Published in final edited form as:

J Surg Educ. 2015 ; 72(4): e94–e99. doi:10.1016/j.jsurg.2014.09.011.

The Impact of a new Surgery Residency Program on Case Volume and Case Complexity in a Sub Saharan African Hospital

Claire Kendig, MD¹, Anna Tyson, MD, MPH¹, Sven Young, MD³, Charles Mabedi, MD², Bruce Cairns, MD¹, and Anthony Charles, MD, MPH^{*,1,2}

¹Department of Surgery, University of North Carolina, CB #7228 Chapel Hill NC 27599-7228

²Department of Surgery, Kamuzu Central Hospital, Private Bag A/104 Lilongwe, 3 Malawi

³Haukland University Hospital, PO Box 7804, NO-5020 Bergen, Norway

Abstract

Background—Improved access to surgical care could prevent a significant burden of disease and disability-adjusted life years (DALYs), and workforce shortages are the biggest obstacle to surgical care. To address this shortage, a 5-year surgical residency program was established at Kamuzu Central Hospital (KCH) in July 2009. As the residency enters its fourth year, we hypothesized that the initiation of a general surgical residency program would result in an increase in the overall case volume and complexity at KCH.

Methods—We conducted a retrospective analysis of operated cases at KCH during the three years prior to and the third year after the implementation of the KCH- Surgical residency program, from July 2006 to July 2009, and the calendar year 2012, respectively.

Results—During the three years prior to the initiation of the surgical residency, an average of 2317 operations were performed per year, while in 2012, 2773 operations were performed, representing a 20% increase. Pre-residency, an average of 1191 major operations per year were performed, and in 2012, 1501 major operations were performed, representing a 26% increase.

Conclusion—Our study demonstrates that operative case volume and complexity increases following the initiation of a surgical residency program in a sub Saharan tertiary hospital. We believe that by building on established partnerships and emphasizing education, research, and clinical care, we can start to tackle the issues of surgical access and care.

© 2014 Association of Program Directors in Surgery. Elsevier Inc. All rights reserved.

*Corresponding author: Anthony Charles, MD, MPH, Assistant Professor of Surgery, UNC School of Medicine, University of North Carolina, 4008 Burnett Womack Building, CB 7228, Tel: 919-966-4389, Fax: 919-9660369, anthchar@med.unc.edu.

Conflict of Interest: No author has any conflict of interest to declare.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Introduction

The burden of infectious diseases in Africa has long been recognized, but only recently has the surgical disease burden been appreciated in low-and-middle income countries (LMIC). Of surgical procedures performed worldwide, 26% occur in LMIC, an area representing 70% of the world's population [1]. Other estimates show that only 4% of the world's 234 million annual surgical procedures occur in low-health-care-expenditure countries, where 35% of the world resides [2]. The burden of disease and disability-adjusted life years (DALYs) that could be prevented with improved access to surgical care is similar to estimates of disease prevention from vaccination programs [3]. Injury is the greatest driver of the increased burden of surgical diseases and is a disease amenable to surgical intervention, but malignancy, congenital disease, obstetric disease, and cataracts are also important targets.

There are considerable obstacles to providing quality surgical care in LMIC. There is a dearth of health care infrastructure to support surgical care but more importantly, there is a staggering shortage of health care personnel (nurses, anesthesiologists and others). Nearly half of 132 surgical facilities in LMIC reported never having access to oxygen or anesthesia machines. Only 36% of the facilities had stable and continuous electricity, while half had access to water [4]. While these shortages are stark, the lack of trained health-care providers has been shown to be the most significant challenge to developing health care programs internationally [5].

The number of surgeons per capita in many African countries is low [6]. Migrations of health care provider to the private sector, nongovernmental organizations (NGOs), or overseas, particularly to the US and UK, places a strain on the ability of a country to provide essential surgical services. The economic loss of a doctor migrating from Africa to another continent is estimated at US \$184,000 [7], and the numbers of physicians leaving Africa are huge. For example, 68% of Ghanaian-trained medical graduates left the country between 1993 and 2000 [8]. In Malawi, a 2003 report revealed that of the 17 surgeons registered with Medical Council of Malawi, only 4 were Malawian [9], and a 2002 report showed that the majority of Malawian medical graduates pursuing surgical training were studying abroad [10]. Now a decade later, the total number of general surgeons registered with the Malawi Medical Council has increased to 31, however, only 6 are Malawian [11].

