
Delivery of Subspecialty Surgical Care in Low-Resource Settings

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Introduction and Overview

The Essentials

- *Subspecialty care should be readily accessible, safe, financially feasible, and allow exchange of ideas for continued quality improvement.*
- *Expanding upon essential surgery, subspecialty surgery consists of the provision of care by trained subspecialists and typically requires advanced technology, materials, and infrastructure related to the services provided.*
- *The history of how subspecialty surgery has developed in resource-limited settings can contribute to an understanding of how to advance its provision.*

Globally, subspecialty surgical care should be readily accessible, safe, financially feasible, and allow exchange of ideas for continued quality improvement. This ideal is not the current situation for millions of people worldwide. In low-resource settings, availability of care is sporadic, outcomes are often subpar, costs are prohibitive, and the skilled personnel and appropriate infrastructure to accomplish this task are lacking. In this chapter, we will discuss the history of subspecialty surgical care, the current models used to deliver it, and how the individual provider may fit into this continuum with the hope of advancing access and improving quality of subspecialty care to low-resource communities.

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Definitions

The Lancet Commission on Global Surgery recently detailed the appalling lack of surgical care for billions of people [1]. The report focused mainly on the lack of essential surgical care, defined as “any and all procedures, contextually and culturally dependent, that are deemed by that region, society, or culture to promote individual and public health, wellbeing, and economic prosperity.” In some settings, this essential surgery is performed by those with medical degrees and further training. In other locations, it is performed by those with apprenticeships and procedural training only. Within low- and middle-income countries (LMIC) that have accredited specialists in surgery, these specialists may provide both essential surgical care and subspecialty surgical care. These divisions of labor will be further explored in the different models available for subspecialty surgery.

In most resource-limited settings, subspecialty surgical care is rarely or sporadically available. Expanding upon essential surgery, subspecialty surgical care consists of the provision of care by trained specialists and includes various subspecialty disciplines such as ophthalmology, ENT, plastic and reconstructive surgery, pediatric surgery, urology, neurosurgery, advanced laparoscopy, and cardiothoracic surgery. Typically, subspecialty care requires advanced technology, materials, and infrastructure related to the services provided. Although some straightforward subspecialty care could be provided at the district hospital level, advanced care is generally suited for a referral center serving a larger population [2, 3].

History of Subspecialty Care in Developing Countries

To better understand the way forward for global subspecialty surgery, it is imperative to understand past successes, failures, and the many factors historically that have contributed to a shortage of healthcare workers, a myriad of health disparities, and a lack of subspecialist surgical care [4]. Global surgery was perhaps founded decades ago during an era defined by highly dedicated expatriates. Funding was often supplied through the generosity of nongovernmental organizations, such as churches and charities. In these early years, expatriates dedicated their careers and lives to the cause of bringing surgical care to people without such access. For example, Peter Parker, who introduced anesthesia to China, was among the first missionary surgeons [5]. Lucille Teasdale practiced surgery in Uganda for years until finally contracting and dying from HIV/AIDS. With a higher purpose of caring for individuals and communities, missionary surgeons invested not only their careers but their lives to the cause. As mission hospitals expanded, general and subspecialty surgical care for community-identified problems also grew. Throughout this era, the surrounding communities of these hospitals were

significantly impacted and enjoyed the benefits of considerable investment in infrastructure, workforce development, and provision of healthcare. But hospitals were dependent upon the missionary to stay and invest his or her life into the cause. Furthermore, the effect was localized, and national healthcare systems were rarely influenced [6].

The Alma Ata Declaration, in 1978, signaled a change in the delivery of healthcare worldwide [7]. In an inadequately supported attempt to achieve “healthcare for all,” funding was directed toward community health initiatives such as breast-feeding, oral rehydration, and immunization, while structural adjustment programs limited investment in medical personnel and infrastructure [8–10]. Although worthy goals, this resulted in disturbingly preferential investments at the great expense of surgical capacity [11]. Consequently, scores of capable, educated physicians and nurses left home for brighter futures elsewhere [12]. Some workers moved to private, urban hospitals within their own countries. Tragically, many were actively recruited by resource-rich nations to fill an increasing need for healthcare workers in those countries [13, 14], depriving LMICs of healthcare workforces and potential leaders [15–17]. In this way, the Alma Ata agreement contributed to the current health disparities, where worldwide, over five billion people lack access to surgical care which the workforce is not yet capable of delivering [1, 18].

The current era is one of increased focus on global provision of surgical care but with an unfortunate lack of focus, organization, and accountability. Globalization has increased awareness of the problem and made travel easier and more affordable. A relatively recent understanding of global surgery as a population-based, cost-effective avenue to restoring health and improving infrastructure has enabled a newfound interest in its promotion. As a result, healthcare providers from resource-rich nations have flocked to resource-poor areas, mostly with good intent, but regrettably too often with mixed results. Hundreds of short-term surgical camps have materialized [19]. In 2004, the American College of Surgeons created a database of volunteer opportunities and facilitated short-term involvement calling the campaign, “Operation Giving Back” [20]. Short-term surgical trips (STSTs) have been a significant yet unquantified source of subspecialist surgical care in resource-constrained settings. Given the abundance of STSTs and the inconsistency in accountability, it is impossible to accurately detail the impact of STSTs on subspecialty surgical care. Both global organizations and academia are beginning to understand the necessity of promoting surgical access in order to further the health and success of communities and have attempted to correct the incongruity of STSTs by establishing partnerships, cultivating educational efforts, and aspiring to longitudinal collaboration [21, 22]. National governments and Ministries of Health have occasionally recognized subspecialty care, although budgets are often constrained by other priorities. And finally, local institutions, including mission hospitals, have tried to adapt subspecialty surgical care appropriate to their settings, but this access is only sporadically available.

Current Overview of Subspecialty Surgical Care in Low-Resource Settings

The Essentials

- *Although data is sparse, evidence suggests there is a large burden of disease globally that could be correctable by subspecialty surgery.*
- *Sufficient personnel for subspecialty surgical care is lacking in low-resource settings.*
- *Access to subspecialty care is challenging and often limited to urban areas.*

The availability of subspecialty surgical care is varied throughout the world, but in LMICs access is especially limited. Few studies exist regarding subspecialty surgical care in LMICs, and extensive data is not yet available to draw conclusions. Current qualitative research shows that there exists great potential for improvement. Outcome reports for various models and experiences are sparse (Table 5.1). The data currently available to draw conclusions may not accurately reflect the ongoing efforts of those working within low-resource settings because many hospitals and surgeons have provided subspecialty care but have never published their experiences. There are many reasons that specialist availability in LMICs is limited including the lack of infrastructure, resources, and trained personnel. Subspecialty care, where available, is often focused on a specific condition and provided by a fragmented group of outside specialists, urban academic institutions, nongovernmental organizations, faith-based hospitals, and various combinations thereof.

