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Cardiothoracic Surgery Training in Africa: History and Developments

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Abstract

Introduction: Cardiovascular disease is the leading cause of death worldwide with a disproportionately huge burden for the low- and medium-income countries. Africa has a huge burden of cardiovascular disease. Even in Africa there is regional disparity in disease burden. This study seeks to highlight the magnitude of cardiovascular disease and identify efforts to improve on the inadequacy. It shows that the challenges are attributable to poor economic status and inadequate training of Cardiac Surgeons. It seeks to highlight areas where international, intraregional, and local groups can develop initiatives that would accelerate the development and implementation of Cardiac surgical practice in Africa, especially Sub-Saharan regions.

Materials and Methods: We looked at the literature of Cardiac surgery and surgical training in Africa and collected data on the infrastructural development for Cardiothoracic surgery from countries present at the Pan African Society for Cardiothoracic Surgery (PASCaTS) meeting. The data underwent analysis and was displayed through graphs, charts, and illustrative maps.

Results: There have been regional developments in training and capacity building. In contrast to previous times when training occurred in the West or Indian Sub-continent, it now happens locally and regionally. There has also been an increase in new Cardiothoracic units in countries where initially there was no capacity.

Conclusion: African Cardiothoracic capacity and training is still way behind the Western world however there is resilience. With collective effort, training capacity, infrastructure, and patient care could grow rapidly and significantly improve.

INTRODUCTION

Cardiovascular disease is the leading cause of death worldwide, accounts for 19.8 million yearly. Eighty percent of these mortalities are in low- and middle-income countries where Africa belongs (WHO 2022). Cardiothoracic surgery has huge financial requirements which makes its infrastructural establishment and creation of centers difficult in African countries. Even in African countries with established Cardiothoracic centers, surgical capacity and training programs are still unable to meet the huge demand.

Africa has a population of 1.4 billion, representing 18.2% of the world's total, yet it has only 1% of global cardiac surgeons, highlighting the continent's burden of cardiovascular diseases. Africa has a sizable portion of the global burden of cardiovascular disease ranging from Congenital Cardiac defects to chronically acquired heart disease, including Rheumatic heart valve disease and coronary artery disease. To put it in perspective, infant mortality from congenital heart disease in Africa is 48%. Africa is currently unable to manage its numbers of surgically correctable cardiovascular diseases; in fact, only 2% of children with congenital heart disease benefit from correctable heart surgery in Africa.

The burden of congenital heart disease is expected to increase as the annual birth rate increases. Africa also has the burden of rheumatic heart valve disease contributing to significant morbidity and mortality. It is important to note that even when children get an opportunity to have heart valve surgery, only about 10% will get valve repair with the majority being subjected to valve replacement. The WHO recommended minimum number of Cardiac surgeries per million is four hundred; the average number of open hearts per million in Sub-Saharan Africa is only two. While WHO has set up a recommended minimum of four hundred cases per million, PASCaTS has set up at least 40 cases per million as its bare minimum, and African centers are still far from that.

Cardiothoracic surgery in Africa faces challenges such as a shortage of qualified surgeons, cardiologists, intensivists, and perfusionists. Another shortcoming is the limited financial resources, reflected in the fact that African countries allocate just 5.8% of their GDP to health, whereas developed countries spend 11.8%. Infrastructures like catheterization laboratories, heart-lung

machines, Cardiac ICU beds, and Cardiac theatre spaces are also inadequate. The absence of an effective health insurance reimbursement scheme makes care costly for patients and their families. These create a growing burden of surgically correctable cardiovascular diseases in the African countries.

REGIONAL DISPARITY IN AFRICAN COUNTRIES PERFORMING CARDIAC SURGERY

Only twelve of the 54 African countries have independent cardiac centers and only 30 countries have some kind of Cardiac surgery. There is a significant disparity in the distribution of Cardiac surgical institutions and performance in Africa. This reflects the disparities in economic development; Northern African countries and Southern Africa have a greater concentration of centers, while Sub-Saharan Africa has a significantly limited number of centers and units. Only Kenya, Ivory Coast, and Senegal have independent Cardiac centers in Sub-Saharan Africa, other than South Africa and Namibia.

THE MAGNITUDE OF DISPARITY IN CARDIAC SURGERY BETWEEN AFRICA AND THE DEVELOPED WORLD

North Africa accounts for a bigger proportion of the Cardiac surgeries in Africa at 91.6 per million, bringing the African mean to 11.8 per million. Comparison between African regions with Germany and China clearly brings out the huge disparity. Germany at 1,038 and China at 158 cases per million yearly respectively are way beyond the African average of 11.8 cases per million and much higher than the North African data of 91.6 cases per million. This highlights the need for significant improvements in cardiac surgery in Africa. In Sub-Saharan African regions, the distribution of cases per million ranges between 2.6 in Southern Africa to 0.7 in the Horn of Africa.