To address this shortage, the Department of Surgery at Kamuzu Central Hospital, Lilongwe, Malawi, Haukland University, Norway, and the University of North Carolina established a 5-year, College of Surgeons for East Central and Southern Africa (COSECSA) accredited surgical residency program at Kamuzu Central Hospital (KCH) in July 2009. The residency program aims not only to train residents to provide surgical care, but rather to be leaders in health care in Malawi through research education, clinical care and research [12]. While several short-term assessments of surgical training partnerships between institutions in High Income countries and LMIC have been described [13, 14, 15, 16] few have assessed the long-term impact of surgical residency programs on case volume and complexity at a LMIC hospital.

As the KCH residency enters its fourth year, we hypothesized that the initiation of a general surgical residency program in an environment of poor capacity and access would result in an increase in the overall case volume and complexity at KCH, thereby building capacity while simultaneously increasing surgical access.

Methods

We conducted a retrospective analysis of operated cases at KCH during the three years prior to and three years after the implementation of the KCH- Surgical residency program, from July 2006 to July 2009, and the calendar year 2012, respectively. We chose calendar year 2012 for the post residency implementation analysis because we hypothesized that the critical mass of resident complement (10 residents) necessary to impact workflow in the program was achieved in 2012.

Study Setting and Population

We used the existing hand written operating theater registry of operated cases at KCH, a 750-bed tertiary care hospital in Lilongwe, Malawi, with a catchment population of over 5 million people in the central region of the country. There were four full-time (greater than 6 month commitment) general surgeons, two full-time orthopedic surgeons, and six clinical officers for the entire study period, and in 2012, there was also a 10-resident general surgery residency-training program. The same cohort of attending general surgeons was present during both time periods and there was no increase in expatriate surgical faculty visit in 2012. There were two attending urologists from 2006 to 2009, and in 2012 there was one attending urologist. Plain and contrast radiography, abdominal ultrasound, and echocardiography were consistently available, while computed tomography and magnetic resonance imaging were not available.

Study Design

Patient demographics (gender, age), indication for operative procedure, procedure performed, and operative acuity (elective versus emergent) were recorded. Operative procedures were categorized as: general, trauma, skin and soft tissue, oncology, burn, urology, orthopedics or pediatrics. Pediatric surgical procedures were further subdivided into general, trauma, skin and soft tissue, oncology, burn, urology, neurosurgery, orthopedics and foreign body extraction as summarized in Table 1 Case complexity was determined by categorizing the operative procedure into Major and Minor surgery.

Minor surgery was defined as any operative procedure in which only skin or mucus membrane and connective tissue is resected. Cases such as incision and drainage of an abscess, skin surgery, and resection of soft tissue tumor were generally considered minor. This category also included biopsy, invasive operative procedure for procurement of tissue samples or body fluids using a needle or trocar.

Major surgery was characterized as an invasive operative procedure in which a more extensive resection is performed, a body cavity is entered, organs are removed, or normal anatomy is altered. In general, if a mesenchymal barrier was opened (pleural cavity, peritoneum, meninges), the surgery was considered major. For surgical procedures that did

not clearly fall in the above categories, the chance for significant inadvertent microbial contamination was a primary consideration, and the chance for significant blood loss was a secondary consideration.

We compared operative case volume and complexity before and after implementation of the surgical residency-training program. Case acuity was either transcribed from the log or extrapolated from the indication for operative procedure where possible. When this criterion was not recorded or reasonably extrapolated, it was excluded.

Results

During the three years prior to the initiation of a surgical residency at KCH, an average of 2317 operations were performed per year, while in the post residency a 12-month period, 2773 operations were performed, representing a 20% increase. Prior to the initiation of the residency program, an average of 1191 major operations per year were performed, and in the post residency period 1501 major operations were performed, representing a 26% increase (Figure 1). There were increases specifically in all categories and subcategories of operations, with the exception of urologic procedures (Figure 2 and Table 2).

