



Effect of Geopolitical Forces on Neurosurgical Training in Sub-Saharan Africa

Kara E. Dempsey¹, Mahmood M. Qureshi², Solomon M. Ondoma³, Robert J. Dempsey³

■ **BACKGROUND:** The population of Sub-Saharan Africa suffers from a critical shortage and maldistribution of health care professionals, especially highlighted in surgical subspecialties, such as neurosurgery. In light of *The Lancet* report and the World Health Organization's directive to provide essential surgical care through the developing world, solutions need to be found to close this training and distribution gap.

■ **METHODS:** Methods correcting the situation will only succeed if one understands the geopolitical forces which have shaped the distribution of health care in the region and continue to this day. Solutions have evolved from service to service with education. The partnering organizations, the Foundation of International Education in Neurological Surgery and the World Federation of Neurosurgical Societies, have supported neurosurgical training in the developing world, including curriculum, equipment, facilities, certification, and local acceptance, with a goal of developing a self-sustaining program within the developing country.

■ **RESULTS:** These ideas heavily rely on partnerships to address classic geopolitical forces, including geography, drought, warfare, ethnic tensions, poverty, and lack of training facilities. Each can be addressed through partnerships, such as development of dyads with programs in developed countries and ongoing programs owned by the countries in question, but partnered with multiple international societies, institutions, and universities.

■ **CONCLUSIONS:** This paper provides both a historic and topical overview of the forces at work which need to be

addressed for success in delivering specialized care. This must always result in a self-sustaining program operated by the people of the home country with worldwide support through philanthropy and partnerships.

INTRODUCTION

The population of Africa is estimated to be 1.2 billion people, occupying 20.4% of the world's land mass. This continent has extensive resources in people, materials, agriculture, and innovation, but also extensive challenges—especially in health care. These challenges, great at every area of health care, are magnified in the subspecialties, such as neurosurgery. Neurosurgery came to Africa quite late, and training in neurosurgery came even later, especially in the Sub-Saharan region. This region's estimated population of 900 million suffers from chronic maldistribution of health care, especially in specialty care. Although distribution of neurosurgeons in the United States may be 1 to 86,000 people, in Sub-Saharan it may be 1 to more than 7 million.¹ Further, in Sub-Saharan Africa, almost all neurosurgical services are located in the national's capital, but most of the population lives elsewhere, often in vastly underserved rural areas.

The realities of such a maldistribution are considerable. It means it is very unlikely that any effective population-based health care can take place, which can in turn adversely affect any attempt to develop a trauma program, coordinate an anesthesia or intensive care unit program, or develop higher levels of surgical care. The realities for a patient suffering a potentially curable brain tumor in Sub-Saharan Africa often involve long travel to the capital in an attempt to be one of the few people who may be treated by the few neurosurgical facilities or practitioners in the country. The

Key words

- Africa
- Educational partnerships
- FIENS (Foundation of International Education in Neurological Surgery)
- Geopolitics
- Neurosurgical residency
- WFNS (World Federation of Neurosurgical Societies)

Abbreviations and Acronyms

CAANS: Continental Association of African Neurosurgical Societies
COSECSA: College of Surgeons of East, Central and Southern Africa
FIENS: Foundation for International Education in Neurological Surgery
WFNS: World Federation of Neurosurgical Societies

From the ¹Department of Geography of Planning, Appalachian State University, Boone, North Carolina, USA; ²Neurosurgical Training Program East, Central and Southern Africa, Nairobi, Kenya; and ³Department of Neurosurgery, University of Wisconsin, Madison, Wisconsin, USA

To whom correspondence should be addressed: Robert J. Dempsey, M.D.
 [E-mail: dempsey@neurosurgery.wisc.edu]

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results for the family are uprooting of their livelihood, whereas the results for their home region certainly include that it will never develop a comprehensive regional care plan for neurologic disorders.¹⁻³ Attempts to address this problem through training of neurosurgeons have come slowly. Although neurosurgery entered some of these areas in the time after World War II, especially in the region of Sub-Saharan East Africa, maldistribution remained. It is important to understand the geopolitical forces which affect such training if we are to correct this incongruity, which resulted from lack of resources and a network of care. It results in an inability to retain talented people because of the lack of facilities and infrastructure to allow them to practice their skills, causing an outmigration of the most talented people. The cost of such outmigration is considerable, estimated to be approximately \$4.55 billion for countries of this region. Additionally, the training of physicians is an expensive venture. For example, Uganda subsidizes \$21,000, Kenya \$36,450, and Zimbabwe \$38,600 per physician educated, but if these physicians do not find a place to practice, they are forced to outmigrate. The resulting expense to the country is high, but the loss of potential health care providers is even more devastating.

