Africa, morbidities from structural heart conditions such as congenital heart disease (CHD) and rheumatic heart disease (RHD) are much higher than in the rest of the world. (5) Although exact data on the prevalence of surgical cases of heart disease are limited, it is clear from different studies that Africa is currently unable to handle its burden of surgical cardiovascular diseases. (6) High fertility rates also mean that the burden of diseases such as CHD is expected to increase, with over 50 million live births in Africa annually. (7) Additionally, Low-middle income countries (LMICs), such as African countries, still share challenges in surgical services that high-income countries have long left behind (6).

This need is further complicated by a lack of sufficient capacity to handle cardiac surgery cases within Africa. Studies show that the overall need for cardiac surgery ranges between 200 – 250 surgeries per million in sub-Saharan Africa. (8) However, in Nigeria, only 0.5 open heart surgeries are carried out per million population, while in South Africa, 142 per million population. In contrast to European countries like Germany, where 1,243 procedures are performed per million
population (8,9). Also, only a small fraction of congenital heart diseases is diagnosed in Africa. A combination of absent or underdeveloped health insurance schemes, inadequate capacities, lack of government commitment, and poor socioeconomic conditions that precipitate poor post-surgical outcomes mean that a significant proportion of cases go unsolved (6).

Since the late 20th century, cardiothoracic surgery services in Ghana, Nigeria, Rwanda, Zambia, South Africa, and parts of North Africa have taken off. Many of them still rely on fly-in missions. For example, a 2016 survey of 15 different tertiary centers in Nigeria showed that only four institutions had teams capable of independent practice of cardiothoracic surgery, with 11 relying on regular or intermittent cardiac missions. (10) Like the Nigerian case, a few practices in Africa have evolved past the era of fly-in missions, and now have independent cardiothoracic surgery centers. (11–13) While good news, the capacity of cardiac surgery in Nigeria still does not meet the need for a nation of 225 million people (12,13).

As to the distribution and diversity of procedures carried out in some African countries, there seems to be marked improvement. A study carried out in Lagos University Teaching Hospital, a major tertiary health institution in Nigeria, revealed a range of major, minor, and endoscopic procedures, with the most common procedures including chest tube insertions, endoscopy, lung procedures, arteriovenous fistulae, pacemaker implantations, and open-heart surgeries. (10) Other operative procedures at the practice include esophageal procedures, chest wall surgery, video-assisted thoracic surgery, closed-heart surgery, thymectomy, and diaphragmatic surgeries. In another review, Ekpe et al. reported that over 700 procedures were carried out in Eastern Nigeria, with the most common conditions being congenital cardiovascular disease, surgical complications of pulmonary tuberculosis, thoracic trauma, and aerodigestive foreign bodies. (14) In the same
vein, several other African countries such as Egypt, South Africa, Ghana, carry out similar
procedures. (See Figure 1)

Notably, countries like Namibia, Zambia, and Uganda have attempted to develop adequate
facilities and cardiothoracic surgery expertise. However, a comprehensive assessment of these
practices revealed significant gaps in administrative capacity, financing, and training and
mentorship. Forcillo et al. report that none of the surgeons were trained locally in the three
institutions studied, and no local programs had yet been approved in these countries. And quite
unfortunately, the delivery of cardiac surgery services is regularly hampered by power outages,
sanitation and water issues, and a lack of consumables such as blood products, surgical materials,
and prostheses. (15) In the three countries, palliative care and rehabilitation programs are severely
lacking, with none offering a cardiac rehabilitation program. Follow-up is also difficult, with most
patients coming from far distances, and only Uganda has signed a national act that prioritizes
cardiac surgery (15).

Much work needs to be done to fill the unmet need for cardiothoracic surgeons in Africa (there are
0.04 adult cardiac surgeons per million in Africa, as opposed to 7.15 in high-income countries).
(16) However, it is crucial to institute sufficient ancillary services and robust, sustainable
programs. Despite these difficulties, there are important improvements. For one, there is a
progressive increase in the number of cases that are handled locally, as well as standard training
programs in regions such as South Africa, West Africa, and North Africa. (17,18) Additionally,
innovative techniques in surgery have begun to appear in a few countries, such as a robot-assisted
surgery programs at Netcare Christiaan Barnard Memorial Hospital, and video-assisted thoracic
surgery and mediastinoscopy in Nigeria (19–21).

6
AFRICAN CARDIOTHORACIC SURGERY PRACTICE

Few African countries can provide cardiothoracic surgical care to their populations. In 2014, the service delivery in Africa stood at 1 cardiac surgeon for every 5.9 million inhabitants (3). Thus the surgeon-to-population ratio remains low.

