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Surgery and Anesthesia Capacity-Building in Resource-Poor Settings: Description of an Ongoing Academic Partnership in Uganda

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Abstract

Background Surgery and perioperative care have been neglected in the arena of global health despite evidence of cost-effectiveness and the growing, substantial burden of surgical conditions. Various approaches to address the surgical disease crisis have been reported. This article describes the strategy of Global Partners in Anesthesia and Surgery (GPAS), an academically based, capacity-building collaboration between North American and Ugandan teaching institutions.

Methods The collaboration's projects shift away from the trainee exchange, equipment donation, and clinical service delivery models. Instead, it focuses on three locally identified objectives to improve surgical and perioperative care capacity in Uganda: workforce expansion, research, collaboration.

Results Recruitment programs from 2007 to 2011 helped increase the number of surgery and anesthesia trainees at Mulago Hospital (Kampala, Uganda) from 20 to 40 and 2 to 19, respectively. All sponsored trainees successfully graduated and remained in the region. Postgraduate academic positions were created and filled to promote workforce retention. A local research agenda was developed, more than 15 collaborative, peer-reviewed papers have been published, and the first competitive research grant for a principal investigator in the Department of Surgery at Mulago was obtained. A local projects coordinator position and an annual conference were created and jointly funded by partnering international efforts to promote collaboration.

Conclusions Sub-Saharan Africa has profound unmet needs in surgery and perioperative care. This academically based model helped increase recruitment of trainees, expanded local research, and strengthened stakeholder collaboration in Uganda. Further analysis is underway to determine the impact on surgical disease burden and other important outcome measures.

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Introduction

Surgery and perioperative care have been neglected in global health despite evidence of cost-effectiveness and the increasing, substantial burden of surgical disease. Surgical conditions account for nearly 11 % of the global burden of disease and are projected to increase, with the disease burden from injuries alone surpassing that of all infectious diseases by 2030 [1–3].

Despite these facts and the growing number of global health initiatives from universities in high-income countries, the number of surgical initiatives focused on building long-term local capacity remains relatively low [4–13]. To date, short-term surgical missions have been the dominant model for global surgery initiatives. Other models have included skills courses, equipment donations, trainee exchanges, or even assisting patients to obtain care abroad. The sustainability and effectiveness of these interventions to decrease the disease burden remain uncertain [8, 14].

With a population of nearly 30 million, five physicians per 100,000 people, an average annual per capita income of US$510 (2010), and a life expectancy of 53 years, Uganda is among the poorest and most medically underserved countries in the world [15]. For these reasons, there are thousands of foreign academic, philanthropic, and governmental health care initiatives in Uganda. Some of the surgical efforts in Uganda are listed in Table 1. Many of them are based at Makerere University (MU) and Mulago Hospital, the nation's largest medical school and the national referral hospital.

This article describes an academic partnership formed at Mulago to improve local surgical and perioperative services in Uganda. Global Partners in Anesthesia and Surgery (GPAS) is a capacity-building initiative led by faculty and trainees from several North American institutions and MU in Kampala, Uganda.

Methods

Partnership formation and project areas

Global Partners in Anesthesia and Surgery was formed in Uganda in 2007 from an existing academic partnership between surgery departments at the University of California San Francisco (UCSF) and MU, as previously described [16, 17]. From 2002 to 2006, the original partnership between these universities focused on trainee and faculty teaching exchange and clinical education.

In 2006, Ugandan surgeons conducted a local survey to help identify challenges and potential solutions to improve surgery and anesthesia care in Uganda [18]. Based on their findings and unpublished needs assessments and stakeholders meetings, the GPAS collaboration formed and selected three focus areas for projects.

Workforce expansion

Sub-Saharan Africa has the world's highest concentration of surgical disease burden but the fewest surgery and anesthesia providers per capita [1, 2, 19]. When GPAS formed in 2007, there were only 13 physician-anesthesiologists and fewer than 100 surgeons in Uganda. Poor recruitment to postgraduate surgery and anesthesia programs was due in part to the high cost of tuition—approximately USD $2000 per year (2008), which is more than four times the average Ugandan income [15]. Insufficient access to educational resources, lack of functioning equipment (exacerbated by a limited biomedical workforce), and the risk of occupational exposure to blood-borne pathogens were identified as additional challenges for recruitment [18]. Poor retention of graduates was a problem in part because of inadequate postgraduate job opportunities. To address these challenges, GPAS created a trainee scholarship program (GPAS Scholars), a postgraduate retention program (GPAS Senior Scholars), a biomedical support program, and several education initiatives.

