

Laparoscopy in Rwanda: A National Assessment of Utilization, Demands, and Perceived Challenges

Faith Robertson¹ · Zeta Mutabazi² · Patrick Kyamanywa³ · Georges Ntakiyiruta⁴ · Sanctus Musafiri^{2,6} · Tim Walker^{2,7} · Emmanuel Kayibanda⁸ · Constance Mukabatsinda⁵ · John Scott⁹ · Ainhoa Costas-Chavarri^{1,10,11}

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Abstract

Background Laparoscopy has proven to be feasible and effective at reducing surgical morbidity and mortality in low resource settings. In Rwanda, the demand for and perceived challenges to laparoscopy use remain unclear.

Methods A mixed-methods study was performed at the four Rwandan national referral teaching hospitals. Retrospective logbook reviews (July 2014–June 2015) assessed procedure volume and staff involvement. Web-based surveys and semi-structured interviews investigated barriers to laparoscopy expansion.

Results During the study period, 209 laparoscopic procedures were completed: 57 (27.3%) general surgery cases; 152 (72.7%) ob/gyn cases. The majority (58.9%, 125/209) occurred at the private hospital, which performed 82.6% of cholecystectomies laparoscopically (38/46). The three public hospitals, respectively, performed 25% (7/28), 15% (12/80), and 0% (denominator indeterminate) of cholecystectomies laparoscopically. Notably, the two hospitals with the highest laparoscopy volume relied on a single surgeon for more than 85% of cases. The four ob/gyn departments performed between 4 and 87 laparoscopic cases (mostly diagnostic). Survey respondents at all sites listed a dearth of trainers as the most significant barrier to performing laparoscopy (65.7%; 23/35). Other obstacles included limited access to training equipment and courses. Equipment and material costs, equipment functionality, and material supply were perceived as lesser barriers. Twenty-two interviews revealed widespread interest in laparoscopy, insufficient laparoscopy exposure, and a need for trainers.

Conclusion While many studies identify cost as the most prohibitive barrier to laparoscopy utilization in low resource settings, logbook review and workforce perception indicate that a paucity of trainers is currently the greatest obstacle in Rwanda.

Faith Robertson and Zeta Mutabazi have contributed equally to this work.

✉ Faith Robertson
faith_robertson@hms.harvard.edu

¹ Harvard Medical School, 25 Shattuck Street, Boston, MA 02115, USA

² College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda

³ Department of Surgery, Faculty of Clinical Medicine and Dentistry, Kampala International University Western Campus, Kampala, Uganda

⁴ Ejo Heza Surgical Centre, Kigali, Rwanda

⁵ Centre Hospitalier Universitaire de Kigali, Kigali, Rwanda

⁶ Centre Hospitalier Universitaire de Butare, Butare, Rwanda

⁷ School of Medicine and Public Health, Faculty of Health and Medicine, University of Newcastle, Callaghan, Australia

⁸ King Faisal Hospital, Kigali, Rwanda

⁹ Brigham and Women's Hospital, Boston, MA, USA

¹⁰ Rwanda Military Hospital, Kigali, Rwanda

¹¹ Boston Children's Hospital, Boston, MA, USA

Introduction

The advantages of laparoscopic surgery over traditional open surgery—minimal incisions and blood loss, decreased pain and infection, and accelerated patient recovery—have highlighted the need for surgeons to have laparoscopy in their armamentarium [1–3]. However, many low- and middle-income countries (LMICs) lack access to laparoscopic surgery and concomitantly face a significant surgical burden of disease amenable to minimally invasive techniques [2]. For instance, sub-Saharan Africa is one of the most burdened by digestive diseases with 1.7 million disability-adjusted life years lost annually from gastrointestinal problems (e.g., biliary pathology, appendicitis, hernias, intestinal ileus) [4]. Furthermore, the benefits of laparoscopy are particularly relevant in LMICs where limited hospital beds, blood banks, and sanitary living conditions contribute to surgical morbidity and mortality [5, 6].

Recent studies have demonstrated the adoption of laparoscopy in LMICs to be safe, feasible, and clinically beneficial [7–12]. In Mongolia, a 2-week training course and over 400 subsequent laparoscopic procedures resulted in reduced hospital stays, reduced incidence of infection, better postoperative pain control, and improved wound esthetics [13, 14]. Still, laparoscopy remains underutilized in many LMICs with cost, lack of equipment, and limited trained personnel frequently cited as obstacles [2, 15–19]. Before attempting to improve access to laparoscopic surgery in an LMIC, a thorough understanding of country-specific needs and barriers to laparoscopy is required.

