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Barriers and facilitators of surgical care in rural Uganda: a mixed methods study

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ABSTRACT

Background: Surgical care delivery is poorly understood in resource-limited settings. To effectively move toward universal health coverage, there is a critical need to understand surgical care delivery in developing countries. This study aims to identify the barriers and facilitators of surgical care delivery at Soroti Regional Referral Hospital in Uganda.

Methods: In this mixed methods study, we (1) applied the Surgeons OverSeas' Personnel, Infrastructure, Procedures, Equipment, and Supplies tool to assess surgical capacity; (2) retrospectively reviewed inpatient records; (3) conducted four semistructured focus group discussions with 18 purposively sampled providers involved in perioperative care; and (4) observed the perioperative process of care using a time and motion approach. Descriptive statistics were generated from quantitative data. Qualitative data were thematically analyzed.

Results: The Personnel, Infrastructure, Procedures, Equipment, and Supplies survey revealed severe deficiencies in workforce (*P*-score = 14) and infrastructure (*I*-score = 5). Equipment, supplies, and procedures were generally available. Male and female wards were overbooked 83% and 60% of the time, respectively. Providers identified lack of space, patient overload, and superfluous patients' attendants as barriers to surgical care. Workforce challenges were tackled using teamwork and task sharing. Inadequate equipment and processes were addressed using improvisations. All observed subjects ($n = 31$) received interventions. The median decision-to-intervention time was 2.5 h (Interquartile Range [IQR], 0.4, 21.4). However, 48% of subjects experienced delays. Median decision-to-intervention delay was 14.8 h (IQR, 0.9, 26.6).

Conclusions: Despite severe workforce and physical infrastructural deficiencies at Soroti Regional Referral Hospital, providers are adjusting and innovating to deliver surgical care.

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Introduction

Assessment of emergency surgical capacity can be considered a litmus test of the efficiency of a health system. The surgical care delivery process is a symphony of collaborative efforts that pulls people, resources, and expertise from different parts of the health system. A third of the global burden of disease is amenable to surgical treatment; yet, about 70% of the world lacks access to essential surgical care.[1,2] The lack of access to surgical care disproportionately affects low- and middle-income countries (LMICs). About 99.5% of people living in LMICs do not have access to basic surgery.[1]

As the world pushes for Universal Health Care, the need for improved surgical access, especially in LMICs, becomes increasingly important.[3-5] To achieve Universal Health Care, collaborative efforts must seek to improve surgical capacity, affordability, safety, and timeliness while ensuring optimum quality of care. Surgical quality improvement efforts in LMICs are hampered because little is known about the processes and determinants of surgical care delivery in these settings.[6,7]

Many district hospitals in LMICs are unable to provide essential surgical services.[8] Because patients seen at district hospitals are often referred to regional referral hospitals, which provide most of surgical care in these settings, these regional hospitals are vital to surgical care delivery. In Uganda, Soroti Regional Referral Hospital (SRRH) provides much of the surgical care in the Teso subregion of rural Uganda.[9] Thus, there is a need to better understand surgical care delivery at this level.

Strengthening surgical care requires a robust situational assessment of surgical care. The World Health Organization tool for Situational Analysis to Assess Emergency and Essential Surgical Care and the Surgeons Overseas' Personnel, Infrastructure, Procedures, Equipment, and Supplies (PIPES) tool are commonly used to quantify surgical capacity.[10,11] Although these are valuable tools, additional methods such as process mapping, surgical volume estimation, and qualitative interviews may also play a vital role in assessing surgical capacity, capturing perspectives, and characteristics of surgical care that may not be otherwise appreciated.[12-14]

Surgical care delivery in sub-Saharan Africa faces diverse challenges that should be studied comprehensively, through both quantitative and qualitative methods.[15] The aim of this study is to identify the barriers and facilitators of surgical care delivery at SRRH using a mixed methods approach. We hypothesize that both barriers and facilitators of surgical care exist in this setting, some of which may be unique to the Ugandan context, but others representative of other similar settings.

Methods

Study setting

SRRH is a regional level facility that serves about two million people from eight districts in the Teso subregion.[9,16] It is the main referral hospital for the 44 public sector health facilities and the private sector.[16-18] SRRH receives an average of approximately 260 surgical referrals and makes an estimated five referrals to a higher level facility monthly.[19] As all SRRH providers are fluent in English, all study procedures were conducted in English.