Need for Subspecialty Surgical Care

Attempts at quantification of the burden of surgical disease as well as its contribution to disability and premature death of a population have been of recent interest. There is a particular interest in essential and emergency surgery given its role in immediate reversal of health disparities. However, little data exist about the burden of subspecialty surgical disease. Specific surgical conditions, those which typically require subspecialty training, have been addressed in various reports of their cost-effectiveness, availability of services, occurrence of disease, and the related disability and mortality caused by the condition. For example, congenital conditions are a leading cause of pediatric mortality and morbidity. An estimated 93 million children and 7% of all births are impacted with some form of moderate or severe deformity [46, 47] which would benefit from surgical intervention. Surgically correctable conditions may significantly negatively impact quality of life. Reports exist on the burden of cataracts [48], otitis media [49], osteomyelitis [50, 51], hypospadias [52], urological conditions [53, 54], and congenital conditions such as cleft lip or palate and clubfoot [55, 56]. As a whole, subspecialty surgical care has not been as

Table 5.1 Reported outcomes of various models [23–45]

Author	Organization	Location	Operation/condition	Outcome
<i>Short-term surgical trips</i>				
<i>Endocrine/ENT</i>				
Rumstadt 2008 [23]	Department of Surgery, Diakonie Hospital Mannheim, Germany, and Hopital de Leo, Burkina Faso	Burkina Faso	Endemic goiter; 253 patients	Recurrent nerve injury 0.8%; exploration for bleeding 1.2%
Cheng 2012 [24]	Mercy Ships	West Africa	Thyroid multinodular goiter; 48 patients	Serohematoma 6%; 2% vocal cord palsy; comparable to results in UK cohort
<i>ENT</i>				
Sykes 2012 [25]	Obras Sociales del Hermano Pedro, Catholic Mission Hospital	Guatemala	Tonsillectomy; 204 patients	197 with follow-up; 1.5% complications
Snidvongs 2010 [26]	Sakao Hospital	Thailand	Otologic surgery; 35 patients; 32 with otorrhea; 31 with tympanic membrane perforation	74% with hearing improvement by average 22.9 dB
Horlbeck 2009 [27]	Otologic surgical team from Wilford Hall Medical Center, San Antonio, Texas	Paraguay and Honduras	Chronic ear disease; 117 patients, 77 with follow-up; 20 with dry perforations; 30 chronic drainage; 25 cholesteatomas	Surgical success reported on those with follow-up as 60% dry perforation, 74% chronic drainage, 92% cholesteatomas
Barrs 2000 [28]	“Oye, Amigos!”	Mexico	Otologic surgery; 85 tympanoplasty patients	Follow-up 83.5%; success rate of 41% for first 2 years and 74% for the following 3 years
<i>Plastic and reconstructive surgery</i>				
Huijting 2011 [29]	Facing Africa and Project Harar	Ethiopia	Facial reconstruction; 35 patients	Objectives met in 14/17 patients with simple operations and 5/18 with complex operations; 26 complications – 2 life threatening, 24 with problems in wound healing

(continued)

Table 5.1 (continued)

Author	Organization	Location	Operation/condition	Outcome
Maine 2012 [30]	Rostros Felices and Resurge International	Ecuador	Cleft palate repair (North American surgeons 46 patients, Ecuadorian surgeons 82 patients)	Oronasal fistula rate 57% for Ecuadorian surgeons and 54% for North American surgeons 20-fold higher than high-income countries
<i>Orthopedic surgery</i>				
Cousins 2012 [31]	Kenya Orthopedic Project (KOP)	Kenya	Orthopedic operations; 187 patients	“Doing well”/of those with follow-up; 10/14 hip; 41/58 lower; 18/25 upper; 2/7 osteomyelitis
<i>Cardiac surgery</i>				
Adams 2012 [32]	CardioSalud	Peru	Cardiac surgery; 15 patients	1 mortality; 2 with bleeding requiring takeback
Falase 2013 [33]	Lagos State University Teaching Hospital	Nigeria	Cardiac surgery; 51 patients (42 cases with visiting teams, 9 cases with local team)	Mortality 18% (14% visiting teams, 33% local team)
Swain 2014 [34]	Rwanda Ministry of Health, Rwanda Heart Foundation, Brigham, and Women’s Hospital	Rwanda	Cardiac surgery; 86 patients	30-day mortality 5%; cerebrovascular accident = 1, hemorrhage with reoperation = 2
Tefuarani 2007 [35]	Operation Open Heart	Papua New Guinea	Cardiac surgery; 337 patients	1.9% short-term mortality; complications “unremarkable”
<i>NGOs</i>				
Young 2013 [36]	SIGN Fracture Care International	Multiple LMICs	Intramedullary nail; 46,113 operations	Follow-up in 23%. Infection rates among patients with follow-up: 2.9% humerus, 3.2% femur, and 6.9% tibia
Jenkins 2014 [37]	International Quality Improvement Collaborative for Congenital Heart Surgery in Developing World Countries	28 sites in 17 LMICs	Congenital heart disease; 15,049 operations	Mortality 6.3%; major infection 7%

Novick 2005 [38]	International Children's Heart Foundation	83 trips in 14 LMICs over 10 years	Pediatric cardiovascular services; 1,580 operations	Mortality 15.4% first 5 years of experience, 6.7% during second 5 years
<i>Specialty and referral hospitals</i>				
Gathura 2012 [39]	BethanyKids at Kijabe Hospital	Kenya	Ventriculoperitoneal shunt; 574 patients	Shunt function at 2 years 65%; complication rate 20–11% shunt malfunction, infection 9.1%; mortality 7.1%
Kulkrani 2010 [40]	CURE Children's Hospital	Uganda	Endoscopic third ventriculostomy (ETV) for pediatric hydrocephalus; 979 patients	No difference in ETV survival when risk-adjusted outcomes compared to 12 resource-rich centers
Meier 1995 [41]	Baptist Medical Centre	Nigeria	Suprapubic prostatectomy; 240 patients	Complication rate 20%; transfusion 5%, clot retention 7%; 3% return to operating room
Stephens 2015 [42]	SIGN – 3 referral trauma centers	Kenya, Ethiopia, Pakistan	Distal tibial metaphyseal fractures; 160 patients	Fracture union 97%; acceptable alignment (<5° deformity) 83%; infection 9%; revision surgery 6%
Leon-Wyss 2009 [43]	Unidad de Cirugia Cardiovascular de Guatemala	Guatemala	Pediatric cardiac surgery; 2,630 procedures	Complication rate 20%; late mortality 2.7%
Gnanappa 2011 [44]	Madras Medical Mission	India	Adult congenital heart surgery; 153 patients (102 “simple”, 51 “complex”)	Major complications: 8% “simple,” 29% “complex.” Mortality: 0 “simple,” 4% “complex.”
Schommeyr 2015 [45]	Guwahati Comprehensive Cleft Center	India	Cleft lip repairs; 3,108 patients	2062 follow-ups. 4.4% complications; dehiscence 3.2%, infection 1.1%

emphasized as emergency and essential care, which in of itself has not been as emphasized as many other public health priorities.

Number of Subspecialist Surgeons

Quantifying the number of surgeons serving a population is a difficult task [57]. Variations of definitions between those who perform operations, general surgeons, surgeon specialist, and surgical subspecialist prevent a complete understanding of the number. Furthermore, surveys of Ministries of Health may not capture the substantial contributions of NGOs and faith-based hospitals. As an example, in southwestern Uganda, a survey of hospitals revealed 43 consultant specialist surgeons (0.7 accredited surgeons per 100,000 population) including all of the specialties of general surgery, obstetrics, orthopedic surgery, ophthalmology, dental surgery, neurosurgery, ENT, and urology. The survey, which reviewed mandatory logbooks maintained at each of the 27 hospitals, observed that 55% of procedures were performed in mission/NGO hospitals, 45% in government hospitals, and <1% in a private hospital. Cleft lip and palate repair was predominately undertaken by plastic surgery teams, with external funding, who performed 80% of 140 operations [58]. Notably the number of operations performed in southwestern Uganda was higher than previous estimates [59]. Walker et al. postulate that the inclusion of NGO and mission hospitals which performed the majority of the procedures accounted for this finding and estimates do not reflect current services available.