In Rwanda, the demand for and perceived challenges to laparoscopy use remain unclear. As Rwanda has partnered with the US federal government and a consortium of North American institutions under the Human Resources for Health Program (HRH) to meet the health needs of its 11 million citizens by 2020, it is an ideal setting for expanded access to laparoscopic surgery [20]. This study aimed to elucidate the volume and range of laparoscopic procedures being performed, the number of practitioners engaging in such procedures, and the perceived barriers to performing laparoscopy.

Materials and methods

Research setting

There are four national referral centers in Rwanda: two university teaching hospitals, Centre Hospitalier Universitaire de Kigali (CHUK) and Butare (CHUB); Rwanda Military Hospital (RMH); and a private institution, King

Faisal Hospital (KFH). Each institution has sufficient equipment to perform laparoscopic interventions. Laparoscopy is performed by both general surgeons and obstetrician gynecologists (ob/gyn). Internal ethics committees at all included hospitals approved this study, along with the Institutional Review Boards of the College of Medicine and Health Sciences, University of Rwanda and Boston Children's Hospital.

Logbook review

Data from July 2014 to June 2015 were retrospectively extracted from surgery and ob/gyn operating room logbooks that were maintained by surgical nursing staff and kept in the operative and perioperative area. Eligible procedures included all laparoscopic cases, as well as open cholecystectomies to obtain a percentage of cases performed laparoscopically versus open for the most common laparoscopic procedure. Variables included date of procedure, diagnosis/indication for procedure, procedure performed, and whether an open-procedure conversion was needed. The procedure detail at CHUB was insufficient to ascertain the clinical indication for laparotomy. The distinction between emergent and elective laparoscopy and laparotomy was not ascertained from the logbook data. The accuracy of these logbooks was perceivably high, but this study did not incorporate formal data validation, so it is possible that some cases were undocumented or documented incorrectly. Cases were excluded if the handwritten procedure type was deemed illegible by multiple data reviewers (less than 1% of cases).

Online survey

All consultants and residents in the Departments of Surgery and Ob/Gyn at the four hospitals were invited via email to complete an anonymous electronic survey. The survey was available in both English and Kinyarwanda. Questions were designed to ascertain perspectives on laparoscopy, interest in techniques, level of exposure and training, and perceived barriers to utilization. Questions included Likert-scale evaluation, rank lists, and open response.

Interviews

Semi-structured interviews served as a qualitative investigation into themes revealed in logbook and survey data [21]. The COREQ checklist structured our analysis and reporting [22]. A purposive sampling technique was used to select key informant interviewees; at least two consultants, a nurse, and residents from each postgraduate year were included from each department. Input from the academic leadership was also sought. Interviewees were either

contacted via email or approached face-to-face to schedule the interview. All interviews were conducted in-person on hospital campuses or in respective staff offices jointly by F.C.R. (female, American medical student) and Z.M. (male, Rwandan medical student) in English with verbal Kinyarwanda interpretation upon request. Consent was obtained and interviews were audio-recorded and transcribed; one interviewee declined audio-recording but allowed contemporaneous field notes of his responses. Two trainees declined participation due to preoccupation with clinical duties. Participants were recruited until thematic saturation was achieved—at which no new relevant knowledge was obtained by the addition of more interviews [23].

Data analysis

Descriptive statistics were used to summarize logbook data and survey Likert-scale scores. Interview transcripts were coded with Nvivo technology and analyzed using grounded theory methodology to derive themes; themes were not identified in advance [24]. Transcripts were not returned to participants for comment and/or correction. Quotations from individual interviewees were used to illustrate and support the broader findings.

Results

Logbook review

A total of 209 laparoscopic procedures were completed (July 2014–June 2015). Fifty-seven (27.3%) were general surgery cases, and 152 (72.7%) were ob/gyn. The majority (58.9%, 125/209) was performed at the private hospital, KFH. In general surgery, the mean patient age was 40.9 years (standard deviation, 12.8) and patients were predominantly female (M:F 1:4.7). KFH performed the highest percentage of cholecystectomies laparoscopically (82.6%, 38/46; Table 1). Of these, 89.5% were performed by one surgeon. One case required conversion to laparotomy. At RMH, 12 of 80 cholecystectomies (15%) were completed laparoscopically by two surgeons. At CHUK, seven (25.0%) of 28 cholecystectomies were performed laparoscopically, all by one surgeon who began operating during the final months of the study. The general surgery department in Butare (CHUB) did not record any laparoscopic procedures despite functional equipment; no general surgeons were trained in laparoscopy. The total number of open cholecystectomies at CHUB could not be elucidated since many cases were recorded as “laparotomy” without specification.