Quantitative methods

PIPES survey

The Surgeons OverSeas' PIPES tool is a quantitative instrument with 105 variables in five domains: PIPES.[11,20,21] The personnel category is comprised of count data, whereas other categories contain binary variables (0 = item was absent or unsatisfactory or unavailable all of the time; 1 = item was present or satisfactory or available all of the time). The score for variables within a category were summed to obtain the score for that category. The PIPES score was generated by adding the score for each of the categories according to the equation below:

PIPES score = personnel score + infrastructure score + procedures score + equipment score + supplies score.

Using the PIPES score, the PIPES index was generated thus:

$$\text{PIPES index} = \frac{\text{PIPES score}}{105} \times 10$$

As the personnel category has no maximum score, the PIPES score and index have no maximum possible values. Consequently, the PIPES tool is primarily used to assess a single facility over time as part of quality improvement efforts or to compare similar facilities in similar settings, rather than placing emphasis on differences between individual scores (PIPES score). This PIPES study serves as a baseline assessment to inform quality improvement efforts. To complete the PIPES survey, a researcher interviewed purposively sampled hospital staff engaged in emergency and essential surgical care at SRRH.

Retrospective midnight census

Surgical inpatient records at SRRH from May 1, 2015 to June 23, 2015 were examined to determine daily surgical inpatient volume. Daily inpatient volume in male and female wards was compared with maximum bed capacity to generate the daily occupancy rate by ward.

Time and motion methodology

Processes of emergency surgical care were directly observed from patients' arrival at the health facility to the point of initiation of definitive surgical intervention (e.g., knife on skin). On a rolling basis, all eligible subjects who presented at SRRH during the study time frame were recruited into the study. Subjects were continuously recruited from May 1, 2015 to June 22, 2015. Only patients presenting to SRRH with nonobstetric emergency surgical conditions that received treatment were included in this study. Patients presenting to the hospital with obstetric surgical emergencies, nonsurgical emergency conditions, and nonemergency surgical conditions were excluded. Patients with nonobstetric emergency surgical conditions that did not receive treatment or left the hospital against medical advice were also excluded. Informed consent

was obtained from all participants. Those who did not consent were not included in the study.

Process mapping was used to examine the timeliness of emergency surgical care. Delay in care was defined as: "any situation whereby a patient is ready for a procedure (decision has been made) but does not immediately undergo that procedure due to the presence or absence of a factor(s) other than a change in the clinical or pathologic state of the patient that necessitates deferment of the proposed intervention". The authors proposed this definition to focus on the in-hospital delays in care; particularly, the delays in period of care during which patient is under the care of the surgical team. Authors favored this definition over a predetermined cutoff time because the little is known about the local standard of care and also to accommodate the heterogeneity in the cases observed and the intervention(s) provided. Specific indicators of interest were (1) decision-to-intervention time (DIT), (2) causes of delays in the DIT phase of care, and (3) proportion of definitive surgical interventions performed by each health worker cadre. Descriptive statistics were generated on these indicators, reported as medians, ranges, and proportions. All quantitative data were analyzed using Microsoft Excel and Stata 13.1 software.[22,23]

Qualitative methods

Focus group discussions

Key personnel involved in the perioperative process of care were purposively sampled for participation in focus groups discussions (FGDs) because they possess key information about the perioperative process of care. This sample comprised all the consultant surgeons and intern doctors in the surgical team, each of the nurses in charge of the theater, male surgical ward, and female surgical ward, an anesthetist nurse, and administrative staff involved in the hospital management. This cohort was selected to capture the picture of surgical care delivery from the perspective of the various cadres within surgical team and the administrative staff that facilitate surgical care delivery. These personnel were placed into four interview groups according to health worker cadre: (1) nurses and anesthetist, (2) administrative staff, (3) intern doctors, and (4) consultant surgeons. A researcher interviewed participants using a semistructured interview guide. Responses were recorded and transcribed. Two researchers independently analyzed the transcripts using a thematic approach and compared findings. Incongruous results were reviewed until consensus was reached. Qualitative data were coded and managed using Dedoose software.[24]

Ethical approval

This study received ethical approval from the administration and ethics committee of SRRH and the University of California, San Francisco Committee on Human Research.