Collaborative research

Lack of data on surgical epidemiology, access to care, and efficacy of interventions were identified as significant barriers to improving care capacity in Uganda. The Mulago Hospital surgery and anesthesia faculty developed a research agenda but lacked local resources to support it. This academic collaboration supported research in these areas, as the data were deemed essential to help guide strategies for improving local surgical capacity.

Promoting harmonization

It is estimated that more than 8000 nongovernmental organizations (NGOs) are registered in Uganda, with several dozen international groups focused on surgical care (Table 1) [20]. "Harmonization" was defined by the Paris Declaration on Aid Effectiveness as the coordination of efforts and sharing of information to avoid duplication [21]. Improving collaboration, transparency, and coordination (i.e., harmonization) among programs in Uganda was identified as a key local priority. An annual conference for international surgical groups in Uganda and mechanisms for increased communication were established through this partnership.

For the design of each project described, multidisciplinary stakeholder meetings and needs assessments were conducted, available literature and prior efforts were reviewed, and institutional review board approval was obtained when necessary. Each project was designed by asking key questions, outlined in Fig. 1, to maximize the chances of success and minimize pitfalls in collaboration that had been previously reported or observed [14, 22]. Because a purely academic-based model was unable to provide enough funding or dedicated faculty time to support these projects, volunteers were recruited, partnerships were sought, and financial

Table 1 International surgical efforts in Uganda (http://www.globalpas.org/projects/harmonization/international-database/, accessed 20 Oct 2012)

Program name	Project areas	Website
AAGBI[b]	Uganda anesthesia fellowship; obstetric anesthesia course; anesthesia book donation program	http://www.aagbi.org
Amalthea Trust	Medical engineering training; equipment management training; GPAS biomedical collaboration	www.amaltheatrust.org.uk
CanHEAR Uganda	Clinical service, ENT	http://www.canhearuganda.com/
CardioStart International (Oregon, USA)	Clinical service, equipment donation, development of pediatric and cardiac services at Mulago Hospital	http://cardiostart.org/
Centre for Global Surgery	Surgical skills training, injury research	http://www.cglobalsurgery.com/
CNIS—Canadian Network for International Surgery	Training courses, education, information systems, infrastructure	http://www.cnis.ca/
CoRSU—Comprehensive Rehabilitation Services in Uganda		http://www.corsu.or.ug/
CURE Children's Hospital of Uganda	Clinical service, center for neurosurgery; training center for CURE hydrocephalus surgical training program	www.cure.org
Duke - Neurosurgery	Equipment donation, training programs, clinical service	http://globalhealth.duke.edu/research/project?pid=48&s=75&p=9&t=0&loc=0&rfm=0
Duke Ortho Spine in Uganda	Equipment, training, service: spine, ortho trauma, PT, nursing, anesthesia, biomedical engineering	www.jambokampala.com
Duke Ortho Trauma in Uganda	Equipment, training, service: spine, ortho trauma, PT, nursing, anesthesia, biomedical engineering	www.jambokampala.com
Duke Ortho/Rehab in Uganda	PT, OT, education, training, equipment, facility support	www.jambokampala.com
FIENS—Foundation for International Education in Neurological Surgery	Neurosurgery, clinical service, education	http://www.fiens.org/
GECC—Global Emergency Care Collaborative	Emergency/acute medicine education; "task shifting"; emergency/acute care provision; health system development; public health; injury surveillance; prehospital care; health-seeking behaviors	http://globalemergencycare.org
GPAS—Global Partners in Anesthesia and Surgery	Workforce, education, infrastructure, prehospital, injury, research, anesthesia, EM, obstetrics, general/pediatric surgery	http://www.globalpas.org
HVO—Health Volunteers Overseas	Clinical service volunteers	http://www.hvousa.org/
IGOT—Institute for Global Orthopedics and Traumatology	Orthopedics, research, knowledge exchange	http://orthosurg.ucsf.edu/oti/outreach/programs/igot/
Interburns[a]	Essential burn care course	www.interburns.org
IVUMed	Urology, workshops, education, research	http://www.ivumed.org/
Lifebox	Training, support, provision of pulse oximeters	www.lifebox.org
Maternal and Newborn Hub Sustainable Volunteering Project	Knowledge exchange, implementation, evidence-based consortium	http://www.ugandanmaternityhub.org/
Med Teams International	Trauma nurse training, prehospital care	http://www.medicalteams.org/