CARDIAC SURGERY CAPACITY IN AFRICA: CARDIAC CENTERS IN VARIOUS AFRICAN REGIONS

Even more glaring is the distribution of Cardiac centers in relation to the population served: West Africa with a population of 420 million has only twenty-six cardiac centers, while North Africa with a population of 256 million has 127 cardiac centers. A comparable pattern appears elsewhere in Sub-Saharan Africa, with East Africa having just thirteen cardiac centers to serve a population of 257 million. Only the Southern African region fares better with forty cardiac centers serving 280 million people. The worst affected are the Horn of Africa and Central African regions. In the Central African region there are only five cardiac centers serving over 200 million people.

The population in millions served by a center in the West African region is 16 million; in the North African region each cardiac center serves 2 million people. In East Africa, each cardiac center serves 20 million people, while in the Horn of Africa each center serves 58.5 million. In Central Africa each cardiac center serves 40 million people and in Southern Africa each cardiac center serves 7 million people. The mean population served by a Cardiac center in Africa is 7 million.

ANNUAL NUMBER OF OPEN-HEART SURGERIES PER MILLION PEOPLE IN SUB-SAHARAN AFRICAN COUNTRIES

The raw number of Cardiac Surgeries in selected Sub-Saharan African countries shows distribution of cases from 655 in Kenya to 83 in Cameroon. The impact of this in demonstrating intraregional disparity is clearer when considering number of cases per million. While Namibia with a population of 3 million performs 68 cases per million, Nigeria with a much bigger population of 232.7 million manages one case per million. Kenya performs 12 cases per million, which is the mean number of cases per million in the African continent due to the North African boost. Uganda and Tanzania with two cases per million have a comparable result to the mean number of cases per million in Sub-Saharan Africa.

POPULATION SERVED BY A HEART SURGEON IN EIGHT SELECTED SUB-SAHARAN AFRICAN COUNTRIES

Computing the number of heart surgeons in various countries helps to understand how dire the deficit of cardiac surgery in Sub-Saharan Africa is. Based on this model, Nigeria with 83 heart surgeons and a population of 232.7 million has a surgeon serving 2.803 million people; Ethiopia has a surgeon serving 5.74 million people; a Kenyan heart surgeon serves 2.57 million people; Ghana 2.87 million; Tanzania 5.72 million; and a Cameroonian heart surgeon serves 5 million people. A Namibian heart surgeon serves the least number of people at 750 thousand, due to its population of 3 million, while a Burkina Faso surgeon serves 11.8 million people. Considering the total population of this sample — 670 million people against 180 heart surgeons — each surgeon serves a population of 3.72 million people.

DISEASE TYPES AND PERCENTAGE DISTRIBUTION OF CARDIAC SURGERY IN 8 SUB-SAHARAN AFRICAN CENTERS

Multiple centers conducted open heart surgeries, performing between 83 and 655 operations each, for a combined total of 1,999 procedures. Rheumatic heart valve surgeries ranged from 8 to 433; congenital heart procedures ranged from 30 to 210; CABG/OPCAB procedures ranged from 0 to 120; aortic root surgeries ranged from 0 to 15. Other conditions including atrial myxomas, LV aneurysm, infective endocarditis, and constrictive pericarditis accounted for 1%.

MODELS OF AFRICAN SURGICAL TRAINING

Traditionally, African prospective Cardiothoracic surgeons went out of the continent seeking training opportunities, returning to establish Cardiac centers. This has been the most common training model. The key challenge with this model has been brain drain. Another model has been through apprenticeship, where trainees linked up with a specific surgeon in a surgical center and trained through shadowing. The primary challenge has been the limited or insufficient opportunities for practical, hands-on experience.

Another approach involves students learning via international journals and online webinars, which demands substantial prior knowledge before they can make connections; however, it still lacks practical, hands-on experience. Training through local postgraduate master's or fellowship programs offers the greatest potential to strengthen the capacity of African cardiac centers.

HISTORICAL DEVELOPMENT OF AFRICAN CARDIOTHORACIC SURGERY TRAINING

Cardiac surgical training started in the 1950s, highlighted by the first human heart transplant pioneered by Christiaan Barnard et al. in South Africa in 1967. In North Africa, Egypt was the first country to establish a Cardiothoracic surgery and training program in 1957. Morocco, Tunisia, Algeria, and Sudan followed. Theirs is a 5–7-year program of adult and congenital cardiac surgery based on the European or American model.