North Africa:

Access to cardiothoracic surgery and surgeons in Egypt is provided through two major branches of the Egyptian healthcare providers. The government sector which forms the largest category and includes university/training hospitals, public hospitals under the ministry of health and national heart institute. They serve mainly those on public health insurance and free health service cadre. On the other hand, are private hospitals/clinics that cater for those with private insurance coverage and out-of-pocket payers. Surgeons in academic and public hospitals are allowed to work in private practice outside their working hours (22). In Sudan, the Salam Centre for Cardiac Surgery continues to perform specialized cardiac surgeries, with over 10,000 operations since its establishment in 2007. The Salam Centre provides medical and surgical care completely free of charge and is a member of the African Network for Medical Excellence (ANME) (23).

Cardiothoracic surgery practice in other countries in the North Africa sub-region follows a similar pattern as obtained in Egypt.

Sub-Saharan Africa:

Cardiothoracic practice in sub-Saharan Africa roughly fits three different models (3). Model 1 is where a senior local cardiothoracic surgeon sets up a center through government support in a public
hospital/ academic hospital, or with private funding as in private cardiac centers. Model 2 suits conditions where there are no sustainable local practice centers in a country, but cardiothoracic surgeons visit for short period thorough charity missions to perform humanitarian surgery. This is the main model currently in practice in most sub-Saharan Africa countries and has been employed to achieve successful skills transfer for surgeons training locally. Model 3 is the less frequently practiced model and is the model in which expatriate surgeons or indigenous surgeons who have practiced with many years of experience abroad are employed to develop a cardiac program. In addition to these models, in countries such as Cameroon, Nigeria and Ethiopia, charity and religious organizations own centers where both expatriate and local surgeons practice and cardiac care is accessible at a reduced cost to the people.

In Ethiopia, where cardiovascular surgery practice is concentrated in the capital, Addis Ababa, cardiac care is provided via mission-based surgical interventions, abroad referral, and local centers. Until 2017, the first two avenues were the main mode of access; however, independent local cardiothoracic practice is currently available alongside private practice (24).

Besides the three models described above, public-private partnership is explored at some centers in Nigeria to provide cardiac care (10). Also, independent teams of cardiothoracic surgeons in joint private practice exist in major cities in the country.

In Ghana, the National Cardiothoracic Center at the Korle Bu Teaching Hospital in Accra, the capital city, serves as the major cardiac center for the country and neighboring countries (25). The Cardiac Centre at the St. Elizabeth Catholic General Hospital of Shisong, is a unique center in Cameroon and surgeons there also serve the Central Africa sub-region. Recently the Yaoundé Regional Hospital and Douala General Hospital have become engaged in cardiac surgery in a low income setting (26).
In 2018, the Tenwek Hospital in Kenya started a cardiothoracic surgery residency program. Based on the Society of Thoracic Surgeons’ curriculum, this program has graduated at least 4 attending surgeons who are now serving their country, with 817 surgeries carried out between 2008 and 2021 (27).

**Southern:**

South Africa has an established cardiothoracic practice. About 60% of surgeons are in the private sector and many hold government part-time appointments (21). Again, most centers are located in the main cities. A heart transplant program is performed in the state-owned University of Cape Town Health Services and some private cardiac centers in Cape Town and Johannesburg (21). Recently, countries such as Mozambique and Rwanda have benefited from the Cardiac Surgery Intersociety Alliance (CSIA), based on the Cape Town Declaration on Access to Cardiac Surgery in the Developing World (2018). Through these, hospitals such as the Hospital Central Maputo (Mozambique) and King Faisal Hospital Kigali (Rwanda) are receiving international support in building cardiac surgery capacity (28).

### Cardiothoracic Surgery Training Programs in Africa

The history of cardiothoracic surgery (CTS) training in Africa dates to the late 1950s, when the first clinical training program was established at Groote Schuur Hospital in Cape Town, South Africa which led to one of the first indigenous trained cardiac surgeons in Africa. This program was initially led by Dr Christiaan Barnard (21). Since then, several training programs were developed in various African countries, such as Egypt, Nigeria, Kenya, Ethiopia, Ghana, Sudan, and Tanzania, (27,29) training fully qualified cardiac surgeons like those offered by WACS, South...
Africa, Egypt, and COSECSA, which is the largest surgical training institution in Sub-Saharan Africa. The advancement of CTS training in Africa has been shaped by several significant milestones outlined in (Figure 2).