As examples of subspecialty surgery, there are only six plastic and reconstructive surgeons in Ghana for a population of 22 million and three in Uganda with a population of 28 million, and in Zambia with a population of 10 million, there is only one [60]. Similarly, there are only six neurosurgeons in Uganda [61]. For urology, Zambia has one trained urologist per 2.3 million people, and most conditions are managed by either general surgeons or nonphysician providers [53]. Though accurate and complete measurements are not yet available, it remains apparent that sufficient personnel for subspecialty surgical care is sorely lacking [62].

Access to Subspecialty Care

Access to subspecialty surgical care is limited in low-resource settings. At least 4.8 billion people do not have access to surgery, including greater than 95% of the population of South Asia and central, eastern, and western sub-Saharan Africa. This compares to the less than 5% of high-income North America, Western Europe, and Australia who lack access to surgery, highlighting the inequitable distribution of healthcare [63].

In most low-income countries, specialty-trained surgeons and anesthesiologists, if available, work exclusively in referral hospitals [64–66]. As a result, district

hospitals are staffed by general practitioners and nurses [67]. Even when hospitals are able to provide emergency and essential surgery, their capacity to deliver subspecialty surgical care is often hindered [66, 68]. In a review of hospitals within Haiti, 93% claimed the ability to perform hernia repairs, while more specialized care was limited: operative repair of fractures (51%), clubfoot (42%), cleft repairs (31%), and cataract surgery (27%) [69].

As anyone who has practiced in a LMIC has experienced, patients travel long distances [70–72], often delay seeking treatment [73, 74], and consequently, present with advanced disease. This becomes particularly true with subspecialty surgical care and is true for the authors' experience with esophageal cancer in western Kenya [75, 76]. A review of the burden of waiting by Poenaru et al. demonstrated significant delays in surgical care and resultant increased burden of disease. They demonstrated prolonged average wait times for pediatric orchidopexy (72 months) and anorectoplasty (74 months) [77] and compared these to much lower wait times in resource-rich Canada.

Millions of people worldwide face catastrophic expenditures from the costs of surgical care and conditions requiring surgery. These prohibitive costs fall mostly upon LMICs and on poor patients within any country [78].

Finances of Subspecialty Surgery

The days of thinking subspecialty surgery is too expensive or a bad investment in low-resource settings are over. Available data and experience point toward massive benefits of life-changing care for individual patients and the resultant improved capacity and infrastructure for communities [21, 79]. Multiple reports suggest the cost-effectiveness of subspecialty surgery: pediatric inguinal hernia repair [80], pediatric neurosurgery [81], orthopedics [82, 83], ophthalmology (cataract [84–88] glaucoma [89] and trachoma [90, 91]), cleft repair [92–95], hand surgery [96], and cardiothoracic surgery [97]. When comparing subspecialty surgery to other public health interventions, the cost-effectiveness profiles are competitive: cleft repair (\$47.74 per disability-adjusted life year (DALY)), hydrocephalus (\$108.74 per DALY), ophthalmic surgery (\$136 per DALY), orthopedic surgery (\$381.15 per DALY) as compared to BCG vaccine (\$51.86–\$220.39), and antiretroviral therapy (\$453.74–\$648.20 per DALY) [98]. High complexity care can reduce costly disabilities while maintaining a cost-effective profile. Pediatric neurosurgery for infant hydrocephalus has been demonstrated to be cost-effective at the permanent referral center of CURE Children's Hospital of Uganda [99]. Provision of care by local surgeons could be most cost-effective; however, in an era where services are not available, even short-term trips, such as a pediatric neurosurgical brigade to Guatemala, are still more cost-effective than no care at all [81]. These reports are encouraging as they reflect the experience of first-line providers who understand the important role that subspecialty surgical care plays in improving public health.

Various Models for the Provision of Subspecialty Care

The Essentials

- *Numerous models, platforms, or methods of delivery for subspecialty surgical care exists.*
- *These models include short-term surgical trips, university and academic partnerships, telemedicine, task shifting/sharing, government initiatives, private health facilities, nongovernmental organizations, and faith-based mission hospitals.*
- *Each of these models has various advantages and disadvantages.*
- *Delivery of subspecialty care could best be viewed as a continuum with various combinations of these models.*

Categorizing each effort into a specific defined platform presents a problem in understanding complex methods of delivery. Although such classification into platforms can greatly inform our understanding of advantages and disadvantages [100], delivery of subspecialty care could perhaps more easily be viewed as a continuum. Often, providers utilize a number of delivery methods to achieve their desired goal. As an example, subspecialists may briefly visit a permanent NGO clinic that partners with faith-based organizations and the local government to address either a specific condition or subspecialty need. Over time, by building on the foundation of short-term service trips, important development can occur, progressing even to a community-owned hospital capable of subspecialty surgery. Trying to describe each method of delivery independently may not be possible, but recognizing the assorted nuances of each variable may facilitate the understanding of the best methods and models available for the needs of a specific community. These findings can then be scaled to the national and global levels. Understanding this continuum of care provision, as seen by first-line providers of subspecialty care, enables appropriate implementation.

There are a number of models for provision of subspecialty surgical care, each with its own advantages and disadvantages (Table 5.2). The range includes short-term surgical trips, academic partnerships, government initiatives, nongovernmental organizations, faith-based mission hospitals, and various combinations of these models. We can crudely break these down and describe approaches. The acknowledgment of the methods, personnel, location, and investment of time of each model may delineate how to best provide subspecialty care to a community.

Short-Term Surgical Trips

Historically, the traditional STST is an outsider approach where a group of skilled individuals bring resources, both human and material, to provide medical services. In scientific literature, there are myriad reports of “mission” or “service” trips,

Table 5.2 Various models of healthcare delivery with benefits and challenges

Model	Characteristics	Benefits	Challenges
Short-term surgical trips	A group of skilled individuals bring resources, both human and material, to provide medical services	Large volume of patients cared for by well-trained subspecialist surgeons Potential to advance to long-term partnerships and collaboration Beneficial to and easy for the participating healthcare provider	Relatively worse outcomes and little continuity of care Potential to overwhelm the community and/or infrastructure in place Often not conducive to health system strengthening
University and academic partnerships	Universities and academic organizations develop partnerships to improve educational efforts and quality of care	An acknowledgement of common interests and a collaboration toward furthering service, education, and research	Potential for unequal partnerships; the resource-rich university can take the credit for the partnership, while the institution in the resource-poor setting accepts the funding without being invited to the table to make decisions Disconnected from first-line providers
Telemedicine	The use of electronic information and telecommunications technology to enable clinical healthcare and education over long distances The delivery of surgical care by nonphysician providers	Can encourage training and provide accreditation Transfer of knowledge and expertise without the costs of travel Provision of healthcare to communities that would otherwise have no reliable access to care	Significant technology costs and the infrastructure to put telemedicine into practice Difficulty in maintaining technology Lack of adequate supervision and quality control
Task shifting		Reduced cost and time of training physician providers May eventually be the path to universal healthcare coverage	Care may be compromised in situations where further training and expertise is necessary Perceived to lack the hospitality and timeliness of the private sector Subspecialty surgical care and training is a low funding priority
Government health facilities	The public sector, funded by the government, rarely offers consistent subspecialty surgical care		