Table 1 continued

Program name	Project areas	Website
Medical Missionaries of Mary	Basic surgical training, admin. hospital/ VVF	www.medicalmissionariesofmary.com
MGH– Mbarara	Regional anesthesia, education	http://www2.massgeneral.org/anesthesia/index.aspx?page=news_media&subpage=052311_globalhealth
Primary Trauma Care Foundation	First responders training	www.primarytraumacare.org
Riley Hospital for Children (Indianapolis, Indiana, USA)	Surgical mission, pediatric cardiac	
Royal College of Surgeons in Ireland/ College of Surgeons of East, Central, and Southern Africa Collaboration	Training of surgical trainers, training of basic science faculty, provision of IT laboratories and online surgical training content	www.cosecsa.org www.rcsi.ie/cosecsa
St. Joseph's Health System International Outreach Program	Residency and fellowship training	http://www.internationaloutreach.ca/Uganda-Conference.htm
Surgical Implant Generation Network[a]	Treating fractures, design/manufacture of implants	www.sign-post.org
UBC Branch for International Surgery	Supports training and research	http://www.internationalsurgery.ubc.ca/
UBC Plastic Surgery Collaboration	Development of a plastic surgery residency program at Makerere	
Uganda Charitable Spine Surgery	Clinical service volunteer	http://ugandaspinemission.blogspot.com/
Uganda Hearing Health Program	ENT collaboration	
Uganda Pediatric Surgery Camps	Pediatric surgery training	
Uganda Sustainable Clubfoot Project	Clinical service	http://www.orthosurgery.ubc.ca/index_usccp.html
UNC Uganda Project	Pediatric cardiac surgery	http://globalhealth.unc.edu/programs/africa/unc-project-uganda/
USTOP—Uganda Sustainable Orthopeadic Trauma Program	Ortho education, training workshops	http://www.orthosurgery.ubc.ca/index_ustop.html

GPAS Global Partners in Anesthesia and Surgery, *ENT* ear/nose/throat, *PT* physical therapy, *OT* occupational therapy, *EM* emergency medicine, *VVF* vesicovaginal fistula, *IT* information technology

[a] University of British Columbia (Vancouver, BC)

[b] The Association of Anesthetists of Great Britain and Ireland

support was obtained through research grants, philanthropic contributions, and local government.

Results

Workforce expansion

Recruitment and retention efforts by this collaboration from 2007 to 2011 helped increase the total number of Master of Medicine (MMed) trainees in anesthesia from 2 to 19 and in surgery from 20 to 40. The recruitment and scholarship programs were conducted using private foundation support and through a partnership with the Overseas Anesthesia Fund of the Association of Anesthetists of Great Britain and Ireland [23]. Competitive scholarships provided tuition for the 3-year MMed program [24]. To date, 16 scholarships have been awarded, and all those sponsored who have been eligible to graduate have done so. Six are working as faculty at Mulago Hospital, three at private or mission hospitals in the capitol, and one has returned to his home neighboring country to work in a teaching hospital (Table 2).

After years of advocacy and collaboration with the Ugandan Ministry of Health (MoH), in 2011 all scholarships for anesthesia MMed trainees were provided by the MoH to ensure sustainability in this area of extreme workforce shortage.