There was a marked difference in trends within the pediatric surgical caseload. There were an average of 686 pediatric surgical cases performed per year prior to the residency program, and 1015 pediatric cases performed after the initiation of the residency program, representing a 48% increase. Minor procedures increased from 369 to 444, representing a 20% increase, and major cases increased from 315 to 571, representing an 81% increase. Among pediatric surgery subcategories, all case volumes increased with the initiation of the residency program, with the exception of urology and skin and soft tissue procedures (Figure 3).

Discussion

The global health community is paying increasing attention to the inadequacy of surgical care in many LMIC, and has identified the lack of an adequate surgical workforce as the main barrier to care [17]. There have been numerous efforts to provide surgical training to various cadres of health care providers, physicians, clinical officers and nurses [18]. The program focuses on Malawian physicians within 2–3 years of their medical degree.

There has been a 20% increase in the number of operative case at KCH since the initiation of the surgical residency program. Not only did total operative case volume increase but major operative cases increased after the residency program by 26%. The increase reflects the not only the contribution of the residents on surgical case volume, but also the ability of the consultants to be more efficient and productive over time as they provide oversight. Furthermore, the increased case volume and complexity may be reflective of the educational environment that a surgical training program brings to bear which enhances surgical decision making, acquisition of operative skill, and clinical judgment, thereby optimizing surgical clinical practice at KCH.

The results noted in our study may be due to the local practice patterns. Urologic procedures were the only subcategory of surgeries to decrease since the initiation of the residency program. Two consultant urologists were operating at KCH prior to the initiation of the residency, however, one retired shortly after the residency program began. The fact that these operations only decreased by 21% is a testament to growing skill of the residents and the flexibility of the consultant general surgeons. The tremendous increase in burn surgeries also coincides with the development of a burn unit and burn clinical officer at KCH, and is likely not a reflection of the residency program, but of another important partnership between UNC and KCH. Also not reflected in this data is that a health-care worker strike in 2012 resulted in cancellation of all elective cases at KCH for several weeks, [19] which may make the increase in operative volume artificially lower.

The initiation of the KCH residency program with the collaboration both foreign and domestic partners has helped mitigate the surgical workforce demands. At the outset, a needs assessment revealed a substantial requirement to augment surgical capacity not through intermittent visits by overseas surgeons, but by the creation of a new surgery residency-training program. Historically, the only other surgery residency-training program in Malawi, based in Blantyre, had failed to recruit enough residents to meet local needs. This may be a reflection of an overwhelming clinical workload and a dearth of surgical faculty in the absence of long-term sustainable partnerships akin to those developed at KCH. We previously described our recognition that increasing surgical capacity, and ultimately access, is dependent on long-term partnerships focused on training of local physicians, thereby promoting sustainability [12, 20].

The creation of this program was based on are several important principles: strong partnerships, locally relevant curriculum development, early program assessment, and substantial involvement of local partners for program leadership and accountability. The health care infrastructure, surgical disease epidemiology, and diagnostic and therapeutic capabilities in sub Saharan Africa differ greatly from those in the US [16]. Thus, the surgical curricula must be tailored to the local environment.

Health-care workforce shortages amplify the already staggering challenges in access, safety, quality, and cost of health care delivery in sub-Saharan Africa. Surgery and surgical care delivery are cost-effective elements of preventive health care, but access to essential surgery is limited in most resource-constrained settings. Resolving these tensions requires a collaborative, comprehensive, generation-spanning approach to global health education. A recent Lancet commission on professional medical education noted that education has stagnated in the face of growing and shifting health challenges; faculty are “essential to investing in future health dividends by training the next generation of health professionals” [21]. Indeed, faculty investment from all resource settings will be essential to lead rational and effective programs. The KCH surgical residency is beginning to address these inequalities.

The modest increases in surgical case volume and complexity in this study occurred in the absence of any other meaningful change in the local processes of care. The severe limitations of operating room access were unchanged as was the absence of a consultant

anesthesiologist and enhancement of any operating room milieu. Admittedly, the absence of an experienced anesthesiologist and critical care capabilities may have affected case complexity.