Results

SRRH has a bed capacity of 300 people. The total PIPES score was 97 (Table 1). The PIPES index was 92.3. SRRH staffs three consultant surgeons, five nurse anesthetists, and no anesthesiologists. Five intern doctors and one medical officer perform surgery. Of 13 infrastructure indicators, only three (running water, medical records, and back-up generator) were available (Table 2). SRRH provided 90% of the 40 surgical procedures assessed but did not perform open reduction of fracture, clubfoot repair, cleft lip, palate repair, and laparoscopic procedures. Tourniquets, chest tubes, eye protection, and laparoscopic supplies were lacking. Of 22 of the surgical equipment assessed, 21 were always available. However, endoscopes were not available.

Table 1 – PIPES results summary.

Category	Score
Personnel (P)	14
Infrastructure (I)	5
Procedures (Pr)	36
Equipment (E)	21
Supplies (S)	21
PIPES score	97

The median inpatient volume was 43 patients (IQR, 36, 50) in the male surgical ward and 24 patients (IQR, 14, 26) in the female surgical ward. The median surgical inpatient bed occupancy rate was 134% (33 beds) for males and 120% (20 beds) for females. Male and female surgical wards were overbooked beyond the maximum available bed capacity 83% and 60% of the time, respectively (Fig. 1).

The time and motion observations captured 31 subjects (20 males and 11 females) with a median age of 18 y. The leading causes of presentation to the hospital were trauma (45%), acute soft-tissue infections (22.6%), and acute intestinal obstruction (12%; Fig. 2). Various cadres of health providers performed various definitive surgical interventions on the

Table 2 – Infrastructure assessment results.

Infrastructure	Availability
Running water?	1
External electricity?	0
Functioning back-up generator?	1
Incinerator?	0
Medical records?	1
Emergency department?	0
Postoperative care area?	0
Intensive care unit?	0
Pretested blood available (blood bank)?	0
Lab to test blood and urine?	0
Functioning X-ray machine?	0
Functioning ultrasound machine?	0
Functioning computed tomography scan?	0
Subtotal *I*-score	3
Number of functioning operating rooms (ORs)	2
Total *I*-score	5

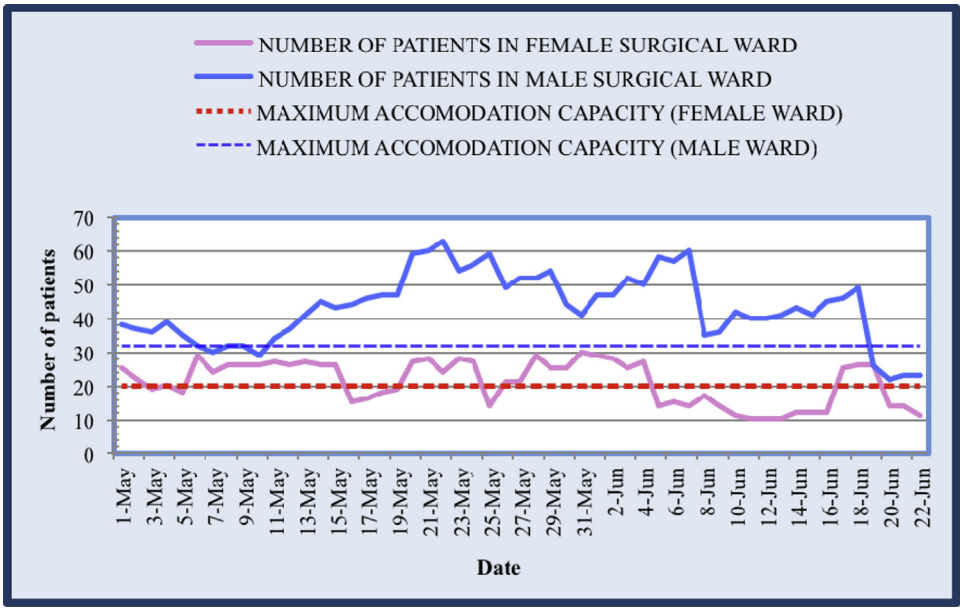

Fig. 1 – Male and female surgical inpatient volume at SRRH (n = 53 d). (Color version of figure is available online.)

subjects, ranging from nonoperative procedures (orthopedic manipulations, wound suturing, and administration of parenteral medications) to operative treatment (Fig. 3). Surgical interns performed half of the surgical procedures and their scope of practice ranged from minor to major operative procedures. Consultant surgeons, orthopedic officers, and nurses performed 21%, 11%, and 4% of the procedures, respectively (Fig. 4). About 4% of subjects did not undergo any definitive surgical intervention.