(continued)

Table 5.2 (continued)

Model	Characteristics	Benefits	Challenges
Private, for-profit, hospitals	For-profit private hospitals are typically located in urban settings and care only for patients who can pay for services	Allows physicians to have a “dual practice” which may limit brain drain	In “dual practice,” private patients receive preferential treatment over poorer patients at public hospitals
		Patients often prefer the private sector due to better accommodations and worker-patient relationships	Care is not available to those who cannot pay the often exploitative prices
Nongovernmental organizations (NGOs)	NGOs can be involved in a range of projects, from community-based programs to global efforts based on a surgically correctable condition, and vary widely in their methods of delivery	Bring vast resources to care for patients regardless of profit	Often work beside the government hospitals with little attention to building public infrastructure
		Provide a results-oriented passion for certain disease process or healthcare priority	The project stops once the initiative is completed, interest is lost, or funding runs out
Faith-based mission hospitals	Faith-based organizations account for a significant percentage of global healthcare, invest in their surrounding communities, and place a priority on serving poor and marginalized people	Within their communities, they are typically among the best choices for care, with high patient satisfaction rates, and in some areas are the only choice that exists	Financial constraints due to dependence on external funding sources
		Tend to adapt to the desired needs of the community, and subspecialist care is provided for the given need	Lack of collaboration with government institutions could reduce the achievement of universal health access as mission hospitals are often not accounted for in the implementation of health planning and policy

which often focus on the volume of patients served. The concept of providing care to a high volume of patients over a brief period of time has been described in numerous terms: surgery camps, brigades, safaris, blitzes, and teams. Since the nineteenth century, faith-based groups have organized, partaken, and advocated for short-term mission trips [19], and surgical groups are among the most represented participants in short-term service [101]. Despite the fact that these groups often share a common goal of encouraging development of the local community, reports and studies are almost uniformly from the perspective of the outsider providers of care and training rather than the receivers [24, 25, 27, 31, 38, 102–105]. This has led to questions about the relevance of such groups from the view of the local community [106].

Advantages of this model include a large volume of patients cared for by an ideally well-trained and capable subspecialist surgeon. The patients with problems that no one has been able to care for in years may have their lives drastically changed. Perhaps, the most dramatic STSTs include quick solutions such as ophthalmology care where sight is immediately restored. These STSTs are attractive to volunteers and are typically reported as positive experiences for the healthcare provider [107]. On the positive side, a short-term trip may be the experience necessary to pique the awareness of an individual so that he or she invests long term in a community [108, 109]. Yet, the long-term impact on patients and communities is rarely reported or understood. Many camps have been successful in developing longstanding commitments to providing care where care would otherwise be unavailable. An example in the ENT subspecialty is the work of BRINOS, Britain Nepal Otology Service, with years of experience sending Nepalese and British ENT surgeons into remote areas lacking ear care [110]. Organizations, such as Resurge International, that have involved plastic and reconstructive surgeons in short-term service trips have also grown to understand the need for long-term partnerships. The group of subspecialist surgeons reported their needs for cooperation with local physicians, predictable presence, emphasis on teaching, and links with structured organizations [111].

STSTs have their drawbacks as well, especially if conducted poorly. While beneficial for the healthcare provider, this model may have the potential to do the most damage to a community. If not done correctly, an STST may amount to “voluntourism” – a perverted form of altruism where providers enjoy the benefits of travel, overstep their qualifications, limit opportunities for local physicians to flourish, are not conducive to health system strengthening, and damage relationships between local healthcare providers and communities in need [112, 113]. During subspecialty camps, a decreased number of elective operations outside the subspecialty offerings are able to be completed at the hospital. Thus, at these times, there are surgeons who could be offering their services, but are unable to do so because of the lack of operating space, an extremely valuable commodity in a resource-constrained hospital [106, 114]. When a large number of visitors descend upon the hospital community, it can be a stressful time with misunderstandings of the local culture. Although these misunderstandings can be partially alleviated by partnerships of the visiting team with local personnel, this must be considered in planning each STST. Typically, there is a considerable amount of logistical work that is required for visitors, which has the potential to overwhelm local staffing. When specialists are already present

and actively caring for patients, these brief surgical camps can create more of a burden on the existing infrastructure than necessary [30, 106]. There are examples of relatively poor outcomes during STSTs that could urge caution in their application to deliver surgical care or at least warrant further exploration in causality [29]. It should be recognized that reports of good outcomes or those equivalent to high-resource settings may be the result of poor follow-up and thus a lack of awareness of complications [115]. Although STSTs may eventually advance to longer partnerships and collaboration among organizations, it remains unknown how many of these efforts fall apart as personnel change or lose enthusiasm.

In response to these questions, the academic surgical community and others have responded to STSTs with ample guidelines, warnings, and lessons [116–121] (Table 5.3). With these suggestions, there is now a trend toward discouragement of these STSTs unless there exists no other possible surgical care alternatives [106, 122, 123]. These attitudes of “first do no harm” must not regress into “first do nothing” [124]. Successful surgical camps are particularly relevant for the provision of specialized surgery in low-resource settings where services are otherwise not available. Short-term teams may be necessary to fill these gaps, provide the necessary resources, and build the capacity and infrastructure necessary to advance the project along the continuum of the delivery of subspecialty care.

University and Academic Partnerships

Numerous, important publications describe how universities and resource-rich organizations have developed partnerships, improved educational efforts, and aspired to longitudinal collaboration [21, 22, 125–128]; yet, there is a paucity of descriptions of the organizational efforts from institutions within resource-limited settings. It is important to note that universities, academic institutions, and professional societies in LMICs have been training and supporting surgeons for years before such partnerships. The College of Surgeons of East, Central, and Southern Africa (COSECSA) is an independent, academic organization that encourages post-graduate training in surgery and accredits surgeons [129]. Some university partnerships are based upon short-term care delivery [130], while others focus on developing long-term partnerships, research, and education [131–134]. Advantages of the university partnership are the acknowledgement of common interests and a collaboration toward furthering service, education, and research. A disadvantage is that the resource-rich university often takes the credit for the partnership, while the institution in the resource-poor setting accepts the funding without being invited to the table to make decisions [135]. Hospitals and universities in low-resource settings may take whatever help might be offered, in the hope of acquiring needed resources, from numerous partnerships that may lack the depth or desire to invest in a community. These high-resource partners may benefit from a distinguished, yet shallow, partnership through publications, increased interest among applicants to their program, and recognition. It is still early to discern if recent partnerships between surgical departments will persist despite changing personnel.