To promote workforce retention, a "Senior Scholar" position was created for anesthesia in 2010 and expanded to include surgery in 2011. Senior Scholars assumed the role of a "chief resident" to mentor and teach junior

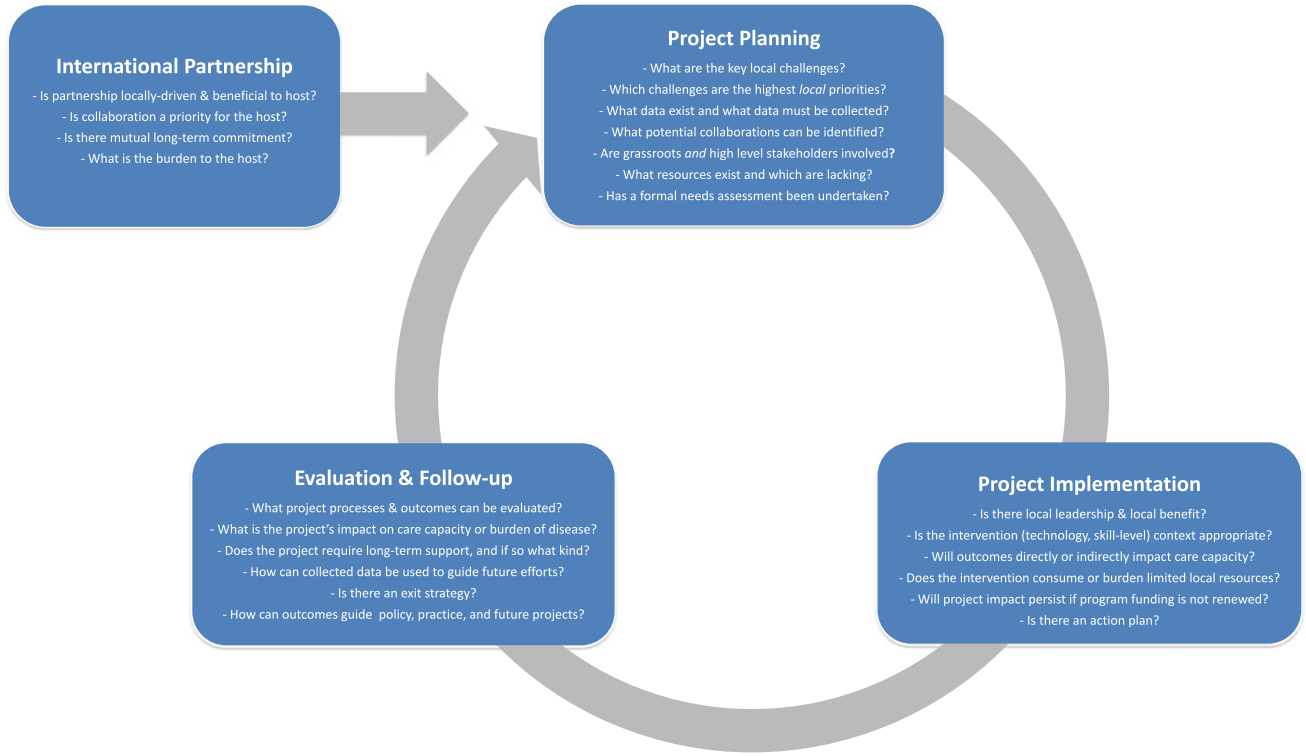

Fig. 1 Conceptual framework for capacity building through academic partnerships

Table 2 Surgery and anesthesia MMed enrollment and GPAS sponsorship

Parameter	2006	2007	2008[a]	2009	2010	2011
Surgery						
Total	20	20	21	32	35	40
1st-year trainees	5	7	12	14	11	14
GPAS Scholars	0	0	3	1	1	2
Anesthesia						
Total enrolled	2	2	9	11	17	19
1st-year trainees	2	0	7	4	6	11
GPAS Scholars	0	0	3	3	3	0[b]

MMed Master of Medicine

[a] First year of GPAS recruitment and scholarship program

[b] In 2011, the GPAS worked closely with the Ugandan Ministry of Health (MoH) to secure MoH sponsorship for unfunded trainees in anesthesia

trainees and conduct collaborative research projects while being supported by a stipend. These Senior Scholars have engaged in a variety of educational, research, and capacity-building activities, including the establishment and co-directorship of the "Intensive Care Society of Uganda," advocacy for more resources for critical care, the development of a postgraduate emergency medicine training program, and leadership of a local advanced trauma care course [25].