Our study demonstrates that operative case volume and complexity increases following the initiation of a surgical residency program in a sub Saharan tertiary hospital. We believe that by building on established partnerships and emphasizing education, clinical care and research, we can start to tackle the issues of surgical access and care. Additionally, we believe these advances can be further augmented by increased investment in surgical infrastructure and anesthesia workforce development.

Acknowledgments

Grant Support: This research is supported by the National Institutes of Health Office of the Director, Fogarty International Center, Office of AIDS Research, National Cancer Center, National Heart, Blood, and Lung Institute, and the NIH Office of Research for Women's Health through the Fogarty Global Health Fellows Program Consortium comprised of the University of North Carolina, John Hopkins, Morehouse and Tulane (1R25TW009340-01) and the American Recovery and Reinvestment Act.

References

1. Tollefson T, Larrabee W. Global surgical initiatives to reduce the surgical burden of disease. *JAMA*. 2012; 307(7):667–8. [PubMed: 22337675]
2. Weiser TG, Regenbogen SE, Thompson KD, Haynes AB, Lipsitz SR, Berry WR, Gawande AA. An estimation of the global volume of surgery: a modeling strategy based on available data. *Lancet*. 2008; 372:139–144. [PubMed: 18582931]
3. Ozgedez D, Jamison D, Cherian M, McQueen K. The burden of surgical conditions and access to surgical care in low- and middle-income countries. *Bulletin of the World Health Organization*. 2008; 86(8):646–7. [PubMed: 18797625]
4. Kushner AL, Cherian MN, Noel L, Spiegel DA, Groth S, Etienne C. Addressing the Millennium Development Goals from a surgical perspective: essential surgery and anesthesia in 8 low- and middle-income countries. *Arch Surg*. 2010; 145(2):154–160. [PubMed: 20157083]
5. Palmer D. Tackling Malawi's human resources crisis. *Reprod Health Matters*. 2006 May; 14(27): 27–39. [PubMed: 16713877]
6. COSECSA. College of Surgeons of East, Central and Southern Africa. <http://www.cosecsa.org/>
7. Ogowe A. Brain drain: colossal loss of investment for developing countries. *Courier ACP-EU*. 1996; 159:59–60.
8. Anderson FW, Mutchnick I, Kwawukume EY. Who will be there when women deliver? Assuring retention of obstetric providers. *Obstet Gynecol*. 2007 Nov; 110(5):1012–6. [PubMed: 17978113]
9. Muula AS. Nationality and country of training of medical doctors in Malawi. *African Health Sciences*. 2006; 6(2):118–119. [PubMed: 16916304]
10. Muula AS, Komolafe OO. Specialisation patterns of medical graduates, University of Malawi College of Medicine, Blantyre. *Cent Afr J Med*. 2002 Jan-Feb; 48(1–2):14–7. [PubMed: 12808783]
11. Malawi Medical Council.
12. Qureshi JS, Samuel J, Lee C, Cairns B, Shores C, Charles AG. Surgery and global public health: the Malawi Surgical Initiative as a model for sustainable collaboration. *World Journal of Surgery*. 2011; 35(1):17–21. [PubMed: 21052998]
13. Khambaty FM, Ayas HM, Mezgebe HM. Surgery in the horn of Africa: A 1-year experience of an American-sponsored surgical residency in Eritrea. *Arch Surg*. 2010 Aug; 145(8):749–52. [PubMed: 20713927]
14. Price R, Sergelen O, Unursaikhan C. Improving surgical care in Mongolia: A model for sustainable development. *World J Surg*. 2013 Jul; 37(7):1492–9. [PubMed: 22941237]