In ob/gyn, the mean age was 33.1 years (SD 7.1). The majority of laparoscopic surgeries were performed at KFH ($n = 87$). Thirty-one laparoscopic ob/gyn cases were performed at CHUB, 30 at RMH, and four at CHUK. The most frequently listed procedure indications were diagnosis and exploration for primary or secondary infertility.

Online survey

Thirty-five individuals completed the survey: 20 of 24 surgery residents (79.2%), eight of 26 general surgical consultants (21 in Kigali City Province, 5 in Southern Province; 30.8%) [25], five of 50 ob/gyn residents (14.0%), and two ob/gyn consultants. General surgery participants showed the greatest interest in diagnostic (71.4%, $n = 28$), cholecystectomy (71.4%) and hernia repair (64.3%; Fig. 1). Ob/gyn respondents showed a high interest in laparoscopy overall, with more interest in gynecologic procedures than obstetric (100% vs 71.4%, $n = 7$).

When asked to identify the single most significant barrier to laparoscopy use, 65.7% of respondents listed the dearth of trainers. When barriers were ranked on a 10-point scale—10 being the most significant barrier—lack of trainers scored highest (mean 8.48, SD 2.81; Fig. 2). Respondents also perceived limited access to videos or training courses (mean 8.15, SD 2.83), and access to training equipment/simulation (mean 7.74, SD 3.35) as significant obstacles. Cost, equipment, material supplies, and patient preference were perceived as less significant barriers.

Table 1 A total of 209 laparoscopy procedures were completed between July 2014 and June 2015

	Hospital				Total
	KFH	CHUK	CHUB	RMH	
Total laparoscopy cases	125	11	31	42	209
General surgery	38	7	0	12	57
Ob/Gyn	87	4	31	30	152
Total cholecystectomies	46	28	a	80	154 ^a
Open	8	21	a	68	97 ^a
Laparoscopic	38	7	0	12	57

The distribution of caseload across hospitals and departments is depicted numerically

CHUB Centre Hospitalier Universitaire de Butare, CHUK Centre Hospitalier Universitaire de Kigali, RMH Rwanda Military Hospital, KFH King Faisal Hospital

^aData on open cholecystectomy cases not available at CHUB

Fig. 1 Interest in various laparoscopy procedures. Results from a survey of 35 Rwandan residents and consultants in general surgery and ob/gyn