Although the public and academics studying health care have long understood the shortage of primary care in the developing world, it was only in 2015 when widespread acceptance of the importance of the shortage of surgical care was fully recognized when *The Lancet* Commission published their findings, suggesting that 6 billion people worldwide lack essential surgical care.⁴ Neurosurgery is a significant portion of this, especially regarding trauma, congenital anomalies, and benign tumors. *The Lancet* Commission and the World Bank calculated that the worldwide cost of not having access to essential surgical care was approximately 16 million unnecessary deaths per year and a cost overall of approximately \$1.3 trillion per year.⁵ In an effort to address these concerns, the World Health Organization received the support of every member state's Ministries of Health to emphasize surgical education as a part of the long-term solution to this problem. It is in this background that the prior work of programs, such as the Foundation of International Education in Neurological Surgery (FIENS), came to much more widespread acceptance.⁶

Early training came to the region often in the period after World War II.² The first trained specialist came to Kenya, Dr. Renato Ruberti, who founded the Neurosurgical Society of Kenya, and the first Pan-African Association, and participated in the African Federation of Neurosurgical Societies. Arriving to setup his practice in 1967, he participated in both public and private hospital care and developed the first clinic in Nairobi. Growth was slow, however, and training was generally done either by an apprenticeship model or by receiving training in another country and returning to East Africa. Although both public and private hospitals began to be developed, the few facilities that were developed were limited by the low rate of return of many trainees.

Geopolitical forces have always played a role in this maldistribution of care. Economy, war, geography, and political instability has restricted the growth of physicians and often led to the outmigration of not only neurosurgeons, but an entire educated class of people who possessed sufficient mobility to leave. Neurosurgical education is long and intense; therefore, relative political

stability is a necessity for medical education and retention of trainees as is the development of a self-sustaining system of care.

GEOGRAPHIC CONSIDERATIONS IN PATIENT CARE

Sub-Saharan East Africa has a long history of transportation difficulties. During colonial times, attempts to connect the region through rural development took place. Indeed, entire cities such as Nairobi were built along new railroads designed to open up the interior. Maintenance, however, has been poor, and the use of railroads in the distribution of health care has been almost nonexistent. As reliance increasingly turned to roads, extensive travel times and poor road maintenance essentially isolated rural communities. In some parts of the regions, river and lake crossings limited travel as much as geopolitical borders. Indeed, limited infrastructural development and the physical geography of Sub-Saharan East Africa has presented challenges to the establishment and accessibility to health care. Although most African subspecialties, such as neurosurgical care, are located in each nation's capital, some countries, such as Uganda, have 96.8% of their population residing outside of the capital. Such geographic infrastructural problems have also contributed to the African brain drain because doctors migrate to wealthier and more developed countries. The result is limited care in the capital and none in other parts of countries. As doctors leave, the consequent health system is then progressively stressed and continued development is increasingly challenging. For example, in 2004, there were only 87 medical schools in all 47 nations within Sub-Saharan Africa⁷; therefore, in addition to the loss of trained physicians, the prospect of training new local physicians after trained doctors leave is exceptionally difficult. Without the development of regional health care, major subspecialty care, such as neurosurgical, including neurosurgical trauma, collapses on the capital in an unsustainable course. This massively overcrowds the capitals' public hospital and hinders the development of networks of care coordination, from trauma to tumor, to develop in the more remote regional cities.