Additional projects to help promote workforce expansion included improvements to the educational infrastructure and clinical work environment. The collaboration invested in trainee teaching workshops and created a resource room with up-to-date medical texts and computers with Internet connectivity. To expand the biomedical workforce necessary to maintain clinical infrastructure, this collaboration helped obtain private funding to support partially the first biomedical engineering technician training school in Uganda. At the time of publication, this school had 20 enrolled students who attend Mulago Hospital to repair equipment as part of the curriculum.

Collaborative research

The collaboration's research agenda was partially developed at a 2008 stakeholders meeting of physicians, nurses, epidemiologists, and policymakers. This was the first multidisciplinary, national meeting to address access to surgical and perioperative services in Uganda [26, 27]. The partnership has produced more than 15 publications and posters in peer-reviewed journals and at international conferences (http://www.globalpas.org/projects/research/publications/).

Research projects to date have focused on the epidemiology of surgical conditions, trauma care and mortality, access to care, occupational exposure, health policy, and

surgical output and capacity in rural hospitals [26–31]. Other projects have examined colorectal cancer tumor biology, thyroid disease, breast cancer, decision-to-delivery intervals in obstetrics, and obstetric morbidity and mortality in Uganda [32].

Findings have been discussed with the Ugandan MoH, and primary injury data have been shared with the Global Burden of Disease Project Injuries Group to improve the knowledge of injury morbidity and mortality in sub-Saharan Africa [33, 34].

For one collaborative research project on occupational exposure at Mulago Hospital, independent funding was obtained for a Ugandan junior faculty member to be principal investigator. This milestone was the first competitive research grant obtained by an MU Surgery Department faculty member, who recently published the first phase of the study [35].

Global Partners in Anesthesia and Surgery mentors have been involved in proposal development and evaluation for MMed trainee dissertations. During the summer of 2012, GPAS partners co-sponsored an MMed research stipend competition to promote projects focused on surgical disease epidemiology, access to care, and cost-effectiveness analysis. To date, all projects resulting in peer-reviewed publications have included Ugandan and international authors.

Increased harmonization

To improve communication between groups working to support surgery and anesthesia in Uganda, GPAS partnered with the Ugandan North American Medical Society to organize a conference in 2010 in San Francisco, California. More than 70 participants from 12 universities and organizations working in surgery or perioperative care at Mulago Hospital attended the conference. A second meeting in 2011 was hosted by the University of British Columbia (Vancouver, BC), and more than 100 participants from 15 universities and organizations attended, including the former Director of Health Services of Uganda. After this 2011 meeting, a list of priority areas for international partners supporting surgery and anesthesia in Uganda was drafted and adopted. As part of this agreement, GPAS and collaborators jointly hired a Ugandan coordinator and created an online calendar to coordinate activities [36]. The annual conference, a full-time shared administrator, and calendar have fostered several new partnerships, including collaborative projects in obstetrics and orthopedics.

Discussion

This article describes an academic collaboration established to improve surgery and perioperative capacity in Uganda. We have done it through promoting workforce expansion, research, and greater collaboration among other international organizations.

The limited health workforce in East Africa has been well documented [19, 37–39]. The approach to workforce expansion described here shares the perspective that long-term support for parallel training of native surgery and anesthesia providers is a cost-effective and sustainable strategy [40–44]. In Uganda, several North American groups have had longstanding commitments to training both medical and nonmedical personnel in surgery and anesthesia (Table 1). To our knowledge, other programs in the region have not reported an increase in the specialist workforce through an academic foundation and emphasis on collaborative research and harmonization. Furthermore, the parallel training of anesthesia and surgical providers while simultaneously promoting local biomedical workforce expansion has been another unique aspect of this collaboration.

As seen in Table 2, although GPAS offered only a small number of scholarships, the increased number of trainees during the first year of the recruitment program (2008) was larger than the number of scholarships offered. Also, the increase was sustained. This observation suggests that continued active recruitment efforts, improvements to the educational infrastructure, and increased postgraduate job opportunities also likely played a role.