Table 5.3 Guidelines, warnings, and lessons for short-term service trips [106, 116, 117, 119, 121, 122]

Grimes et al. 2013 [116]	Ensure that all projects are appropriate with locally identified need
	Have an emphasis on training local healthcare providers
	Monitor outcomes
	Work alongside local and regional training programs
Welling et al. 2010 [117]	Avoid all of the following “sins”:
	Leaving a mess
	Not matching technology to local needs and abilities
	Failing to cooperate with other NGOs
	Not having a follow-up plan
	Allowing other factors to be more important than “service”
	Being poor guests or coming when not welcomed
Having disingenuous motivations	
Meier 2010 [119]	Helpful do’s and don’ts:
	Do remember you are a guest and respect the culture
	Don’t try to make sweeping reforms
	Don’t blame your hosts for perceived inadequacies
	Do treat your hosts as colleagues
	Do plan follow-up trips to the same locale
	Do relax, be flexible, provide quality care, and train local personnel
Wright et al. 2007 [121]	Assess the needs of the community
	Involve the local team at every opportunity
	Have team members who are experts
	Conduct research which contributes to the sustainability of the project
Nthumba 2010 [106]	Involve the local community with a goal to train and retain surgeons
	Work with local training institutions
	Partner directly with smaller, rural training institutions to overcome bureaucratic hurdles
Dupuis 2004 [122]	One should never perform an operation abroad that one would not perform at home
	Residents should not be unsupervised
	Avoid trying to maximize the number of patients treated

Telemedicine

Telehealth is the use of electronic information and telecommunications technology to enable clinical healthcare, education, and administration over long distances [136]. As the availability of technology advances and feasibility improves [137], telemedicine may help with more thorough preoperative workup and evaluation for STSTs [138, 139], remote screening [140], and postoperative follow-up [141]. Telemedicine may also improve educational collaboration and be relevant to

continued training, mentoring, and skills development [142–144]. Telesimulation, linking trainees and instructors in simulation through the Internet, has been shown to be promising, teaching laparoscopic skills to surgeons in Botswana and Colombia [145, 146]. As surgeons practicing in a low-resource environment with limited subspecialists available, the authors can personally attest to the importance of discussing complex cases via phone, email, or video conferencing with colleagues trained in subspecialty disciplines.

Task Shifting Versus Task Sharing

Many LMICs and organizations have attempted to overcome surgical disparities by training nonphysicians to perform procedures [147]. Task shifting, the delivery of surgical care by nonphysician providers, has been shown to be a viable solution in some low-resource settings with limited workforces [148]. Nonphysician providers have been advocated in essential surgery [149, 150], obstetrical care [151–153], and even subspecialty surgical care: orthopedics [154], pediatric surgery [155], and select urological and neurosurgical procedures [156]. The advantages of task shifting include the provision of healthcare to communities that would otherwise have no reliable access to care and the reduced cost and time of training physician providers. Disadvantages include the lack of adequate supervision and quality control and the concern that care may be compromised in a low percentage of situations where further training and expertise are necessary. Most advocates for task shifting acknowledge these limitations and recommend a restricted number of procedures be carried out by such providers. Certain subspecialty procedures, such as cataracts, could be adopted by nonphysician providers if appropriate oversight is in place [157]. To help address the lack of access, some subspecialty care such as basic and emergency neurosurgery in Tanzania has been taught by neurosurgeons to nonphysician clinicians. In that model, the trained healthcare workers then taught other healthcare workers to perform basic and emergency neurosurgery independently [158]. Clear definitions of the scope of practice, high standards for accreditation, and shared responsibility and oversight with specialist providers are necessary to ensure safe and quality care by the nonphysician provider [159, 160].

While task-shifting seems like a necessary stop-gap measure in the current era of significant disease burden, we advocate for a task-sharing approach with adequate training of physicians to oversee nonphysician providers [161]. This training model requires the long-term presence of highly trained personnel which results in a remarkable investment of human potential [162]. There are many challenges in training subspecialty surgeons in low-resource settings including a lack of standardization [163–165]. The authors do not advocate for sending personnel to high-resource institutions for further subspecialty training due to their propensity to stay and work in these high-resource settings. Training models appropriate to the resource-level and context should be developed and maintained to provide adequately trained personnel [166].

Government Health Facilities

Within LMICs, government hospitals, or the public sector, provide a variable amount of subspecialty care, and district or county hospitals do not typically offer subspecialty surgery [3, 66, 68, 150, 167, 168]. A review of district government hospitals in Mozambique, Tanzania, and Uganda demonstrated that no general surgeons were present. With essential surgery lacking priority in administration of these hospitals, subspecialty surgical care is not possible [67].

Generalized comparisons of public vs. “private” (including for-profit, nonprofit, faith-based) sectors show that the public sector is perceived to lack the hospitality and timeliness of the private sector [169]. Arguments exist that the public sector may offer expanded coverage to poor patients and is the path toward universal coverage. However, there is no data to guide the debate in subspecialty surgery. Governments often lack commitment to funding subspecialty care and training [170] and sometimes send patients abroad for subspecialty care [33, 171]. Yet, there are encouraging examples of how governments have partnered with institutions to expand and strengthen their specialist workforce [133, 172].

The facilitation of cataract surgery in India during the 1990s is one example of a government-identified need in which subspecialist surgical care was subsidized, expanded, and improved. Each district was allowed to finance providers to accomplish the goal of reducing blindness. Government mobile camps, state medical hospitals, and nongovernmental hospitals had an average cost for each individual patient of \$97, \$176, and \$54, respectively, and resulted in patient satisfaction at 51%, 82%, and 85%, respectively [88].

Where specialists are not locally available within the public sector, there is certainly a role for short-term surgical camps. Though when specialists are already present and actively caring for patients, these brief surgical camps may create more of a burden on the existing infrastructure than necessary [30, 113].

Private, For-Profit Hospitals

Due to perceived problems in the public sector, private for-profit clinics and hospitals are quickly increasing their market share in LMICs, particularly in urban centers [173, 174]. Physicians often have a “dual practice” in a public hospital, such as a university, with a private clinic to supplement income [175]. Fifty-five percent of physicians working in three capital cities in Africa subscribed to this dual practice [176]. Private health facilities have often been small operations, owned by individual practitioners, which then grow over time into larger hospitals [177]. If dual-practice providers have patients in both private and public institutions, the private patients may receive preferential treatment at the expense of patients in public hospitals.

The Muhimbili Orthopedic Institute in Tanzania attempted to overcome the perception that specialty care could only be done at private or NGO facilities. They reported on their acceptance of and recruitment of private patients to maintain a

private/public mix. During a 5-year period, private patients accounted for only 30% of outpatient visits and 5% of inpatients, yet generated 77% of the hospital's income from patient fees and 35% of all hospital income including government subsidies. With their experience, they found that patients prefer the private sector due to poor accommodations and the perceived poor worker-patient relationships in the public sector [178].

Nongovernmental Organizations

Numerous nongovernmental organizations (NGOs) or charitable organizations provide surgical care in low-resource settings. It is difficult to quantify the number of NGOs involved in care and equally impossible to estimate their impact. NGOs can be involved in a range of projects, from community-based programs to global efforts based on a surgically correctable condition, and vary widely in their models for delivery [179]. In a review by Ng-Kamstra et al., 313 NGOs were identified delivering surgical care in all 139 LMICs. Subspecialty surgery is performed and supported by numerous NGOs. Of all the NGOs surveyed, a number contributed to some form of subspecialty services including 22% of NGOs which perform cleft repair and 28% of NGOs which provide ophthalmology care [180].

Some NGOs are devoted to a specific condition, while others focus on a specific subspecialty. Smile Train is the largest charity group aimed at the subspecialty surgery of cleft repair. As a condition recognized to cause significant morbidity without operative repair, Smile Train has funded thousands of operations through local institutions and trained scores of local providers [181]. Throughout the last 20 years, a nonprofit organization, IVUMed, has supported educational programs for urology through numerous partnerships. In over 30 countries, IVUMed has worked in conjunction with a network of providers, institutions, societies, and industry to create collaboration built on training the subspecialty surgical discipline of urology [182]. Each NGO has a role in reducing the surgical burden of disease within its own area of strength.