Geopolitical Determinants of Health Care: Transportation, Agriculture, Politics, War, and Health

The geopolitical climate of the region over the last 50 years has had an enormous impact on the quality, access, and stability of the health care systems in these states and the availability of training. In geographic terms, access to health care is defined by the distance to and availability of quality care. Overall, infrastructural development in Sub-Saharan Africa cuts across an urban/rural divide such that peripheral locations are more likely to be disadvantaged and face health disparities; however, very large populations remain rural. This also takes into account the various modes of transportation, or the lack thereof, that patients use to obtain needed care. Not surprisingly, studies demonstrate that physical access to care influences a patient's ability or decision to use health care.⁸ For example, empirical results suggest that proximity to cities correlates with significantly higher levels of immunizations. Conversely, rural lack of access to such services coincides with increased mortality. Physical distances between patients and care is a greater challenge for patients in a developing nation. Because mobility poses a greater challenge,

patients often are forced to travel to the closest facility regardless of the quality of the facility because they cannot afford the additional cost of traveling to higher quality care.⁹ Moreover, often the health care that is available was established to treat infectious diseases rather than train and provide specialty surgical care.¹⁰ Before the 1960s, the geography of neurosurgery on the African continent was limited to the cardinal geographic extremes, practiced only in Morocco, Egypt, and South Africa. When comparing the neurosurgeon-patient ratio in 1980, the U.S. ratio was 1:75,000 in contrast with Africa's 1:3 million.

Sex is an additional factor regarding access to quality health care in Africa. In 2005, the United Nations reported that Sub-Saharan Africa was one of the few places in the world where women are paradoxically listed as a disadvantaged group in respect to both life expectancy, death rates, and quality of life, particularly as one moves down the social ladder in society. Similarly, households with access to electricity and/or piped drinking water reflect notable reduced rates of infant deaths within the region.⁹

Political turmoil often is an important factor in the emergence of famine, epidemics, and refugee migrations. Welfare destroys the economic foundation of a country and contributes to making a region susceptible to poor health.¹¹ These conditions often result in outside organizations, such as the World Bank, instituting external structural adjustment policies which limit the possibility of opening new training programs. Neurosurgical education and training is time and resource dependent and essentially stops in times of war or political turmoil. Drought, migration, and war have always affected or even stopped education. At the same time, crisis or war cause an existing neurosurgery program to change to a primarily trauma response model as opposed to a population health model. More subtle influences are the effect of drought, economic recession, and outmigration on neurosurgical programs, which are not allowed sufficient stability or growth potential. For example, Zimbabwe's socioeconomic instability in the 1990s and early 2000s resulted in a substantial decline in its quality of health care. Ethnic tensions between the Ndebele and Shona also contributed to marked increased instability within the country, essentially halting progress in specialty training. Geopolitical volatility had ramifications within the national health care as life expectancy within the state plummeted from 60 to 39.8 years in the span of a single decade and there was an increase in child mortality.¹¹

The socioeconomic and geopolitical history of Uganda has also presented great challenges to patient care and medical education. Although the country gained independence from Britain and established an independent Republic by 1963, prolonged socio-political instability prompted a brain drain of physicians who left the country as a result of the geopolitical climate. The health system was further complicated by refugee influx. In 2014, the region of Sub-Saharan Africa received 3,648,902 refugees who had fled across an international boundary because of geopolitical instability in their home country.⁵ Although regional geopolitical instability slows training of new medical specialties, the need for their services is magnified by the refugees that result from such instability. Geopolitical instability can also cause displacement of people within their home country. There are over a million international displaced persons at risk within

Uganda, which also reflects instability in neighboring regions, such as South Sudan and Congo. Instability of a country's politics or perceptions pertaining to political elections can also work to destabilize the training programs and institutions necessary to establish quality medical care.

The development of subspecialty medical care in Kenya has been slow in the country, and the impact of the brain drain is acute. Again, this is further impacted by the strain on the health system by a large influx of refugees as external attacks threaten the political stability that is fundamental for the establishment of quality medical care in regions of the country.¹¹

Neurosurgery may well have been the most affected specialty, but at the same time, it presents the greatest opportunity.^{12,13} Even a small number of trained and equipped neurosurgeons could potentially reverse the process and reestablish regional care in the interior of the country. Addressing this historic issue through education has been one of the goals of FIENS. This organization, founded in 1969, is dedicated to both service and education by the training of neurosurgery by neurosurgeons and the development of self-sustaining systems of specialty neurosurgical care.

FIENS continues to desire to address distribution of care based on service. The period of the latter half of the 20th century showed an emphasis on addressing neurosurgical needs in Sub-Saharan East Africa, primarily through developing a network of services along with partner organizations.⁶ In some cases, these were driven by geopolitical forces and national interests, and others by religion or mission-based objectives, and other times humanitarian. Geopolitical forces can sustain health care just as they can derail it; the realization by political entities both within the African countries, and in international organizations such as the World Health Organization, that health care is an essential right may be a stabilizing political force that can be channeled to a common goal.

