

Cardiothoracic surgery training in Africa: History and developments



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ABSTRACT

Objective: 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. Cardiothoracic surgery, with its heavy financial outlay, is unavailable in many African countries. Many African healthcare givers are under the erroneous impression that the cardiovascular surgical landscape of Africa is blank. This review aims at describing the cardiothoracic surgery practice in Africa, the different training programs in the region, and its future prospects.

Method: Through a literature review, the authors elaborate on key points, such as healthcare and cardiothoracic surgery in Africa, African cardiothoracic practice and training, and the future of cardiothoracic surgery in Africa.

Results: African countries with established cardiothoracic surgery capacity and training programs still face several challenges across multiple levels, including a persistent low enrollment rate in residency programs, insufficient local expertise, a lack of financial resources, an inadequate health infrastructure, and a skewed health insurance reimbursement system. Thus, there is still a growing burden of surgically correctable cardiovascular disease in these countries.

Conclusions: Cardiothoracic surgery in Africa has faced great 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 cardiothoracic surgery is limited. With investment, support, and the implementation of comprehensive healthcare policies, cardiothoracic surgery practice can improve in this region and this can make a significant impact on the health and well-being of its population. (JTCVS Open 2024;19:370-7)



Map depicting countries of Africa with established CTS centers and training programs.

CENTRAL MESSAGE

Despite the growing burden of cardiovascular diseases in Africa, there is still a lack of specialized institutions with CTS centers and training programs in the entire region.

PERSPECTIVE

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 CTS programs, the number of procedures is limited with a long wait-list due to insufficient local expertise, lack of financial resources, and inadequate health infrastructure.

Africa's more than 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 2 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 (CTS) practice in North and sub-Saharan regions of Africa increased in the 1950s and 1960s.³ These early years witnessed considerable

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Abbreviations and Acronyms

CTS = cardiothoracic surgery
GDP = gross domestic product

progress with the first human-to-human heart transplant performed at the University of Cape Town, South Africa.⁴ The years after the nascent periods failed to keep up with the pace of progress set in some countries in the continent. Although the subspecialty continues to widen within the African continent, not all nation states possess the facilities, trained personnel, and economic means to establish and maintain a viable CTS practice.³ In response to this situation, diverse models and initiatives are used by surgeons to sustain the practice of CTS in Africa, particularly in resource-constraint settings. In this article, we describe the CTS practice in Africa and analyze its different training programs in this region. We also share our perspective on the future of CTS 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 and rheumatic heart disease are 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 congenital heart disease is expected to increase, with more than 50 million live births in Africa annually.⁷ Additionally, low-middle income countries, 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 from 200 to 250 surgeries per million in sub-Saharan Africa.⁸ However, in Nigeria, only 0.5 open surgeries are performed per million people, whereas in South Africa, 142 are performed per million people. In contrast, in European countries such as Germany, 1243 procedures are performed per million people.^{8,9} Also, only a small fraction of congenital heart diseases are 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 postsurgical outcomes mean that a significant proportion of cases go unsolved.⁶

Since the late 20th century, CTS services in Ghana, Nigeria, Rwanda, Zambia, South Africa, and parts of North Africa have increased. Many of them still rely on fly-in missions. For example, a 2016 survey of 15 different tertiary centers in Nigeria showed that only 4 institutions had teams capable of independent practice of CTS, 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 CTS centers.¹¹⁻¹³ Although this is 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 surgeries.¹⁰ Other operative procedures at the practice include esophageal procedures, chest wall surgery, video-assisted thoracic surgery, closed surgery, thymectomy, and diaphragmatic surgeries. In another review, Ekpe and colleagues¹⁴ reported that more than 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. In the same vein, several other African countries, such as Egypt, South Africa, and Ghana, carry out similar procedures (Figure 1).

Notably, countries such as Namibia, Zambia, and Uganda have attempted to develop adequate facilities and CTS expertise. However, a comprehensive assessment of these practices revealed significant gaps in administrative capacity, financing, and training and mentorship. Forcillo and colleagues¹⁵ report that none of the surgeons were trained locally at the 3 institutions studied, and no local programs had yet been approved in these countries. Unfortunately, the delivery of cardiac surgery services is regularly hampered by power outages, sanitation, water issues, and a lack of consumables such as blood products, surgical materials, and prostheses. In the 3 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



FIGURE 1. Map showing African countries with established CTS centers.

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 Christian Barnard Memorial Hospital and video-assisted thoracic surgery and mediastinoscopy in Nigeria.¹⁹⁻²¹

AFRICAN CARDIOTHORACIC SURGERY PRACTICE

Few African countries can provide CTS 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 CTS and surgeons in Egypt is provided through 2 major branches of the Egyptian healthcare providers. The government sector forms the largest category and includes university/training hospitals and public hospitals under the Ministry of Health and National Heart Institute. They serve mainly those on public health insurance and free health service. On the other hand, there 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 more than 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.²³ CTS practice in other countries in the North Africa subregion follows a similar pattern as obtained in Egypt.