NGOs are often involved in multiple delivery models even within their own organizations; 66% utilize STSTs and 68% claim to have long-term partnerships [180]. This allows us to draw comparisons between models within an NGO. One interesting example comparing the STST to a permanent center was done by Nagengast et al. in India [183]. They reviewed the costs associated with providing cleft repair during surgical missions, or short-term trips, to a center developed and staffed in an area found to have a high burden of disease from clefts. They found a 40% decrease in cost per surgery for the center as compared to the mission and a different distribution of expenses. Within the STST, air travel (52%) and hotel expenses (22%) were the largest expenses. In contrast, the center's budget expenses were attributed to salaries (46%) and infrastructure costs (20%). This finding reflects a goal of rewarding institutions that shift aid dollars toward the local economy and should encourage the movement of partnerships along the continuum of care delivery.

Faith-Based Mission Hospitals

The aforementioned era of physicians and surgeons motivated by faith, who first recognized the importance of providing surgical care to a low-resource community, consequently helped to build mission hospitals, and devoted lifetimes to service, did not disappear entirely. They, along with their local counterparts, have continued to invest in their surrounding communities with access to hard-to-reach populations and a priority on serving poor and marginalized people [184]. Faith-based organizations still account for a significant percentage of global healthcare provision, estimated at 20–70% of the health infrastructure in Africa [185–188]. However, these estimates are markedly different for individual countries and communities and cannot be generalized to all low-resource settings [189, 190]. Currently, there are numerous faith-based hospitals operating in resource-limited areas throughout the world, and there is a growing awareness that faith-based organizations play an important role in the delivery of global healthcare [191]. These mission hospitals and the surgeons that help staff them have long been and continue to be an incredible asset to the communities in which they serve [192, 193]. Within their communities, they are typically among the best choices for care, with high patient satisfaction rates [194], and in some areas the only choice that exists. Mission hospitals tend to adapt to the desired needs of the community, and subspecialist care is provided for the given need [39, 42, 75]. There is great potential for academic surgery to partner with faith-based organizations that offer cross-cultural experience and context-appropriate surgical knowledge, which is essential for a successful training model [161, 191]. Nevertheless, disadvantages of this model have been noted. There can be the perception of weak governance at the administrative level [195], but when compared to teaching and district hospitals, a mission hospital had the highest management ratings [196]. Any management issues are contrasted by a motivated staff providing service exceeding expectation [197, 198]. A possible lack of collaboration with government institutions could reduce the achievement of universal health access as mission hospitals are often not accounted for within the organization and implementation of health planning and policy [190].

The Continuum of Delivery of Subspecialty Surgery

While in some situations, the delivery of healthcare is achieved through a pure form of one of the above models, the most successful and “sustainable” programs usually employ some combination. By recognizing that the delivery of healthcare to low-resource settings is a continuum, it enables stakeholders to realize that no model, in of itself, is wrong; rather, all are working toward the same goal: universal, affordable access to subspecialty surgical care.

Within this continuum, partnerships are instrumental to success [199]. Collaboration and networking have a role among surgical subspecialists who have similar interests in reducing health disparities. A unique collaborative effort among subspecialists exists within the pediatric surgery community, with surgeons delivering care through

multiple platforms and models. With an emphasis on networking, educational efforts, research, and advocacy, this global network of surgeons helps to encourage and advance the cause of pediatric surgical care in low-resource settings [200]. Learning from others' experiences in the provision of care within similar resource-limited settings can help to overcome challenges and provide encouragement.

Until access to subspecialty surgical care is universally available, there will be a need for outside personnel and resources. The key to providing the best possible care is to balance each of the advantages and disadvantages of different models to create the ideal template for the individual region, nation, and community.

Classification of Models

The Essentials

- *Models can be understood through time, personnel, and location.*
- *Long-term investment in a community is a goal. Where this is not possible, shorter duration of care, but only if conducted effectively, is better than no care at all.*
- *There is a balance of personnel providing subspecialty care where “outsiders” offer expertise while “insiders” offer effective provision of care that is culturally relevant.*
- *The benefits from the referral of subspecialty care must be balanced with appropriate access to care.*

These various models can be understood through different means. The investment of time, the location, and the personnel delivering care help to inform the advantages and disadvantages of each model. With this understanding, one can draw conclusions for the appropriateness of the model to a community.

Classification by Time Investment

Perhaps the most notable distinction in the various care delivery models is the amount of time the individual or team providing subspecialty surgery invests in a particular community. The time invested can vary from a few days of an STST to decades of development by a community-owned hospital offering specialty services (Table 5.4). Although difficult to generalize, it can still be informative to evaluate the type of delivery platform and the time desired to attain the goals of providing subspecialty surgical care to a community. The duration of partnership between hospitals and Smile Train, a large international NGO, showed improvement in surgical care, patient follow-up, increased number of trainees, and additional ancillary services [201]. As STSTs develop over time, outcomes improve [28, 202].

It is our view that long-term investment in a community is a goal during the provision of subspecialty surgical care. Where this is not possible, shorter duration of care, but only if conducted effectively, is better than no care at all.

Table 5.4 Investment of time in surgical subspecialty care

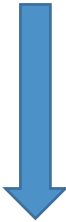

Models of delivery	Investment of time
Short-term surgical trip	Days
University partnerships	
NGO partnerships	
Private, for-profit, hospitals	
Nongovernmental organization hospitals	
Government hospitals	
Faith-based hospitals	Decades

Table 5.5 Personnel involvement in surgical subspecialty care

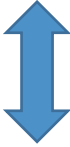
Models of delivery	Personnel
Short-term surgical trip	“Outside” specialists
University/NGO partnerships	
Nongovernmental organization hospitals	
Faith-based hospitals	
Private, for-profit, hospitals	
Government hospitals	
Task-shifting	“Local” providers

Classification by Personnel

Some models rely on the presence of “outsider” personnel with the necessary skills to provide specialist care. Others focus on local or “insider” providers trained to do specific operations. Most care providers acknowledge some balance in this spectrum in order to deliver optimal care to a population (Table 5.5).

A sometimes contentious issue of who should be providing subspecialty care allows us to classify these models of delivery by the personnel’s understanding of the local culture and community. This understanding is a key to success in the delivery of quality care and is closely tied to the time invested by an outsider subspecialist. Time learning language, culture, and investing in relationships [203] may result in an “outsider” having a more complete understanding of a local community than a national government. The transfer of skills through training can also accomplish this aim. We should be clear that the reciprocal benefits of cross-cultural collaboration exceed the pure transfer of skills and resources [108]. So, the goal is not for complete transition from the cultural outsider to the insider, but for long-term exchange of ideas, skills, and ingenuity. Rewarding cross-cultural experiences can be fulfilling to both partners as demonstrated by collaborative neurosurgical training in Ethiopia [204]. There is too much to gain from both sides working alongside one another to unbalance the scale toward one side or another.

Table 5.6 Location of surgical subspecialty care

Models of delivery	Location
Task-shifting	
Short-term surgical trip	
Faith-based hospitals	
Government hospitals	
University partnerships	
Private, for-profit, hospitals	Urban, referral

Classification by Location

Similar to resource-rich countries, outcomes for subspecialist care are better at referral centers with high volumes of specific conditions [205, 206] and when performed by experienced subspecialty surgeons [207–209]. This acceptable referral benefit must be balanced with appropriate access, especially due to the burden of travel expenses on poor patients [70] (Table 5.6).