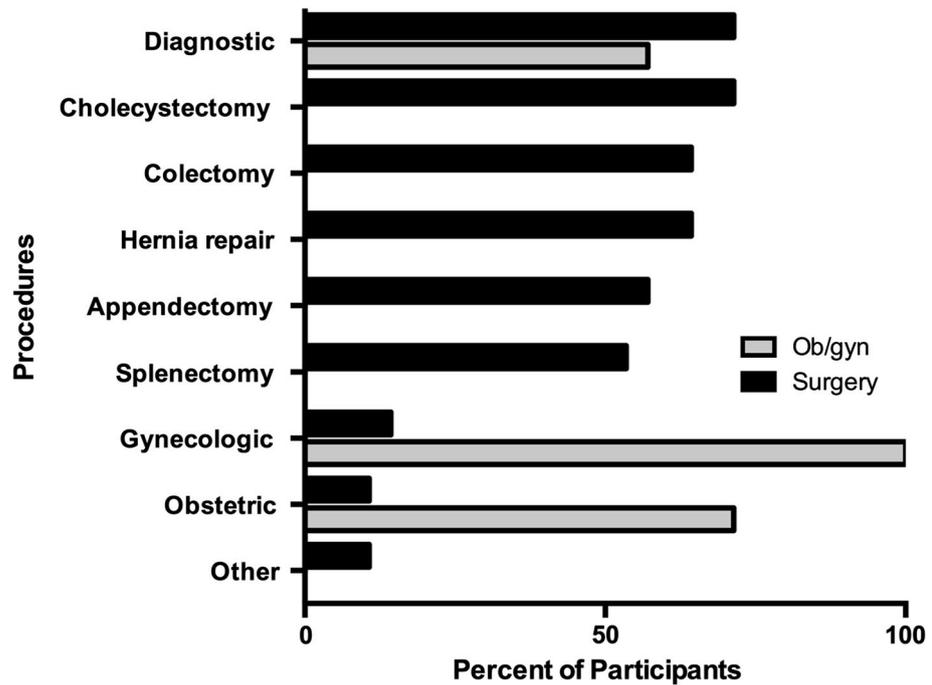
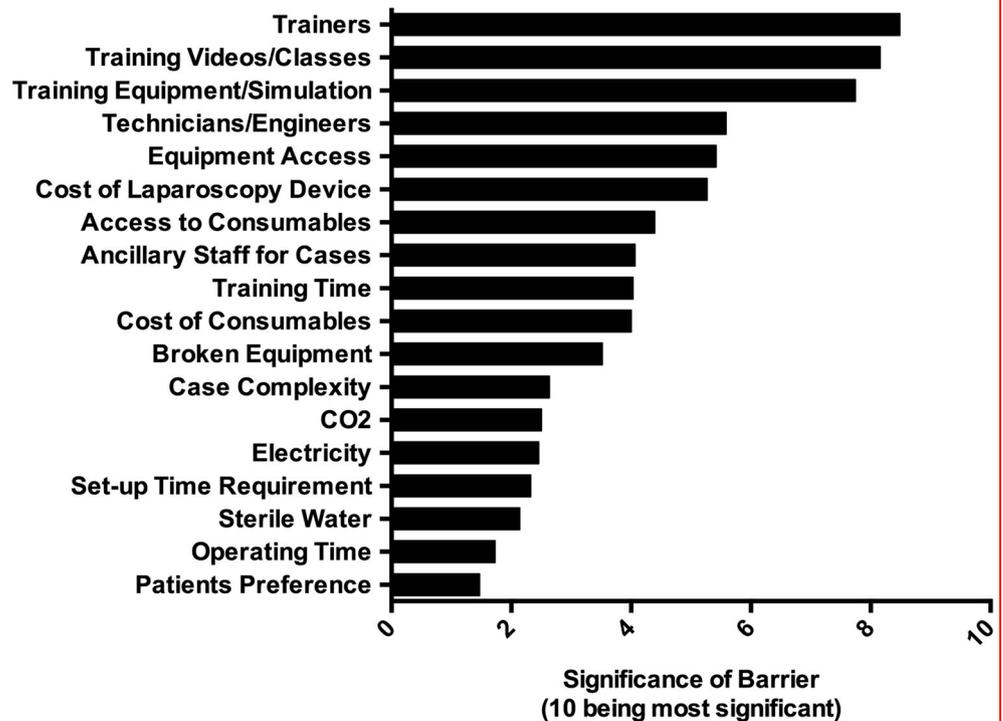


Fig. 2 Perceived barriers to laparoscopy utilization in Rwanda. Results from a survey of 35 Rwandan residents and consultants in general surgery and ob/gyn



Interviews

Twenty-two interviews were conducted. Participants from general surgery included three consultants who routinely perform laparoscopy, two consultants who do not perform

laparoscopy, eight general surgery residents, and a laparoscopy nurse. From ob/gyn, two consultants, four residents and a nurse were interviewed. The medical school Dean and Deputy Dean were included in the above sample. Three themes emerged: substantial interest in laparoscopy,

insufficient laparoscopy exposure during and after post-graduate training, and demand for experienced trainers.

In the department of surgery, two of three Rwandan consultants performing laparoscopy obtained training abroad (Germany, Belgium), while one trained in Rwanda through the HRH program. All three received supplemental teaching via visiting-surgeon workshops in Rwanda. All eight surgery residents expressed interest in laparoscopy, and the majority reported insufficient laparoscopy exposure (1–2 months during residency, mostly camera navigation, and < 30 min of simulation). All requested that laparoscopy become part of the formal curriculum. Three residents argued that laparoscopy is the gold or international “standard” for many conditions. “Even patients are requesting more laparoscopy than open surgery, and it is an international standard, if I can say. So everyone should be familiar with how to do it because it is replacing open [surgery] in many ways [surgery trainee 8].” Residents wanted to “apply what is advised in textbooks [surgery trainee 1].” Multiple residents commented on laparoscopy being the “*future of surgery*” and one articulated: “We are not supposed to be doing what the world was doing 15 years ago. We want to be current [surgery trainee 5].”