In most countries, the path to becoming a CT surgeon starts with completing a five to seven-year undergraduate medical degree. Aspiring surgeons must then undergo a one-year internship, followed by a four to five-year general surgery residency at approved hospitals. A specialized fellowship program must then be applied for. These two to three-year fellowships provide comprehensive training in both adult and pediatric cardiothoracic surgery. The final step on this path involves registering as a specialist with the relevant national authority or professional society. The total duration of training to become a CT surgeon in Africa varies from 12 to 17 years after secondary/high school education, depending on the country and program (25). These pathways have similar characteristics as other emerging countries with regard to training (30–33).

North Africa is a prominent region for CTS training centers and specialists in Africa with Egypt leading in both quantity and quality of CTS services. The first program was established in Egypt in 1957, followed by centers in Morocco, Tunisia, Algeria, and Sudan (22). These programs follow European or American models, lasting five to seven years after medical school. Training covers adult and pediatric CTS, cardiac anesthesia, and intensive care. Accredited by national authorities and professional societies, some centers are even recognized by international organizations like the WHO.
In contrast, West Africa faces challenges in CTS education, having the lowest number of training centers and specialists in Africa. Only Ghana, Nigeria, Senegal, and Ivory Coast have active CTS programs. Ghana’s National Cardiothoracic Center (NCTC), established in 1989, offers a 6-year residency covering adult and pediatric CTS (17). Infrastructure, equipment, funding, and referral system limitations hinder other programs (27). Typically based on British or French models, CTS training lasts 4 to 6 years, with a focus on adult CTS. National or regional organizations accredit the programs, including the WACS, Ghana Medical and Dental Council, the Nigerian Association of CT Surgeons, and the Senegalese Society of Thoracic and Cardiovascular Surgery (17).

Conversely, East Africa boasts a moderate number of CTS training centers and specialists. Leading the region is Kenya, where the first training program was established at Nairobi’s Kenyatta National Hospital in 1970 (27). Tenwek Hospital, also in Kenya, began a cardiothoracic surgery training program in 2018 (27). Tanzania, Uganda, Zambia, and Zimbabwe have also joined the ranks with their own CTS centers. These programs, modeled on the British approach, span 4 to 6 years’ post-medical school, covering adult and pediatric CTS, cardiac anesthesia, and intensive care. Accreditation is granted by national authorities or societies such as the Kenya Medical Practitioners and Dentists Board or COSECSA (27).

Southern Africa houses a significant number of CTS training centers and specialists. South Africa leads the region with more CTS centers emerging in Namibia, and Zimbabwe (18). Modelling the American approach, these 5 to 7 yearlong programs cover adult and pediatric CTS, cardiac anesthesia, and intensive care. Accreditation is also granted by national authorities or societies like the Health Professions Council of South Africa or the South African Society of CT Surgeons (18). Notably, select Southern African CTS centers are also recognized by international organizations such as the American Board of Thoracic Surgery or the International Society for Heart and Lung
Transplantation. The University of the Free State in Bloemfontein also hosts an advanced cardiothoracic surgery training program at the Robert W M Frater Cardiovascular Research Centre, which was developed to address regional educational and training challenges. This programme provides advanced training in techniques such as video-assisted thoracic surgery and high-fidelity human factor simulation. (34)

The programs’ strengths lie in providing trainees with exposure to a high volume and diversity of cases, particularly prevalent diseases in Africa. Valuable mentorship is offered by experienced faculty who often work under challenging conditions with limited resources. However, inadequate infrastructure, equipment, and support staff limit surgical services and training (29). Furthermore, trainees face obstacles such as insufficient funding, poor working conditions, and limited career prospects (29).

Despite its achievements, CTS training in Africa still faces many difficulties. The continent lacks enough CT surgeons to meet the demand, and several barriers hinder the progress of CTS education in Africa. These include inadequate infrastructure, equipment, consumables, and support staff, along with limited funding, remuneration, incentives, poor working conditions, security, governance, and the need for ongoing skill maintenance (29).