The distribution of aid through past or future political partners often led to the development of large government hospitals, often located in the capital. Examples include the Mulago Hospital in Kampala, the Kenyatta Hospital in Nairobi, and the Black Lion Hospital in Addis Ababa. Supportive infrastructure may have been tied to previous colonial relationships, with some of the structures dating back to preindependence times. However, increasing influence of support from major geopolitical players in the United States and the Eastern Bloc also contributed. Although quite large, these hospitals were inadequate to cover the population. Indeed, these facilities, taxed by overcrowding and undersupply, were unable to provide truly specialized care to all but select patients.

One approach to providing care in more rural settings occurred through mission-based hospitals often with religious connections, such as the CURE International Hospital in Mbabe, Uganda, and the Bethany Hospital in Kijabe, Kenya.^{14,15} These often serve patients closer to their native region, therefore allowing less disruption for families and loss of livelihood while seeking care for a family member. These were largely populated by volunteers from developed countries who would spend months to years providing services to a large number of patients. Interestingly, in select cases, these also advanced care through scholarly study of the diseases and disorders treated. Dr. Benjamin Warf's work on postinfectious hydrocephalus is an example because he showed the role of third ventriculostomy in select patients to treat hydrocephalus and allow patients to be shunt independent.^{15,16} Such

advances impacted both the developing and the developed world.^{16,17} Further programs were developed, often as a result of a partnership or relationship with a particular country, such as Norwegian neurosurgeons to Ethiopia. These hospitals provided a base network of services. Although inadequate to cover the large population base, they did begin the process of redistributing care within the country and the more rural population. However, there is limited local governmental investment in specialized services, such as neurosurgery in these areas, primarily because of the crushing needs in primary care and infectious disease, which became a major emphasis of governmental health care.

With the turn of the new century, a significant emphasis came from volunteers from education-based programs in the developed countries.¹⁸ Contributions from such people as Dr. Paul Young from St. Louis in Kenya and universities from Norway to Ethiopia, began to develop the concept of service-based education in Sub-Saharan Africa and attract the collaboration of FIENS. As this organization began to embrace the process of education as the method to allow developing countries to maintain self-sustaining neurosurgical care, it began to explore opportunities to build on the existing infrastructure through partnerships within the geopolitical networks within Sub-Saharan East African countries.⁶ Its contributions included providing volunteers, but also links to institutions and medical schools in developed countries, which could be a source of supplies, equipment, and teaching. In the area of education, it developed a curriculum for neurosurgical training and worked with ministers of health to obtain support and credentialing for residents to be trained within their home countries, thereby increasing the likelihood of them staying.² To maintain such a program means it would need to also address equipment, ancillary services, and collaboration across multiple medical fields. Just as the absence of neurosurgical care diminished anesthesia, critical care, pediatrics, trauma, and cancer services, the presence of high level neurosurgical care was postulated to raise the quality of medical services throughout these and other collaborating areas. Equally important, by developing an educational program within the country, trainees from a particular region could be recruited for training in the capital and on completion of their training, establish or allow development of satellite and regional neurosurgical centers distributed throughout the country. This could be the nexus on which one could build a trauma system and models of an improved health delivery system for anesthesia, trauma, cancer care, and so forth.

It becomes increasingly clear that problems of the magnitude of maldistribution of health care across a continent can only be solved by partnering the people most directly affected with worldwide, political, philanthropic, societal, and professional organizations willing to address these problems. Within neurosurgery, this role has been significantly taken on by the World Federation of Neurosurgical Societies (WFNS). Long known as an organization with education at its forefront under multiple leaders, it has begun to address through its educational and philanthropic arms, and has contributed to solutions to this problem. The importance of curriculum in education and educational standards, especially when developed by the people most directly affected, has taken a combined role through the WFNS sponsorship of African scholarship. Specifically