Comparisons of models for subspecialty surgery are limited. But a study from Peru examined surgical outcomes after cleft lip and palate repair. When comparing location of operation, whether a mission model or a private referral center, and while controlling for surgeon and technique, the authors found that the mission model showed an increased complication rate [210]. An Ecuadorian study found similar results with the complication of palatal fistula ten times more likely in the mission model than the private center [30]. Moving along the continuum from surgical camp to referral center seems to also have cost-savings implications as well. Hackenberg et al. compares 17 STSTs and a comprehensive care center for cleft lip and palate surgery in Guwahati, India. The researchers found that the cost/disability-adjusted life year ranged from \$247/DALY through medical missions to \$190/DALY at the center [95].

The Tenwek Hospital Experience

The Essentials

- *Tenwek Hospital, a faith-based mission hospital, utilizes a number of models to provide subspecialty surgical care.*
- *To meet a significant need, a successful cardiac surgery program has developed through the investment of time, training of personnel, and improvements in infrastructure.*
- *The Tenwek Hospital experience demonstrates that the progression from temporary, short-term teams to self-sustaining independent care is truly a continuum.*

The particular experience of Tenwek Hospital is an example in several areas of moving along this continuum from very short-term isolated advancement to sustainable programs providing capacity building and training of local healthcare providers in an

independent setting. Tenwek Hospital is a 300-bed mission hospital in southwestern Kenya. It began as a small clinic in the late 1930s staffed by American missionary nurses. A full-time American missionary doctor joined the staff in 1959, and the hospital began to grow rapidly throughout the 1960s and 1970s. In the 1980s, a nurse training school was begun with a goal of providing higher-level training for local nurses, and providing a reliable source of nurses for the hospital, thus making it less reliant on outside resources. In the late 1990s, the hospital began cooperating with the national Ministry of Health in providing internship training for new graduates of Kenyan medical schools. In the early 2000s, a program of residency training was established in family medicine, followed by a general surgical residency in 2008 and an orthopedic surgery residency in 2014. Currently, there are more than 35 African doctors training at Tenwek Hospital in postgraduate medical programs. In addition to this, Tenwek serves as a clinical rotation site for many Kenyan medical students from a variety of medical schools around the country. Graduates from these programs are taking up posts around the country, and throughout other African countries, providing reliable, cost-effective healthcare to large areas of the region.

Development of subspecialty care was also occurring during these years at Tenwek Hospital. With the arrival of a full-time American thoracic surgeon in 1997 (R. White), Tenwek began to be able to offer more advanced pulmonary and esophageal surgery. Given the very high incidence of esophageal cancer in the region [76, 211], Tenwek soon became the regional referral center for thoracic surgery. When the general surgical residency became fully functional, residents were exposed to thoracic surgical training in a more extensive way than in most general surgical residency programs. By the completion of 5 years of general surgical training, graduates of the Tenwek General Surgical Residency Program usually feel quite comfortable with esophagectomy and basic pulmonary resection techniques.

Different types of subspecialty surgery require different investments of time and infrastructure. Some areas of subspecialty surgery require relatively short, prescribed times of training and limited changes in infrastructure and equipment. Examples of this include cleft lip repair and pedicled soft tissue transfers in the area of plastic surgery. Other areas, such as advanced laparoscopy [212, 213], require more careful planning and outlay of capital investment and infrastructure. Then there are other areas, such as cardiac surgery, which have extensive requirements for training, infrastructure, and physical facilities [33, 44, 214–216]. In these areas, it often requires a “quantum leap” to move into them, rather than a gradual introduction of new procedures and techniques.

Rheumatic heart disease is endemic in the area around Tenwek Hospital. Most patients present with advanced valvular disease at a stage when valve replacement is the only reasonable option. In fact, many present when myocardial function has suffered so severely that any surgical intervention is extremely dangerous. Although the need was clear, it initially seemed that the training, technology, and infrastructure requirements were so monumental that it would not be wise to embark upon a program of cardiac surgery at Tenwek Hospital. Cardiac surgery made its first appearance at Tenwek Hospital in 2007 through an unusual circumstance. A personal friend of one of the authors (R. White) is an American cardiac surgeon who visited Kenya that year with a view toward starting a cardiac program at one of the government facilities in the country. After visiting several facilities, he became convinced that those particular institutions lacked the necessary infrastructure to begin such a program. With

several days of extra time remaining in his planned trip, he visited Tenwek Hospital. Seeing the burden of disease and the existing infrastructure, he challenged us at Tenwek to consider beginning a cardiac program. This began with several cases of mitral commissurotomies for severe mitral stenosis performed with no cardiopulmonary bypass. Success in these cases encouraged us to plan for acquisition of all the necessary equipment to prepare for open heart cases requiring cardiopulmonary bypass. The open heart program began very clearly with short-term surgical trips, with teams coming regularly from Brown University, Vanderbilt University, Maine Medical Center, and the Ocala Heart Institute. These teams would consist of surgeons, perfusionists, cardiologists, anesthesiologists, and critical care physicians and nurses. During the first few STSTs, the visiting team members carried out virtually all of the direct patient care. However, within a short time, a very purposeful transference of knowledge and skills began to occur. Through specific times of didactic and hands-on-learning, the Tenwek staff began to take over areas of critical care medicine and nursing, cardiac anesthesia, and perfusion, while the author (R. White) resurrected cardiac skills not practiced for many years. It was very gratifying for the STSTs to find themselves less required for direct care and spending more and more time perfecting the skills in the Tenwek staff. Likewise, the local staff found that their ability to care for other critical, noncardiac patients improved considerably during this time. After 4 years of visiting teams, it seemed an appropriate time for the Tenwek team to begin open heart cases in the absence of visiting teams. To date, we have completed nearly 300 open heart cases at Tenwek Hospital, with about 2/3 of these performed with visiting teams present and 1/3 done solo. This has been achieved with a perioperative mortality rate of less than 1%. Currently, straightforward cases are handled by the Tenwek staff, while riskier cases and small pediatric cases are saved for the STSTs.

From this example, it is clear that this progression from temporary, short-term teams to self-sustaining independent care is truly a continuum. Tenwek Hospital has made significant progress along this continuum; yet, there remains much to accomplish. Tenwek continues to depend on outside help for some areas of equipment procurement and in management of complex cases. However, it seems inevitable that this progress will continue.

Role of Subspecialty Care in Reducing Disparities in Global Surgery

The Essentials

- *Subspecialty surgical care provides benefits not only to the individual patient but also to the community at large.*
- *Since subspecialty care requires certain infrastructure and training, other healthcare priorities can benefit from its implementation.*
- *Enhanced ability to care for patients improves acceptance of primary care.*

Over time, the care of the individual benefits the community at large by improving its access to healthcare, infrastructure, skilled personnel, and microeconomics [217]. Through the examples of Tenwek Hospital and others, the associated

improvements surrounding the implementation of subspecialty surgical care become apparent.

Building Infrastructure and Capacity

Considerable infrastructure is often required for subspecialist surgery. With this infrastructure, other departments reap the benefits as well [218–220]. Improvements in anesthesia care benefit all surgical patients. The laboratory and blood banking capabilities [221] are able to withstand the shock of the subspecialty care and are thus better prepared for both challenges and routine care. The screening program has both stemmed from and advanced the community health and primary care programs at Tenwek Hospital [222]. Radiology [223] benefits from enhancements in echocardiography and ultrasound. Donated equipment is provided, but biomedical engineers work together with the hospital maintenance department to ensure equipment does not fall into disrepair and abandonment [224, 225]. The potential for curative intervention improves outpatient relationships. The hospital administration [196, 226] fosters the growth and development of a program to help build a major referral center [227].