THE FUTURE OF CARDIOTHORACIC SURGERY IN AFRICA
Advancement in the field of cardiothoracic surgery has been shown to be in parallelism with economic development (11,16). With most cardiothoracic surgeons concentrated outside the borders of Africa, over 42% in North America and 32% in Europe, Africa has about 1% cardiothoracic surgeons at her disposal. An interesting fact, however, is that the density of cardiothoracic surgeons has been shown to follow the distribution of the gross domestic product (GDP) which is a cue of the heavy financial outlay required to establish or maintain the practice of modern cardiothoracic surgery as seen in well advanced countries. High-income countries, on average, spend 11.8% of GDP on health, in contrast to low- and middle-income countries which spend about 5.8% of GDP on health, severely restricting health services to essential priorities (16). Factors that affect the economic growth of a country will, therefore, inadvertently affect her advancement in the field of cardiothoracic surgery. A typical factor is the political stability of a nation. Nations that are critically impaired by political crises, such as war, will have more lag in its advancement compared to peaceful regions (11).

Globally, the costs relating to cardiothoracic surgery ranks high among other healthcare costs. Thus, for most countries, especially the developed ones, measures have been deployed to meet up with this high cost. The most viable of this is the medical insurance scheme. In Africa, especially in the Sub-Saharan regions, there is a dearth of insurance schemes, and patients must pay for services received out of their pockets (11,16).

An alternative is the reliance on philanthropy and donor support, however, this offers no lasting solution. A typical example is the Ghana Heart Foundation, a non-governmental organization set up by Professor Frimpong-Boateng, which has been of immense help in Ghana. It covers most of the cost for Ghanaian patients requiring an open-heart surgery, serving as a good alternative to health insurance coverage which oftentimes is not feasible. However, without any consistent
economic growth, most philanthropy support has become a thing of the past. Moreso is the fact that philanthropy and donor support sometimes mask the problem of healthcare crises by diverting the attention, making the government lack in policy implementation plans (11,35).

Thus, the need for economic growth and fiscal prudence in Africa is vital. Lack of economic growth facilitates brain drain in cardiothoracic surgery, worsening the development, maintenance and advancement of cardiothoracic surgery in the affected country. (36,37) In order to curb this, African nations must do well to manage their economy judiciously and make sound healthcare policy decisions to enhance infrastructural layouts, staff training and retention in cardiothoracic surgery and other fields of health study. Collaboration with established centers has become a sine qua non highly encouraged in order to accelerate the development of this specialty in our African nations (11).

CONCLUSION

Cardiothoracic (CT) surgery in Africa has faced significant challenges due to resource constraints, but it has demonstrated resilience and growth through diverse models and initiatives. The burden of cardiovascular diseases in Africa remains high, yet the capacity to provide cardiac surgery is limited. Access to CT surgery falls far short of meeting the substantial demand.

The reliance on fly-in missions for cardiac surgery highlights the unsustainable nature of the current approach, which fails to meet the needs of the population. While some progress has been made in establishing independent CT surgery centers, there is still a significant gap in the
deliverance of comprehensive care. To address this scarcity, more training opportunities for CT surgeons in Africa must be established.

Despite these challenges, there are promising developments in the field. The introduction of innovative surgical techniques, including minimally invasive approaches, holds great potential to improve patient outcomes and reduce complications. These advances can significantly improve the lives of millions across the continent.

To achieve sustainable progress, continued investment in CT surgery is crucial. Economic growth and fiscal caution are necessary to create a favorable environment for healthcare advancements. African nations must make sound healthcare policy decisions to enhance infrastructure, staff training, and retention in CT surgery and other healthcare fields. Furthermore, addressing the disparities in access to CT surgery will need concerted efforts and collaboration among governments, healthcare institutions, and international partners.

This manuscript is however limited due to limited availability of data reporting cardiac surgery development and national cardiothoracic surgery registry in some African countries. There is as such a call for concern for cardiothoracic surgery researchers in African countries with no available or up-to-date data to put up works on the current status and make them public by using cardiothoracic journals or websites, so the actual burden of cardiothoracic surgery can be known. This will help call attention to existing gaps and open opportunities for collaboration in cardiac surgery. In conclusion, the future of CT surgery in Africa holds promise. With continued investment, support, and the implementation of comprehensive healthcare policies, CT surgery can make a significant impact on the health and well-being of African populations. By expanding training programs, enhancing infrastructure, and fostering collaboration, Africa can overcome its challenges and provide accessible, high-quality CT surgical services to those in need.
REFERENCES


Figure 1: A map showing African countries with established cardiothoracic surgery centers