The median DIT (n = 31 patients) was 2.5 h (IQR, 0.4, 21.4). Fifteen subjects (48.4%) experienced delays during the decision-intervention phase of care. The median delay time for these subjects was 14.8 h (IQR, 0.9, 26.6). These delays, which were encountered by 15 subjects, accounted for 64.8% of the total DIT for all the subjects combined. The leading factors contributing to prolonged DIT (Table 3) were large patient volume causing prolonged waiting time for surgery (47%), the unavailability of personnel responsible for a particular service (19%), and deferment of the procedure to a more convenient time (11%). Unavailability of drugs and blood products contributed to 9% and 5% of the delay time, respectively. Equipment unavailability (2%) contributed the least to the total delay time observed. Equipment unavailability led to improvisation. For example, FGDs and direct observation showed: (1) latex gloves were used to fashion wound drains; (2) commercial plastic water containers were used to fabricate underwater seal chest drainage apparatus; and (3) in the absence of endoscopes, a Foley catheter is used blindly to remove foreign bodies lodged in the esophagus or airway.

FGDs reached theoretical saturation by the fourth group interview. Providers identified institution-, patient-, and provider-related factors and policy and/or governance as key determinants of quality of surgical care delivery (Table 4). Institution-related factors revolving around inadequate physical infrastructure, equipment and supplies, services, funds and finances, processes, standard operating procedures were prominent barriers to care. Lack of physical space to perform duties was regarded as the single most important

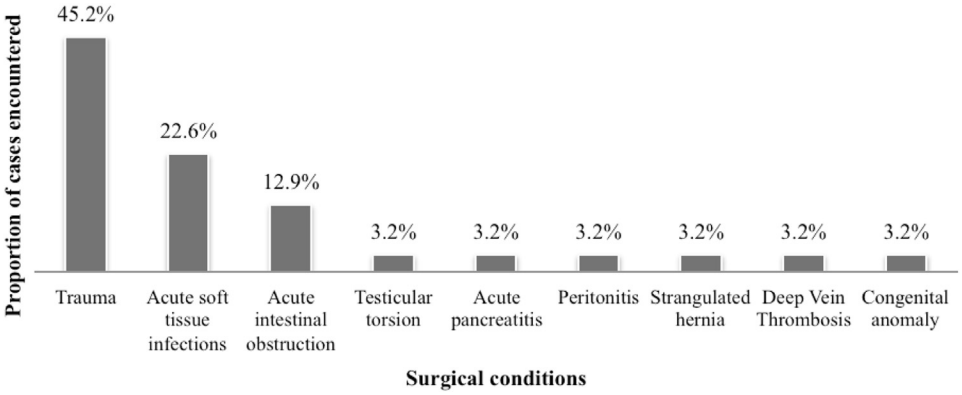

Fig. 2 – Distribution of emergency surgical conditions observed (n = 31).

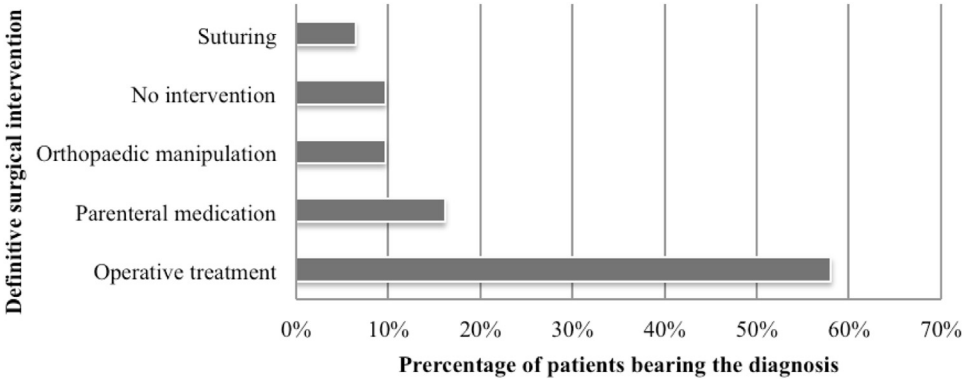

Fig. 3 – Frequency of emergency surgical procedures performed for study subjects ($n = 31$).

barrier to care. Electricity, equipment, supplies, and services were as institution-related factors that adversely affected the quality of care at SRRH. Patients were less likely to access lab and image diagnostic services after 4 PM, highlighting a shortage of nurses exacerbated at night. Due to nursing shortage, patients' attendants often performed some nursing functions.