Sustainability of the scholarship program was achieved through partnership with the Uganda MoH. In 2011 and 2012, the MoH gave greater recognition to the critical shortage of trainees in surgery and anesthesia and agreed to provide scholarships in these areas.

In Uganda an estimated USD $13.6 million of Ugandan government investment in medical training has funded training of physicians who subsequently emigrated to higher-income countries [45]. Although GPAS scholarships did not contractually bind trainees to stay in Uganda, Scholar selection prioritized those committed to practicing locally, and all graduated Scholars are working in Uganda or home countries in the region. In addition, the Senior Scholar program was created to help retain high-performing graduates and improve teaching capacity.

As recruitment helped increase the number of trainees at Mulago Hospital, the limitations of the existing educational and clinical infrastructure became even more apparent, as reported elsewhere in the region [39, 43, 46, 47]. Inadequate supplies and functional equipment remain a problem at Mulago Hospital, but we chose not to focus on donations because of the relative abundance of inappropriate donations (e.g., a bypass machine when blood pressure cuffs are not routinely available) and lack of ongoing technical support. We continue to use our observations, needs assessments, and the published reports of other groups to

help guide local health expenditure and external donations to Mulago Hospital [48, 49]. We have also been encouraged by our collaboration with a biomedical technician training program in Kampala. Expansion of the biomedical support workforce is a critical and often overlooked aspect of surgical and perioperative capacity building.

In addition to workforce expansion and retention efforts, locally identified research priorities have defined this collaboration. The competitive research grant on occupational exposure awarded to a Ugandan junior faculty member in 2009 was significant not only because it was the first such grant awarded directly to a local surgical principal investigator but because it addressed a pressing concern for surgeons and operating room personnel in Uganda.

Surgical research relevant to public health must translate into policy and service delivery. A number of action items were endorsed at a stakeholders meeting in 2008, although only a few have had close follow-up. A coherent national plan to increase access to surgical services has not yet been developed in Uganda, as has been done elsewhere in the region [27, 50].

Collaboration with the Institute of Public Health and the MoH to refine the research agenda, disseminate findings, and improve the impact of research on delivery of care is underway. Recent work has emphasized the importance of collaborative scholarly work, and our projects have adhered to this principle in both publications and conference presentations [51].

The final core project area of our partnership focused on increased collaboration with other international organizations. Lack of harmonization among the many health care-related efforts in Uganda poses a significant obstacle to optimizing our limited resources [39].

As we continue to work on mechanisms to prevent duplication of efforts and promote collaboration—such as shared activity calendars, full-time coordinators, conferences, project databases—an increasing number of international partners are communicating more regularly. Local trainees and faculty benefit in different ways from the various resources individual partners bring to the collaboration. No partner is able to provide optimal support needed in all areas (e.g., hands-on skills building, scholarship support, mentoring, research support, fellowship training), although each partner makes some contribution to local capacity. Improved communication and planning is a first step to maximizing the collective impact.

Limitations, challenges, lessons learned

Several recent reports have described collaborative surgical programs in resource-constrained settings [10, 13, 50, 52–55]. A critical review of these initiatives and the best metrics for capacity-building in surgery and perioperative care, although necessary, is beyond the scope of this article. Several studies have described the formation of specialist surgery training programs and short skills courses in Africa. Their primary outcomes were the number trained and retention of these providers. Some have reported follow-up of several decades [56, 57]. The metrics for such programs are less obvious than those of more traditional delivery-based models through short-term missions, although more global health organizations have promoted "operations research" as a crucial component of accountability [58–61].

Although our analysis included process measures of surgical capacity such as workforce, research, and collaboration, it did not include more objective impact measures such as surgical outcomes, perioperative complications, or other traditional indicators of safe surgical and anesthesia care. To our knowledge, no groups with similar longer-term capacity-building missions have measured and published such outcome data. Although many groups have used simpler outcomes measures (e.g., surgical case volume), at Mulago Hospital the large number of independent interventions ongoing simultaneously makes even this outcome challenging to utilize. For example, it is difficult to conclude which intervention could account for the 106 % increase in surgical case volume reported at Mulago Hospital in recent years [53].