Table outlining the African countries with cardiothoracic surgery capacity, number of cardiothoracic surgery procedures carried out, types of cardiothoracic surgery procedures carried out and the number of cardiothoracic surgery centers in each of these countries.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Countries</th>
<th>Types of Cardiothoracic surgery Procedures</th>
<th>Number of Cardiothoracic surgery centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nigeria</td>
<td>Open heart surgeries, heart valves surgeries, congenital heart defects repairs, CABG (Coronary artery bypass grafting), thoracic tumor resections and lungs surgeries</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Cameroon</td>
<td>CABG, open heart surgeries, heart valves surgeries, congenital heart defects repairs</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Country</td>
<td>Services</td>
<td>Count</td>
</tr>
<tr>
<td>---</td>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>3</td>
<td>South Africa</td>
<td>Open heart surgeries, heart valves repairs/replacement, CABG, congenital heart defects repairs, lungs surgeries and thoracic tumors resections, minimal invasive cardiac and thoracic surgeries</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>Egypt</td>
<td>CABG, thoracic tumors resections, lungs transplants, minimal invasive cardiac surgeries, repairs of congenital defects within the thorax (tracheoesophageal fistula), heart valves surgeries, heart transplantation, thoracic tumor resections</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Ghana</td>
<td>Valvular surgeries, congenital heart defects repairs, thoracic surgeries, open heart surgeries and CABG</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Gabon</td>
<td>Thoracic surgeries, vascular surgeries, congenital heart surgeries</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Congo-Kinshasha</td>
<td>Congenital heart surgeries, open heart surgeries, thoracic surgeries</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Zambia</td>
<td>Open heart surgeries, valvular surgeries, congenital heart surgeries</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Uganda</td>
<td>Open heart surgeries, valvular repair/ replacement, CABG, Coronary Angioplasty, heart transplant, minimal invasive surgeries, congenital heart surgeries</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>Kenya</td>
<td>CABG, heart valves surgeries, congenital heart defects repairs, thoracic surgeries and open heart surgeries</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Country</td>
<td>Surgical Procedures</td>
<td>Count</td>
</tr>
<tr>
<td>---</td>
<td>--------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>11</td>
<td>Zimbabwe</td>
<td>Open heart surgeries, congenital cardiac surgeries, valvular repair/replacements</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>Burkina Faso</td>
<td>Open heart surgeries, valvular repair/replacements</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>Senegal</td>
<td>Open heart surgeries, congenital repair surgeries, vascular surgeries, valvular repair/replacements</td>
<td>7</td>
</tr>
<tr>
<td>14</td>
<td>Ivory Coast</td>
<td>Congenital heart surgeries, valvular repairs/replacements, vascular surgeries, open heart surgeries</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>Rwanda</td>
<td>Thoracic surgeries, cardiac surgeries, valvular repair/replacements</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>Namibia</td>
<td>Congenital cardiac surgeries, open heart surgeries</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>Ethiopia</td>
<td>Open heart surgeries, congenital heart surgeries</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>Mali</td>
<td>Open heart surgeries, valvular repairs/replacements, congenital heart surgeries</td>
<td>2</td>
</tr>
<tr>
<td>19</td>
<td>Tanzania</td>
<td>CABG, open heart surgeries, minimal invasive heart surgery, valvular repairs/replacement, thoracic surgery, congenital heart surgery</td>
<td>4</td>
</tr>
<tr>
<td>20</td>
<td>Morocco</td>
<td>Open heart surgeries, valvular repairs/replacement, thoracic surgery</td>
<td>11</td>
</tr>
<tr>
<td>21</td>
<td>Algeria</td>
<td>Open heart surgeries, CABG, congenital heart surgery</td>
<td>18</td>
</tr>
<tr>
<td>22</td>
<td>Sudan</td>
<td>Valvular repair, congenital cardiac surgeries, thoracic surgery</td>
<td>5</td>
</tr>
<tr>
<td>23</td>
<td>Mozambique</td>
<td>Open heart surgery, valvular surgery, congenital cardiac surgeries</td>
<td>2+</td>
</tr>
<tr>
<td></td>
<td>Country</td>
<td>Procedure</td>
<td>Count</td>
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<td>---</td>
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<td>---------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>24</td>
<td>Zimbabwe</td>
<td>Open heart surgery, congenital cardiac surgery, valve surgery</td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>Rwanda</td>
<td>Valvular surgery</td>
<td>1</td>
</tr>
</tbody>
</table>
Founding of the ASEA in 1950

Founding of the WACS in 1960

Founding of PASCAR in 1981

Launch of the African Heart Seminar in 2004 (changed to PAScTS in 2011)

Founding of COSECSA in 1996

Founding of AATCVS in 1992

Launch of the WHO GIEESC in 2005

Creation of the AHN in 2009

Development of ASOS in 2014