15. Petroze RT, Mody GN, Ntaganda E, Calland JF, Riviello R, Rwamasirabo E, et al. Collaboration in surgical capacity development: A report of the inaugural meeting of the strengthening Rwanda Surgery Initiative. *World J Surg.* 2013 Jul; 37(7):1500–5. [PubMed: 22956013]
16. Mutabdzic D, Bedada AG, Bakanisi B, Motsumi J, Azzie G. Designing a contextually appropriate surgical training program in low-resource settings: The Botswana experience. *World J Surg.* 2013 Jul; 37(7):1486–91. [PubMed: 22851149]
17. Gruen RL. Template for surgical training in resource-poor countries. *ANZ J Surg.* 2006; 76:871–872. [PubMed: 17007613]
18. Sani R, Nameoua B, Yahaya A, Hassane I, Adamou R, Hsia RY, Hoekman P, Sako A, Habibou A. The impact of launching surgery at the district level in Niger. *World J Surg.* 2009 Oct; 33(10): 2063–8. [PubMed: 19653031]
19. Nyasa Times. 2012 Jul 25. Ethics, locum and strikes among healthcare practitioners in malawi.
20. Qureshi JS, Young S, Muyco AP, Borgstein E, Charles AG, Mulwafu W, et al. Addressing malawi's surgical workforce crisis: A sustainable paradigm for training and collaboration in africa. *Surgery.* 2013 Feb; 153(2):272–81. [PubMed: 23063312]
21. Kerry VB, Ndung'u T, Walensky RP, Lee PT, Kayanja VF, Bangsberg DR. Managing the demand for global health education. *PLoS Med.* 2011 Nov.8(11):e1001118. [PubMed: 22087076]

Figure 1.
Number of major and minor cases over time

Figure 2.

Average number of major cases by category in the pre and post residency period

Figure 3.
Case volume within pediatric surgery by category in the pre and post residency period

Table 1

Categories to Classify Operative Procedures at KCH

Category	Definition and examples
Trauma	Operative procedure for treatment of blunt or penetrating injury.
Skin and Soft Tissue	Simple suturing of lacerations, skin grafting for indications other than burns, incisional and excisional biopsies, and removal of benign soft tissue tumors such as lipoma or fibroadenoma, wound debridement, and incision and drainage
Oncology	Operative procedure for treatment of a known cancer, including palliative and curative procedures.
Burn	Operative procedure for treatment of thermal injury including escharotomy, fasciotomy, skin grafting, and debridement.
Urology	Operations on the penis, testis, kidney, ureter, bladder or urethra.
Pediatric	All operations on patients under the age of 18. For the pediatric subtypes, the above criteria were used in addition to the following:
Neurosurgery	Ventriculoperitoneal shunt placements and revisions, craniotomy, and resection of meningomyelocele or meningocele.
Foreign body	Extraction of foreign body from the ear, nose, trachea, bronchus, or esophagus.

Table 2

Most common operated cases at Kamuzu Central Hospital, pre- and post-residency

Case	Pre-residency	Post-residency	% Change
Laparotomy			
Exploration NOS	140	173	
Resection and anastomosis of small bowel	98	121	
Colostomy	88	101	
Appendectomy	63	86	
Small bowel repair	31	53	
Other	269	218	
Total	689	752	+9%
Skin and Soft Tissue			
Biopsy	252	269	
Debridement	58	120	
I&D	72	117	
Other	69	122	
Total	451	628	+39%
Urologic			
Testicular/Scrotal	111	85	
Cystoscopy	76	69	
Circumcision	97	50	
Urethral dilation	77	51	
Renal surgery	46	59	
Prostatectomy	44	41	
Other	23	18	
Total	474	373	-21%
Hernia			
Elective	215	223	
Emergent	96	125	
Total	311	348	+11%
Burns			
Total	6	210	+3400%
ENT			
Tracheostomy	47	71	
Foreign body	27	60	
Laryngoscopy	12	17	
Other	71	47	
Total	157	195	+24%
Neurosurgery			
VP shunt	83	95	

Case	Pre-residency	Post-residency	% Change
Craniotomy	8	24	
Total	91	119	+31%
Other Major			
Mastectomy	21	24	
Amputation	12	25	
GYN	14	15	
Thoracotomy	3	7	
Total	50	71	+42%
Other			
Total	62	71	+15%
TOTAL *	2292	2767	+21%

* Total represents total numbers of log entries with a recorded procedure. Six surgeries in the post residency period and 25 surgeries in the pre-residency period (8.3 per year) did not have a procedure recorded.