Issues related to the impact of Ugandan health policy and governance on surgical care delivery were also revealed during FGDs. Ugandan government health facilities do not charge user fees. Facilities receive quarterly financial allocations based on negotiation and utilization during previous quarters. Although providers appreciate the potential benefit of this policy, they believe it inadvertently has inimical effects care (Table 5). Opportunities for collaboration with international development partners were recognized as facilitators of quality surgical care and education. Respondents regarded good clinical acumen, commitment, and teamwork among providers as provider-related facilitators quality surgical care.

Discussion

Study findings reveal a significant surgical burden that exceeds workforce and infrastructural capacity. SRRH experienced overbooked wards at least two-thirds of the time resulting in patients sharing beds, sleeping on the floor, and sleeping outside the ward. Large patient volume, workforce limitations, and unavailability medical equipment, drugs were the leading causes of delay in instituting the definitive surgical intervention. The lack of screened blood and blood products, drugs, and equipment accounted for about a tenth of the total DIT delay time measured in this study. The potential effects of these inadequacies on patient outcomes compel future research.

This study highlights the need for infrastructural development to accompany population growth and surgical needs in LMICs. Originally built in 1920 as a syphilis treatment center, SRRH became a regional referral hospital in 1996 with a catchment population exceeding two million people.[17,18] However, it has seen little infrastructural growth.[17,18] Electricity remains a challenge and reliance on generators results in higher costs.[25] There is presently no emergency department (ED) at SRRH; the provision of an ED may help streamline processes of care by creating one point of entry for patients with emergency surgical conditions.[26] Having an ED may also aid triaging and treating and minor and day cases that may be otherwise admitted, thereby ameliorating the surgical inpatient volume.[27]

Lack of physical space at SRRH is a major infrastructural challenge, limiting providers' ability to perform necessary surgical and ancillary services. Insufficient bed space, number of operating rooms, and number of operating tables adversely affects surgical care delivery and contributes to observed delays in providing definitive care. The PIPES survey hints that SRRH is also limited in its ability to perform certain surgical procedures associated with rapid recovery time and shorter in-hospital length of stay. For example, such procedures like

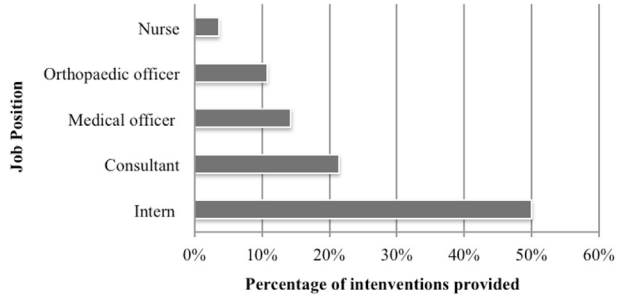

Fig. 4 – Proportion of emergency surgical interventions provided by various types of providers ($n = 31$).

Table 3 – Causes of delay in DIT time ($n = 31$ patients).

Identified cause of DIT delay	Proportion of the total DIT delay for which it accounts (%)
Large patient volume	47
Provider unavailable	19
Deferred by provider	11
Lack of drugs needed	9
Patients' attendant	7
No blood in blood bank	5
Unavailable equipment	2

Table 4 – Emergent themes from the provider FGD.

Theme	Description	Relation to quality
Institution-related factors	Includes physical infrastructure, equipment, supplies, funding, collaboration, processes, and services	Major determinants of quality of care. Mostly lacking and often mentioned as barriers to quality.
Provider-related factors	Refers to the number, skills, and motivations of health providers	Lack of adequate skill and number of surgical and ancillary staff served as barriers to quality.
Patient-related factors	Includes patients' attitudes, role of patient attendants	Patients' attendants occasionally facilitate quality of care by augmenting patient nursing. However, large numbers of attendants can disturb clinical work, education, and deplete hospital resources.
Policy/governance	Policies affecting the quality of surgical care delivery directly and indirectly	Policy and governance set the stage and dictate the quality of care. Some existing policies infringe on quality of surgical care.

open repair of fractures and laparoscopic surgeries are unavailable. Limb fractures are treated using traction, a technique that keeps beds occupied for at least six weeks.[28] Open reduction procedures are associated with an average hospital stay of one week.[29] Considering the high surgical burden and workforce limitations in Uganda, training surgeons to perform procedures like open reduction or techniques with a more rapid recovery time may help decongest facilities.[30]

SRRH faces severe surgical workforce challenges in terms of workforce numbers, quality of training, and available skill sets. Considering the large trauma burden and impact on in-hospital stay, the absence of an orthopedic surgeon poses

Table 5 – Focus group discussion results and excerpts.