Dr. Kazadi Kalangu's outstanding textbook, *The Essential Practice of Neurosurgery*, drawn from extensive experience, highlights the contributions that a robust Africa can make to world neurosurgery. Under the leadership of Dr. Madjid Samii, the WFNS undertook the Africa 100 Project with funding through its philanthropic arm, WFNS. This project aimed at developing 100 neurosurgeons for regions of Africa which did not have well-developed neurosurgical care and has grown through WFNS philanthropy and WFNS educational programs, specifically the development of regional training centers within Africa and South America to train neurosurgeons from countries where no training program exists while directly affecting the brain drain question by assuring a return to their home country at completion of training. This can only be possible if their hospitals can be adequately equipped for neurosurgical care. The WFNS Foundation has addressed this through partnering with equipment, microscope, and drill companies to develop basic neurosurgical equipment supplies for these new programs. These efforts by WFNS are just one example of multiple organizations capable of partnering around a program of service through education to address a common perceived need. These efforts continue to this day with an emphasis on volunteerism or Neurosurgical Peace Corps from the WFNS, made possible by partnering with organizations such as FIENS who have long coordinated volunteers in developing areas, and they in turn partner with other organizations for curriculum, equipment, and certification, as an example of a difficult problem achieved only through the partnership of many organizations and people.

BUILDING MULTINATIONAL TRAINING IN NEUROSURGERY

The seeds of a first multinational and regional training program were sown in Kenya through a desire to decentralize neurosurgical services at outreach hospitals where large numbers of patients requiring neurosurgical care were present, but were unable to access care in the capital.¹ In November 2001, a group led by Dr. Mahmood Qureshi (Moody), began offering a monthly outreach service at the Coast General Hospital Mombasa, Kenya. The impact was modest, but revealed a huge demand for neurosurgical care, as many began to travel hundreds of miles to seek consultation and surgical care at this hospital. Personal equipment and supplies of shunts for hydrocephalus treatment formed the early, basic mission supply source.

During one such mission in 2002, Dr. Paul Young of St. Louis Missouri, United States, joined in the development of a training program for Kenya, and a template of the program was sketched as the Neurosurgical Training Program of Kenya. Dr. Young returned to St. Louis determined to make this happen. FIENS was able to introduce Dr. Young to the work of Dr. Ben Warf, a U.S.-trained pediatric neurosurgeon in Mbale, a small town 200 km from the Ugandan Capital, Kampala. Here Dr. Warf was providing care for many children with hydrocephalus. Because of a high infection rate for shunts, Dr. Warf began to rely on endoscopic third ventriculostomy, but his results revealed a set of new challenges. As an academic, Dr. Warf began to research endoscopic treatment for hydrocephalus in Sub-Saharan Africa. Subsequently, colleagues from around the region started to seek training at Mbale.

This led Dr. Warf to write to FIENS, seeking to start a neurosurgical training program with its support. Dr. Merwyn Bagan, President of FIENS at the time, received requests from Drs. Young and Warf, and Dr. Bagan helped to facilitate a connection between these practitioners. In 2003, Drs. Young and Qureshi traveled to Mbale, with a plan to incorporate the CURE International Hospital into the neurosurgical training program. The Mulago Medical Complex in Kampala, Uganda, was also evaluated and accredited. Colleagues in Muhimbili Orthopedic Unit in Tanzania (housing the neurosurgical service) were contacted with the aim of incorporating that unit into a regional program of training. The intention was to harness the various strengths of each unit, recognizing that the ability of an individual unit to offer a full and comprehensive training was lacking. The name changed to Neurosurgical Training Program-East Africa. The Black Lion Hospital of the Addis Ababa University, Ethiopia, participated in the program, after an accreditation visit.

In tandem with these efforts, Dr. Young adapted the U.S.-based curriculum, and with appropriate modifications suited to the region, a formal curriculum was prepared. On September 29, 2004, stakeholders meet in Nairobi, and regional neurosurgical leaders endorsed the curriculum. Then a certifying body was sought. The natural entity was the regional College of Surgeons of East, Central and Southern Africa (COSECSA). Its leadership was most helpful in reviewing the curriculum and aligning it to its existing format of training of general surgeons and specialty training. Neurosurgery was among the first specialty fellowships to be endorsed by the College at its meeting in Blantyre, Malawi, in August 2005. Therefore, a huge milestone of a multinational training program had been achieved from the humble beginnings of outreach neurosurgical missions and a curriculum template.

This program was unique in that it spawned a series of agreements with Tanzania, Uganda, Kenya, and Ethiopia for collaborative education with multinational training,^{14,19,20} evidence of cooperative geopolitical efforts for the betterment of health care in the region. In addition, it spawned the development of the concept of a multinational neurosurgical society for Sub-Saharan Africa, which would gradually lead to the eventual development in 2015 of the Continental Association of African Neurosurgical Societies (CAANS).