Sub-Saharan Africa

Cardiothoracic practice in sub-Saharan Africa fits approximately 3 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 used to achieve successful skills transfer for surgeons training locally. Model 3 is the less frequently practiced model in which expatriate surgeons or indigenous surgeons who have practiced with many years of experience abroad are used 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 2 avenues were the main mode of access; however, independent local cardiothoracic practice is currently available alongside private practice.²⁴

In addition to the 3 models described, 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. 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 CTS 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 performed between 2008 and 2021.²⁷

Southern

South Africa has an established cardiothoracic practice. Approximately 60% of surgeons are in the private sector, and many hold government part-time appointments.^{18,21} 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.^{18,21} Recently, countries such as Mozambique and Rwanda have benefited from the Cardiac Surgery Intersociety Alliance, 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 (Table 1).³¹

Cardiothoracic Surgery Training Programs in Africa

The history of 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.^{18,21} Since then, several training programs were developed in various African countries, such as Egypt, Nigeria, Kenya, Ethiopia, Ghana, Sudan, and Tanzania,^{27,32} training fully qualified cardiac surgeons, such as those offered by the West African College of Surgeons, South Africa, Egypt, and College of Surgeons of East, Central, and Southern Africa, 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 cardiothoracic surgeon starts with completing a 5- to 7-year undergraduate medical degree. Aspiring surgeons must then undergo a 1-year internship, followed by a 4- to 5-year general surgery residency at approved hospitals. A specialized fellowship program must then be applied for. These 2- to 3-year fellowships provide comprehensive training in both adult and pediatric CTS. 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 cardiothoracic 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.³³⁻³⁶

North Africa is a prominent region for CTS training centers and specialists in Africa, with Egypt leading in the

TABLE 1. Table outlining the African countries with CTS capacity, the types of CTS procedures carried out, and the number of CTS procedures carried out^{3,15,28-30}

S/N	Countries	Types of CTS procedures	No. of CTS centers
1	Nigeria	Open surgeries, heart valves surgeries, congenital heart defects repairs, CABG, thoracic tumor resections and lungs surgeries	15
2	Cameroon	CABG, open surgeries, heart valve surgeries, congenital heart defects repairs	3
3	South Africa	Open surgeries, heart valve repairs/replacement, CABG, congenital heart defects repairs, lungs surgeries and thoracic tumors resections, minimal invasive cardiac and thoracic surgeries	27
4	Egypt	CABG, thoracic tumors resections, lung transplants, minimal invasive cardiac surgeries, repairs of congenital defects within the thorax (tracheoesophageal fistula), heart valve surgeries, heart transplantation, thoracic tumor resections	15
5	Ghana	Valvular surgeries, congenital heart defect repairs, thoracic surgeries, open surgeries, and CABG	10
6	Gabon	Thoracic surgeries, vascular surgeries, congenital heart surgeries	2
7	Congo-Kinshasha	Congenital heart surgeries, open surgeries, thoracic surgeries	2
8	Zambia	Open surgeries, valvular surgeries, congenital heart surgeries	2
9	Uganda	Open surgeries, valvular repair/replacement, CABG, coronary angioplasty, heart transplant, minimally invasive surgeries, congenital heart surgeries	5
10	Kenya	CABG, heart valve surgeries, congenital heart defects repairs, thoracic surgeries, and open surgeries	7
11	Zimbabwe	Open surgeries, congenital cardiac surgeries, valvular repair/replacements	5
12	Burkina Faso	Open surgeries, valvular repair/replacements	3
13	Senegal	Open surgeries, congenital repair surgeries, vascular surgeries, valvular repair/replacements	7
14	Ivory Coast	Congenital heart surgeries, valvular repairs/replacements, vascular surgeries, open surgeries	2
15	Rwanda	Thoracic surgeries, cardiac surgeries, valvular repair/replacements	2
16	Namibia	Congenital cardiac surgeries, open surgeries	1
17	Ethiopia	Open surgeries, congenital heart surgeries	2
18	Mali	Open surgeries, valvular repairs/replacements, congenital heart surgeries	2
19	Tanzania	CABG, open surgeries, minimal invasive heart surgery, valvular repairs/replacement, thoracic surgery, congenital heart surgery	4
20	Morocco	Open surgeries, valvular repairs/replacement, thoracic surgery	11
21	Algeria	Open surgeries, CABG, congenital heart surgery	18
22	Sudan	Valvular repair, congenital cardiac surgeries, thoracic surgery	5
23	Mozambique	Open surgery, valvular surgery, congenital cardiac surgeries	2+
24	Zimbabwe	Open surgery, congenital cardiac surgery, valve surgery	1
25	Rwanda	Valvular surgery	1

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 5 to 7 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 such as the World Health Organization.