Catergory	Issue	Excerpt
Barriers to surgical care delivery	Lack of physical space	"Space is in fact a very limiting factor because we do not have enough… You find patients sharing beds; breaching all rules of infection control. Other patients are on the floor. You cannot examine a patient. Issues of privacy come in. When there is an emergency you cannot push a trolley in the wards because there is a patient in the corridor." (FGD002)
	Unavailability of electricity, equipment, and supplies	"Electricity is also a big challenge because most of our equipment runs using electricity… power goes off without warning. Sometimes even during the operation… at night it is even worse. Sometimes it goes off for 3-4 d… and this affects us a lot because you can not sterilize. Sometimes you can not do operations… It really affects us a lot."(FGD002)
		"There are instances whereby we have a senior consultant to offer that specialized service, but the right equipment is unavailable. So, someone is referred because of lack of equipment or lack of the supplies like blood. So those are the challenges." (FGD004)
	Policies may adversely affect care	"The policymakers…make policies that directly infringe on the practices we have here in the hospital. For example, they say, nobody should pay any money and yet the hospital cannot afford to provide everything for the patients." (FGD011)
	Patients' relatives/attendants	"The patient who is sick has to be visited by the relatives…Many relatives will come around…will tend to congest the wards, our waiting areas, our ablution centers. Because literally they are there in large numbers and therefore increase on the utility costs (especially water) in this hospital." (FGD004)
Facilitators of surgical care delivery	Provider dedication and teamwork enhance care	"The topmost is teamwork. We have a very dedicated team. I think for me there are other issues but that is the major thing. Just having a dedicated team on the ground; people who stay and work." (FGD002)
	Development of medical education	"Our medical education needs to be regulated and tailored to the needs of the country. There are very many other players (local and international)… So can all those players come to a round table and say this is the way to do it?" (FGD001)
	Patients' relatives/attendants	"Because of shortage of staff, often times we tend to get, take a hand from the (patient's) relative: to offer social support and they liaise with the staff to be always close to support the patient from the social aspect especially. And also there also happens to be liaisons between the patient and the staff… purely because we lack the staff to monitor these patients adequately." (FGD004)

Table 6 – Action list and/or recommendations.

Theme	Potential intervention
Surgical workforce	Hire an orthopedic surgeon
	Create training opportunities for interns in the area of trauma
	Develop collaborative partnerships to improve surgical education and training
	Explore a nursing practicum partnership with the Soroti School of Nursing
Process of care	Evaluate the triage process for emergency surgical patients with a view to improving it
Infrastructure	Expand surgical wards and theater
	Provide preoperative and postoperative room
	Streamline process for approval and disbursement of funds for maintenance and repair of equipment
Policy, governance, and health financing	Evaluate the impact of the current "no user fees policy" on quality of surgical care delivery
	Identify other context appropriate alternative health financing or funding mechanisms
Health economics	Assess the cost effectiveness of providing an orthopedic surgeon for SRRH
Further research opportunities	Measure the impact of delays in care on patient outcomes
Health technology research	Identify valuable local fabrications and improvisations being used by providers to make up for the unavailability of standard medical equipment and devices and evaluate their efficacy, safety, and the health outcomes associated with their use

significant challenges. Such challenges are often seen in developing settings and across Uganda with nonsurgeons performing a significant portion of surgeries.[31] A recent study of five hospitals in Uganda showed that nonspecialist physicians performed over 5000 surgeries annually.[30] Despite the incorporation of surgical interns and medical officers into the operative workforce, there are still challenges in meeting the surgical demands at SRRH. Task shifting may be worth exploring as a cost-effective solution for improving access to essential surgical care.[31] Clinical officers represent a potential solution to the workforce deficiencies, but their role and scope of practice requires further exploration with respect Ugandan setting.