The rapid development of CAANS has allowed an African-based education by Africans. In keeping with an educational focus, the role at CAANS meetings had provided a forum for educational programs for Sub-Saharan neurosurgeons. The strength of this forum was shown during the 2016 CAANS meeting when the first neurosurgical training course, or boot camp, was held in Africa. This provided a hands-on training instruction in surgical techniques, disease recognition, and pathophysiology to establish a consistent level of excellence in neurosurgical trainees across countries. Most important, however, was that bringing together instructors from various member nations throughout Africa, working together in teaching the boot camp, led to a central goal of understanding the quality of strength of teaching possible by Africans working together toward this common goal. This is the greatest strength of CAANS, as an organization that would partner as equals with multiple education and philanthropic organizations from throughout the world.

A very important measure of the success of these partnering efforts of multiple organizations working toward the same goal has been the retention of trainees. Because the geopolitical forces and educational forces have been understood, large areas of Sub-Saharan Africa have gone from having no trainees to multiple trainees. Meetings in Dar es Salam have been populated by 93 trainees from multiple countries throughout Sub-Saharan Africa, and most recently, in Zimbabwe, a meeting took place with over 50 trainees from multiple countries—all training in Africa and working in Africa. This has been transformational in the possibilities of addressing the issue of inadequate or maldistributed care and has paralleled the rise of CAANS as a robust representative of neurosurgeons throughout the continent.

A multinational training program must take advantage of the strengths and resources between individual components. In this case, it includes the addition of state-, private-, and religious-based facilities within the program, allowing subspecialization at particular hospitals. Integral to the development of a curriculum is development of evaluation certification which would have bearing within the country. The COSECSA program for general surgery was approached for expansion of its certification to include neurosurgery so that certification be from within the region and by an established local board.

As this program developed, several important benefits were identifiable. Geopolitical cooperation across borders with the ministers of health took place, and curriculum formalized programs as did the evaluation certification through COSECSA, whose administrative structure now runs the program. Dr. Sydney Makarawo, a neurosurgeon in Zimbabwe, was its first council member responsible for the Fellow of the College of Surgeons of East Central and Southern Africa (Neuro) fellowship program.

The program is a 6-year training program; the first 2 years include rotations in accredited hospitals, general surgery, orthopedics, accident and emergence, and intensive care unit. The candidate is examined for the Membership of the College. The member then pursues his or her chosen specialty. Fellowships are now available in neurosurgery, orthopedics, general surgery, plastic surgery, and pediatric surgery. The neurosurgical fellowship is a further 4-year program with rotations in the hospitals in the region. The first year is usually in the original center which selected the candidate. Rotations in the second and third year are carried out in Nairobi (at the Kenyatta National Hospital and the Aga Khan University hospital). External rotations are undertaken in the third year at accredited centers abroad. These are in Izmir, Turkey, Mumbai, India, and in England. The final year trainee undertakes senior duties as chief resident, prior to sitting the written examination in September and a clinical/oral examination in December. These examinations are held in the regional country holding the COSECSA Annual Scientific Conference.

To date, 10 trainees have passed the final examination. Five Kenyan, 3 Ugandans, and 2 Ethiopians hold the Fellow of the College of Surgeons of East Central and Southern Africa (Neuro) award of the College, 3 of them as heads of department at Kenyatta, in Nairobi, Kenya, Mbarara, Uganda, and Mombasa, Kenya. Subspecialization within neurosurgery became possible because it primarily took the place of selected rotations emphasizing adult or child, or tumor or trauma. Partnering agreements remain with multiple organizations of neurosurgeons worldwide. Specifically,

in addition to FIENS, they include the WFNS, the Neurosurgery Education and Development program, and the American Association of Neurological Surgeons/Congress of Neurological Surgeons; each provides expertise of different types from availability of equipment to bricks and mortar, to curriculum, to electronic communication tools, to volunteers.²⁰ As these partnerships formalized, the concept of dyads became a philosophy of FIENS. Dyads are a pairing of university programs in the developed world with one being built in the developing world. This allows repeated visits to the site by multiple faculty from the dyad university to help facilitate understanding the equipment, curriculum needs, and surplus equipment transfers. In addition, residents began to collaborate and work with each other, allowing the possibility for limited bidirectional rotations of educational value as well.²¹

EQUIPMENT

Equipment supply was done through 2 major approaches. One was emphasized by the Duke program in Uganda, which would heavily rely on donations and surplus equipment from the home institution. In this system, philanthropy is used to ship and maintain the dyad program. The other, through the WFNS, allowed negotiation with supplies for a basic surgical kit, including operating room equipment, basic microscopes, and drills, thereby allowing modern neurosurgical procedures to be done. With philanthropy, these could be purchased for establishing new programs.