Process measures do not ensure improved outcomes, but a staged evaluation that includes process measures initially is an integral aspect of health program evaluation and is recommended for capacity-building programs targeting the global health workforce [62, 63]. Despite the limitations in measuring outcomes discussed above, data are being collected using traditional metrics, such as operating room and hospital mortality, infection rates, and transfusion rates. We are also collecting data on clinical and academic performance of trainees and tracking workforce retention in the short and long term.

At the core of the GPAS model is a focus on local capacity-building rather than short-term, unsustainable interventions. Although we believe that this particular aspect of our model is applicable in most other low-income countries (LIC), other aspects of the model may not be. For example, our efforts to conduct local research and formally train surgeons and anesthetists have been dependent on the preexistence of a host academic institution. Furthermore, although the public health needs in LICs are often similar, local priorities and local champions may differ widely and may not align with the capabilities or interests of prospective collaborating groups.

In settings with no postgraduate program, a greater reliance on visiting volunteers or training nonspecialist physicians or nonphysician clinicians (task-shifting) may

be necessary to build capacity [64]. The latter, in particular, requires broad political, financial, and regulatory commitment from local policymakers and clinicians, which we did not tackle directly through our collaboration. Nonetheless, adequate specialist surgeon and anesthesia supervision is an extraordinary and unmet need. Improved training capacity of the allied health workforce (theater staff, nursing) is also a necessary area not yet tackled through this program.

Several recent reports have outlined common pitfalls in global health collaborations, and we have tried to strengthen our model accordingly (Fig. 1) [8, 22, 65]. Nonetheless, our projects have suffered from some of the challenges encountered elsewhere. Key local partners have been reassigned or pursued further training, challenging the sustainability of specific programs. Local clinician-leaders are also few and overstretched, and expansive collaborative program development agendas can become burdensome. A full-time Ugandan administrative assistant and sponsored Senior Scholars have addressed some of these issues. Faculty salary support for research is rarely available in Uganda and other similar settings despite being standard practice in academic settings in high-income countries. We have included support for the local principal investigator in our collaborative grants to help address this lack.

One of the greatest challenges to similarly structured programs is support through an academic model. This type of work is often viewed as purely humanitarian, not academic, yet clearly there are elements of teaching, service delivery, and research that comprise the typical academic mission [17]. Some groups have done similar work through a pure NGO model; other historically delivery-oriented groups have shifted toward a capacity-building approach [40, 41].

Nonetheless, securing extended time away from the home institution for faculty in high-income countries remains a challenge in the current economic climate of academic medicine. To support GPAS projects, volunteers were recruited and both traditional competitive research funding and philanthropic support were pursued. Whereas new sources such as Medical Education Partnership Initiative grants are available, more traditional hypothesis-based research funding can be challenging to obtain for capacity-building programs, leaving an enormous global surgical research agenda unaddressed [66]. To promote sustainability, a critical component of every project has been the pursuit of additional support through partnerships with local government and other organizations.

Finally, as more medical schools and residency programs offer global health experiences that are rewarding for trainees and may serve as the inspiration for a career in global health, careful focus on the needs of host institutions is necessary when planning such programs.

Conclusions

Surgical conditions including obstetric complications and injuries represent a growing proportion of the global disease burden, with the burden from injuries alone projected to surpass that of all infectious diseases combined by 2030. Although numerous strategies to address the surgical disease crisis have been described, few have reported a long-term impact or reproducibility in multiple settings. Here we describe a model (Fig. 1) for academic global health work that focuses on long-term, multidisciplinary partnership, designs projects based on local needs and resources, and emphasizes local capacity building rather than direct service provision. A collaborative needs assessment in Uganda identified the local priorities to be workforce expansion, research, and increased communication between groups as initial objectives to building surgical care capacity. Projects in these areas increased recruitment into surgery and anesthesia training programs, expanded local research, and improved stakeholder collaboration. Further evaluation of the impact of this model on the surgical disease burden and other important outcome measures in Uganda is needed. Nonetheless, this model may be applied in other low-income settings to develop context-specific, international, academic collaborations to increase surgical and anesthesia capacity.

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