In West African countries, the first open-heart surgeries were in Ghana in 1964 and Nigeria in 1974. In 1983, cardiac surgeons in Côte d'Ivoire reported a three-hundred-case series of Rheumatic and Congenital heart surgeries. West African training has had challenges with a lower number of training centers and surgeons. Ghana, Nigeria, Senegal, and Côte d'Ivoire have active programs. Ghana provides a six-year residency program in both adult and congenital cardiac surgery. The West African College of Surgeons (WACS) provides accreditation.

East Africa boasts a moderate number of Cardiothoracic training centers and specialists, with Kenya leading the regional capacity. The East African training program originated in the 1970s at Kenyatta National Hospital and the University of Nairobi in Nairobi, led by Professors Peter Odhiambo and Hillay Ojiambo, Cardiac surgeon and Cardiologist respectively. Tenwek Hospital in Kenya offers training since 2018 under the COSECSA fellowship program, accepting two residents yearly.

CARDIAC SURGICAL TRAINING PROGRAMS IN THE EAST AFRICAN REGION

The University of Nairobi offers a Master of Medicine program in Cardiothoracic surgery — a 5-year training with admissions of 6–8 students per year. Muhimbili University Hospital in Tanzania offers a three-year Cardiothoracic Surgery Fellowship for general surgery master's graduates, admitting two to three students annually. In Ethiopia, Addis Ababa University at Tikur Anbessa Specialized Hospital offers fellowship training: a blended program in partnership with COSECSA that annually admits three trainees for a 3-year program.

Uganda, Zambia, and Zimbabwe have joined by offering fellowship programs in their own Cardiothoracic surgery centers modelled on the British 4–6-year General surgery and 3-year fellowship, and have been granted accreditation by COSECSA — the College of Surgeons of East, Central and Southern Africa, the largest surgical training institution in Sub-Saharan Africa.

Cardiac Surgical Training in the East African Region: Kenya

At present, there are twenty-two cardiac surgeons actively practicing. Of these, twelve received their training through the traditional pathway, completing a Master of Medicine in General Surgery followed by a two- to three-year fellowship in Cardiothoracic Surgery. Eleven surgeons completed the University of Nairobi's five-year master's program in cardiothoracic surgery. The first graduate of this program was in 2016 and the last in this group of independent surgeons graduated in 2022. Ten of these surgeons are Kenyan and one Ugandan. Twelve more surgeons qualified between 2023 and 2025 and will work under supervision for three years before practicing independently. Six of them will become independent practitioners this year and one of them is Cameroonian though practicing locally.

Currently there are forty-two residents in training: eleven in year 5, including one from Sierra Leone; nine in year 4, two of them from Botswana and one from Rwanda; six residents in year 3, one Ugandan; eight residents in second year, of which one is Somalian; and eight first-years, of which one is Ethiopian and another Cameroonian. The program offers hands-on training with direct involvement in patient care, surgery, and trainer-led simulations.

DISCUSSION

Cardiothoracic surgical practice, having high financial demands, runs parallel to economic development, obviating higher commitment from the African political class. This is highlighted by the disparity in healthcare expenditure between the high- and middle-income nations. While high-income countries dedicate 11.8% of their GDP to healthcare, only 5.8% is allocated by middle-income nations, thus restricting healthcare to essentials. This disparity is evident in the significant gap in cardiac cases per million between African nations, particularly Sub-Saharan Africa, and developed countries — even as reflected in WHO guidelines. Given the prohibitive costs of cardiac surgery and other advanced medical procedures, along with Africa's low GDP, it is advisable for African governments to allocate at least 15% of their GDP to healthcare, which would support funding for cardiac surgery and similar medical interventions.

Promoting the development of financial schemes for health insurance can improve funding, which in turn supports better delivery of cardiac surgical care. Cardiac care in Sub-Saharan Africa is still insufficient, requiring additional actions to reduce death and disease rates due to restricted availability of heart surgery.

Local centers provide some training, but the number of African specialists produced remains far too low to address the significant shortage. Heart surgeons are responsible for training the next generation of specialists and establishing heart centers. With enhanced training programs, Africa can anticipate significant advancements in cardiac surgery standards. Intraregional collaboration in cardiac surgical training and patient management should be systematically conceptualized and promoted to foster a cohesive environment for South-to-South support, thereby enhancing both the volume and quality of surgical performance.

It is important to note that simulation training will be an important adjunct in improving the surgical skills of students and building confidence in handling complex cases. Just as important is the need to rethink North-to-South collaboration in terms of access to training, equipment mobilization, and personnel collaboration to help reduce the unmet burden of Cardiothoracic surgical care.

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