The scarcity of skilled health providers often resulted in prolonged patient wait times. Delays in emergency surgical intervention are a predictor of morbidity and death.[32-35] Some hospitals in LMICs have an average waiting time of up to 40 h.[34] About half of the patients experiencing delays in DIT had a wait time of 2.5 h or less. Although causes of delay may be multifactorial, challenges inpatient throughput at SRRH are a primary factor. About 19% of the delay in DIT occurred due to unavailability of a necessary provider. Further research could assess the impact of such delays.

It is crucial for LMICs to design their medical education process to meet their local needs.[36,37] Adapting a trauma training course to suit the local resources and needs of local general doctors (intern doctors and medical officers) has been shown to be a cost-effective approach to building surgical capacity in developing settings.[38] Creating a nursing practicum program that offers student nurses practical clinical experience, under the tutelage of experienced ward nurses, may be valuable for both partner institutions and the trainees.[39] This may also obviate the need for patients' attendants to perform certain nursing functions as was observed in this study. There is also a place for collaboration between LMIC stakeholders and international development partners to shape medical education curriculums to address identified priorities.[36,37]

The absence of user fees at government facilities is an Ugandan health policy that addresses the financial barrier to accessing care but does not guarantee quality of care. The expected greater access to healthcare is not accompanied by, nor does the policy make specific provisions for, a commensurate increase in the health workforce to match increased demand or to improve quality of care. Consequently, this policy may exacerbate the patient throughput challenges at SRRH.

Team spirit, motivation, innovation, and ability to improvise are reportedly the strengths of SRRH. In response to the unavailability of lifesaving medical devices and equipment, providers resort to self-made fabrications and improvisations. This situation highlights the need and opportunities for health innovation in this and similar settings. There is a need to systematically study these improvisations and processes to ensure quality and safety. Table 6 presents a list of items identified as pertinent to improving surgical care delivery in this setting.

Limitations of this study include the absence of an ED at SRRH, which led to multiple points of patient entry and directly affected the time and motion activities of this study. Patients also exited the hospital to obtain unavailable diagnostic tests and imaging services. This posed a challenge for direct observation. The Hawthorne Effect is understood to be a limitation of direct observation.[40] We attempted to mitigate this by delaying data collection until the investigator was well integrated with providers and the hospital setting. A limitation in assessment of delay in care was encountered in few instances when of the observed cause delay was multifactorial. The PIPES tool was also limited in its ability to identify the role of external factors affecting surgical capacity. At last, retrospective findings represent a 2-mo period and may not be generalizable across a full year. However, the information

elicited from the provider interviews suggests the study provides an accurate understanding of surgical patient volume at SRRH.

Conclusions

The surgical burden and inadequacies in infrastructure, workforce, and resources at SRRH creates an environment that is disproportionately adverse to surgical patients. Although the PIPES surgical capacity assessment tool is widely used, the information gaps associated with using this instrument are largely unknown. This study provides a more complete picture of surgical care at a Regional Referral Hospital level so that users of tools like the PIPES survey can have an idea of the types of information that they may be missing. Also, this study uncovered some pivotal, yet, unanticipated issues. One of such issues is the breadth of the impact of lack of space on surgical care delivery at SRRH, as captured by this study, differs from similar LMIC settings and is distinctively vast. It also creates a unique perspective, which draws attention to the importance of health infrastructural planning and development in healthcare delivery in LMICs. Another notable finding is that providers devised positive innovations, improvisations, locally fabricated devices, and other adaptive methods to tackle the lacking equipment and infrastructure, and ineffective processes.

SRRH has an urgent need for infrastructural development: building an ED and more operating rooms, expanding hospital wards, and maintaining a number of beds commensurate with the surgical demand. Infrastructural investment, however, must be accompanied by a commensurate enhancement of the surgical workforce numbers and skills. This entails strategically training local providers to address locally prevalent surgical conditions like trauma. Creating local partnerships presents a symbiotic solution to workforce limitations. Furthermore, global surgical initiatives and exchange programs between high-income countries and LMICs holds considerable potential. The challenges of surgical care delivery in LMICs require a holistic response involving health providers, governments, and international development partners identifying, prioritizing, and designing apt solutions for local challenges. A further detailed analysis of existing local health policies and their impact on surgical care delivery in this setting is necessary to ensure that policies and programs are and continue to be relevant to population needs.

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Disclosures

The authors declare no conflict of interest.

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