CONCLUSIONS

The path forward for distribution of specialized health care is through service, education, and partnership. Service has long been a hallmark of neurosurgical care in developing regions, but by developing a teaching program, one student carries the message on to patients not yet seen. Future service through education is a hallmark of the FIENS mission. By involving the doctors of the country in the educational program, it gives hope for a self-sustaining health system. In the initial stages, all aspects need to be considered, including equipment, supplies, collaborations, impact, and needs of other services and other health care programs. These require cooperation of the geopolitical forces. This includes government forces, ministries of health, but also the will of the people of that region. Facilities, equipment, and maintenance of equipment are only possible by developing a team with the same ideas. Each need to be taught, trained, and certified. This is as true for the laboratory, nursing, and biomedical people as it is for the physician. Coordination with government is best understood when one believes that it is the role of government to advance the health and welfare of its citizens. Therefore, political and cultural stability are important for any educational program. Neurosurgical training programs average 6 years in length, and there needs to be stability during that training program and during the tenuous time when one is establishing a health system.

Nothing exists in a vacuum. Our experience has been that war, or even civil unrest after an election, can shut down an education program completely. Therefore, the absence of such war is essential to ongoing education. We therefore are interlinked.

Geopolitical forces drive the distribution of migration, people's nutrition, and ability to sustain agriculture, all affecting the health system not only at the primary care level, but also at the surgical specialty level. Only by having a stable and cooperative government are we able to establish and maintain a training program which would in turn benefit critical care, anesthesia, general surgery, and the overall health of the hospital system. It becomes clear that government's contribution is key. This contribution should not simply be that of career politicians, but rather career health care experts. These are often served as Director of Health Services in the Ministry of Health or are required officials who have spent their life trying to establish these programs that effect rural populations. It is their input which is likely to have a lasting impact with the development of a comprehensive health system of care. By redistributing the care throughout the country as opposed to focusing only on the capital city, such programs allow integrated health systems to exist in the smaller cities and eventually even the rural areas of the country. Each program needs a champion to establish a dyad. Often such a person already exists, a pioneer neurosurgeon within the nation, country, or city, but sometimes these have to be developed. In Africa, this may mean training of the first neurosurgeon in that country. That training is now being done through the partnership with the WFNS training programs in Cape Town, Rabat, Cairo, Nairobi, and Recife. The WFNS has been keen to support local training of neurosurgeons and to overcome the expensive training abroad, with the attendant problem of candidates not returning home after completion of training. In Africa, the WFNS reference sites of training are supported by the WFNS through provision of a scholarship/stipend toward assisting trainees' needs and the support toward acquiring specialized equipment at subsidized costs.^{12,13}

New successes give hope for further developments. For example, the Rabat Reference Training Centre was the first to be accredited in 1999. This mainly serves trainees from French-speaking countries of West and Sub-Saharan Africa.¹³ However, because of the growing need and popularity of the center, candidates from English-speaking countries have also been trained in Rabat. The Neurosurgical Training Program East, Central and Southern Africa (NSTP-ECSA) was evaluated by the WFNS in 2012 and has been formally designated a reference training site through Nairobi. It is known as the Consortium of Collaborative Neurosurgical Sites of Training of the East, Central and Southern African Region. Currently, Dr. Qureshi serves as its coordinator, for purposes of liaison with the WFNS Foundation and the WFNS Central Office, which disperses the WFNS Scholarship to its Consortium of Collaborative Neurosurgical Sites (of Training) of the East, Central and Southern African Region candidates through the Neurological Society of Kenya. With the help of philanthropy, these people are educated, but they need the support of organizations such as FIENS and the equipment support of organizations such as the WFNS to establish the first program in their nation and hopefully become the champion for a dyad which allows other natives of that country to be trained in place and supplied. Such a comprehensive plan is based on service, education, and strategic partnership. Its goal must always be a plan of neurosurgical care that is local and self-sustaining.

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