Improving Personnel Skills and Retention

As departments improve, it is only through the personnel that guide them. At Tenwek, the nursing staff and operating room technicians have been involved in the cardiac camps, and the eagerness to strive for excellent cardiac care helps in the care of all patients. Personnel have readily participated in improvement of critical care [228]. And, there is a greater willingness and ability to take care of patients who are critically ill.

Improving Community Access and Care

In communities with a distrust of modern medicine, the successful treatment of an individual should not be disparaged as a lack of investment into community. Inspirational stories of recovery and treatment can encourage a community to seek care at that hospital and surrounding healthcare facilities. It is difficult to quantify the impact on a community from the care of an individual. Anecdotal experience from Tenwek Hospital demonstrates increased participation in screening programs and public health ventures among communities with direct knowledge of previous patients' treatments and recovery. The Tenwek cardiac program has improved the lives of a number of individuals. Yet, it has also improved the care that the hospital provides to the community. The excellent care of an individual patient is evidence that inspires that patient's community.

As the cardiac program has progressed, numerous referrals for cardiac care from outside institutions have occurred, and reciprocal referrals from Tenwek to outside institutions for other specialty services have improved. This advantage has improved

not only the perception of the local community but awareness in the national health-care system. Additionally, these referrals improve communication and connect providers, all trying to deliver optimal healthcare to a large population in need.

Role of the Individual Subspecialty Surgical Provider

The Essentials

- *The key question is not related to where along this continuum the individual provider finds himself or herself, but rather that he or she is moving in the right direction.*
- *It is helpful to consider strategic questions prior to becoming involved in subspecialty surgical care.*
- *Involvement in subspecialty surgical care and its advancement within low-resource settings can be extremely rewarding for all involved.*

Understanding the Model of Care and Making Progress on the Continuum

The role of the individual provider in delivering subspecialty surgical care in low-resource settings is often described as a dichotomous choice between two extremes that is phrased something like this: “is the goal of the surgeon to directly care for a handful of individual patients, and in so doing provide himself/herself with the self-satisfaction of having reached out to those of a lower socioeconomic status, or is it to selflessly empower local caregivers to develop independence and skill in caring for complex cases and situations to the extent that eventually the external provider’s presence will no longer be required?” Common to many situations in life in which a multileveled process is reduced to a dichotomous decision, the appropriate answer to the question as phrased here is probably simply “Yes.” Of course the individual provider will hopefully be changing the lives of a small group of actual patients during his or her time in a given situation. And of course, this should reasonably bring satisfaction to the provider who is reaching out to a group of people who may not enjoy all the privileges that the individual provider has available. But this does not need to be exclusive of the goals of developing sustainable programs which empower local caregivers to provide this care in the future as well. As has been described in this chapter, providing subspecialty care in low-resource communities represents a continuum of development. The key question is not related to where along this continuum one finds himself or herself, but rather that he/she is moving in the right direction.

In this same train of thought, subspecialty surgical programs are in a unique position to contribute to the research literature in their endeavors within LMICs. However, this also needs to be done with the same thoughtful consideration of developing local capacity and infrastructure. Academic affiliations with STSTs and

Table 5.7 Questions for an individual provider to consider prior to engaging in subspecialty surgery in a low-resource setting

<i>Physical infrastructure</i>
1. Does the facility have adequate supplies for the intended care?
2. Does the facility have adequate sterilization facilities?
3. Does the facility have adequate oxygen and suction?
4. Does the facility have reliable electrical supply?
5. Should the provider consider taking along self-contained head lamps or necessary equipment?
6. Does the facility have adequate intraoperative and postoperative monitoring capabilities (oxygen saturation, ECG, pressure monitoring, etc.)?
<i>Staffing infrastructure</i>
1. Does the facility have adequate staffing to accommodate the intended care?
2. Should the STST consider bringing along staff to make up for gaps in local staff?
3. Is there adequate staffing for safe, effective postoperative care?
4. What is the plan to ensure that all patients are cared for completely through recovery to the time of discharge (potentially after the team leaves)?
<i>Financial infrastructure</i>
1. What is the plan to cover patient costs?
2. Is this plan eventually a sustainable plan?
3. Is there a plan for costs of equipment maintenance?

longer-term teams can be very effective in fostering an environment of inquiry and research [229–231]. Both institutional and individual partnerships can be sought to benefit both the visiting teams and the local providers, in addition to the population being served. Once again, this is often not a simple dichotomous question of “either/or,” but rather “both/and,” as long as care is taken in planning to truly achieve a “both/and” result.

There are also a variety of very practical issues which should be considered by any individual subspecialty provider engaged in this type of work. Particularly in the area of STSTs, these relevant questions (by no means an exhaustive list!) should be considered (Table 5.7).

Words of Caution

Programs offering subspecialty surgical care often fail to achieve long-term stability and independence for a variety of reasons. Frequently, the driving force behind the initiation of the program is the interest of the individual or group dedicated to that specialty, rather than a real need within the community. In some cases, communities will accept outside input in areas with minimal need, with the hope that the providers will eventually bring something of more benefit to the community. This can lead to disappointment in the minds of the providers and a feeling of being “used” for ulterior motives. When subspecialty surgical care requires significant physical materials (as in the case of cardiac surgery), there is often little thought about the long-term

Table 5.8 Questions for consideration before initiation of a subspecialty surgical program

1. Is there a genuine perceived need within the community?
2. Is there ownership/buy-in from the appropriate administrative body?
3. Is there a plan in place for eventual local procurement of needed supplies?
4. Is there a tangible element of teaching and capacity building within the program from the outset?
5. What will be the effect of the program on the existing infrastructure?

supply of these materials. When local staff are given inappropriate or incomplete training, there can easily develop a feeling among the staff that they have been “used and abused.” Finally, introduction of subspecialty care will necessarily have some effect on the provision of other care within the institution (either in a positive or negative fashion). It is therefore wise to consider the ramifications for the existing infrastructure. With these thoughts in mind, it is helpful to consider the questions in Table 5.8 when considering involvement in a program of subspecialty surgical care.

Words of Encouragement

Despite such warnings, involvement in subspecialty surgical care and its advancement within low-resource settings can be extremely rewarding. Regardless of the model, participation in delivering surgical care to people in need can be immensely satisfying to all involved. The cross-cultural experience and collaboration to solve difficult problems are fulfilling. Providers, including the most specialized surgeon, should be quick to learn from their colleagues. Practicing in resource-limited settings can foster innovation [232–239] and benefit not only the recipients of care but the providers.

Conclusion

Surgery has only recently been considered a global health priority, and subspecialty surgery remains an even newer area of consideration. Yet, more and more data are emerging that support the cost-effectiveness, practicality, and numerous benefits of prioritizing the provision of many subspecialty surgical services to communities in need. Models for delivering subspecialty care are numerous, and the most efficacious method of delivery is variable region to region and country to country, likely requiring a combination of multiple models. As the proponents of global surgical care, and specifically subspecialty surgery, continue to work toward a goal of quality surgical care for all, it must be with an awareness of past mistakes and shortcomings. We must also recognize the successes of particular organizations and programs as examples and standards of how such care can be offered capably, responsibly, and successfully, even in the most resource-constrained setting. We believe excellent, compassionate care of patients through subspecialty surgery can not only significantly impact the lives of the individual patients but will also improve the care of the community and as such should be a global health priority.

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