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, 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 West African College of Surgeons, Ghana Medical and Dental Council, Nigerian Association of CT Surgeons, and 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 CTS

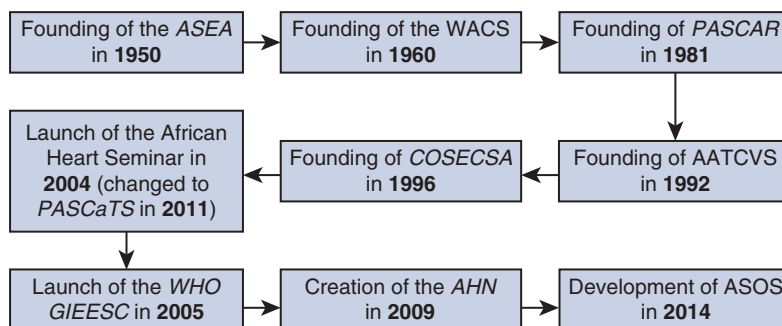


FIGURE 2. The major milestones in the development of CTS training in Africa. ASEA, Association of Surgeons in East Africa; WACS, West African College of Surgeons; PASCAR, Pan-African Society of Cardiology; AATCVS, African Association for Thoracic and Cardiovascular Surgery; COSECSA, College of Surgeons of East, Central and Southern Africa; PASCATS, Pan-African Society for Cardiothoracic Surgery; GIEESC, Global Initiative for Emergency and Essential Surgical Care; AHN, African Heart Network; ASOS, African Surgical Outcomes Study.

training program in 2018.²⁷ Tanzania, Uganda, Zambia, and Zimbabwe have joined the ranks with their own CTS centers. These programs, modeled on the British approach, span 4 to 6 years of postmedical 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 College of Surgeons of East, Central and Southern Africa.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 Modeling the American approach, these 5- to 7-year programs cover adult and pediatric CTS, cardiac anesthesia, and intensive care. Accreditation is also granted by national authorities or societies such as 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 CTS training program at the Robert W. M. Frater Cardiovascular Research Centre, which was developed to address regional educational and training challenges. This program provides advanced training in techniques such as video-assisted thoracic surgery and high-fidelity human factor simulation.³⁷

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.³² Furthermore, trainees face obstacles such as insufficient funding, poor working conditions, and limited career prospects.³²

Despite its achievements, CTS training in Africa still faces many difficulties. The continent lacks enough cardiothoracic 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.³²

THE FUTURE OF CARDIOTHORACIC SURGERY IN AFRICA

Advancement in the field of CTS has been shown to be in parallelism with economic development.^{11,16} With most cardiothoracic surgeons concentrated outside the borders of Africa, more than 42% in North America and 32% in Europe, Africa has approximately 1% cardiothoracic surgeons at its disposal. However, an interesting fact 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 CTS 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 that spend approximately 5.8% of GDP on health, severely restricting health services to essential priorities.¹⁶ Therefore, factors that affect the economic growth of a country will inadvertently affect advancement in the field of CTS. 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 with peaceful regions.¹¹

Globally, the costs relating to CTS rank high among other healthcare costs. Thus, for most countries, especially the developed ones, measures have been deployed to meet 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 nongovernmental 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 open surgery, serving as a good alternative to health insurance coverage that oftentimes is not feasible. However, without any consistent economic growth, most philanthropy support has become a thing of the past. More so 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.^{11,38}

Thus, the need for economic growth and fiscal prudence in Africa is vital. Lack of economic growth facilitates brain drain in CTS, worsening the development, maintenance, and advancement of CTS in the affected country.^{39,40} 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 CTS and other fields of health study. Collaboration with established centers has become a sine qua non highly encouraged to accelerate the development of this specialty in our African nations.¹¹

CONCLUSIONS

CTS 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 CTS falls far short of meeting the substantial demand.

The reliance on fly-in missions for CTS highlights the unsustainable nature of the current approach, which fails to meet the needs of the population. Although some progress has been made in establishing independent CTS centers, there is still a significant gap in the deliverance of comprehensive care. To address this scarcity, more training opportunities for cardiothoracic 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 CTS 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 CTS and other healthcare fields. Furthermore, addressing the disparities in access to CTS will need concerted efforts and collaboration among

governments, healthcare institutions, and international partners.

This article is limited because of limited availability of data reporting cardiac surgery development and national CTS registry in some African countries. There is as such a call for concern for CTS researchers in African countries with no available or up-to-date data to generate work on the current status and make them public by using cardiothoracic journals or websites so the actual burden of CTS can be known. This will help call attention to existing gaps and open opportunities for collaboration in cardiac surgery. The future of CTS in Africa holds promise. With continued investment, support, and the implementation of comprehensive healthcare policies, CTS 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 CTS services to those in need.

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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