Academic leaders admitted that resident exposure was minimal, and attributed that to an absence of a dedicated curriculum and few trainers. One consultant said that nearly all Rwandan surgeons and residents desired to learn more laparoscopy, and stated: “You don’t want to go barefoot when you know there are shoes [surgery consultant 4].” One administrator emphasized the importance of incorporating laparoscopy into the curriculum, but also recognized that “there is limited time for elective surgery... emergencies take priority.” Unanimously, all members from the Department of surgery reported a demand for trainers. The medical school Dean stated, “We need some champions and we need some experts to come and train us. I seek experts from all over the world to come” [ob/gyn consultant 1].

Within the ob/gyn department, all four interviewed residents reported interest and more experience with laparoscopy than their general surgery colleagues. While residents observe, assist, and occasionally perform laparoscopy themselves, this is mostly limited to diagnostic laparoscopy. A paucity of trained consultants prohibits systematic teaching all students equally. They expressed that their confidence in technique remained limited by insufficient time with the few trainers, but noted that materials and cost were not barriers. Many requested a formal simulation course as part of their training. One emphasized: “Laparoscopy is more precise and efficient for conditions such as pelvic inflammatory disease, infertility, and endometriosis, which we see much of [ob/gyn trainee 4].”

For both fields, the laparoscopy-trained nursing staff was often limited to one person per site. One nurse trained in France for 4 months; another, in Rwanda over 5 years of working with visiting ob/gyn teams. Both mentioned the additional responsibility of handling delicate, expensive equipment and requested a formal laparoscopy training and certificate program for nurses.

Discussion

Our study assessed the current utilization of laparoscopy in Rwanda and barriers to more widespread use. The logbook review demonstrated that the majority of healthcare providers using laparoscopy were within the ob/gyn department. Laparoscopy procedures in general surgery were limited to cholecystectomies and were performed by few consultants. Hospitals with functioning equipment were able to successfully conduct laparoscopic operations with minimal need to convert to an open approach. The online surveys and semi-structured interviews underscored that the greatest perceived limitation for laparoscopy use in Rwanda is the number of adequately trained consultants and the lack of a formal trainee curriculum. This corroborates findings of a recent systematic review by Chao et al. [15] that barriers to laparoscopy in LMICs are often trainers and training opportunities. Given that few surgeons are performing laparoscopy at present, and the system is not structured for training residents, there is a risk that surgeon migration or retirement will result in the cessation of institutional laparoscopic use, which has already occurred at CHUB.

The cost-effectiveness of laparoscopy in LMICs warrants further discussion. A recent study at Rwanda Military Hospital demonstrated that when at least 65 cases were performed annually, laparoscopic cholecystectomy resulted in 16% more quality adjusted life years than open surgery [26]. The incremental cost-effectiveness ratio for laparoscopic versus open cholecystectomy was \$4946.18. Furthermore, if the initial equipment purchase was omitted, given that all tertiary hospitals in Rwanda presently have a laparoscopy machine, the cost-effectiveness was even greater. Diagnostic laparoscopy can also be less expensive than CT or MRI scans, which are often unavailable [15, 27]. Finally, adaptive measures can be taken to reduce operational cost, such as reusable equipment, extracorporeal knot tying, syringe suction, homemade endo-loops, mechanical insufflation with room air, and spinal and local anesthesia [15]. Overall, it is predicted that laparoscopy can be cost-effective in Rwanda if performed regularly.

In addition to patient safety and cost-effectiveness, laparoscopy training is important to professional development and motivation. Residents unanimously requested

formal laparoscopy training for the national residency curriculum. The procedures of greatest interest were diagnostic laparoscopy, cholecystectomy and hernia repair. The principle interest in diagnostic procedures likely reflects the technical simplicity and prior knowledge of the procedure given its extensive use in ob/gyn. Its popularity may also result from a unique demand to look inside the abdomen in the setting of limited imaging capabilities and region-specific diseases (e.g., peritoneal tuberculosis) [28]. Importantly, many surgical residents discussed laparoscopy as the standard of care and future of surgery. The consultant's comment "You don't want to go barefoot when you know there are shoes," alludes not only to frustration with the inability to perform desired surgeries, but also points to a common reason for workforce emigration [29]. If there is not an opportunity for trainees to obtain the desired skill set within country, they may seek career opportunities abroad, leading to higher rates of attrition from training, emigration, and "brain drain [30, 31]."

Implementation of large-scale laparoscopy training program in Rwanda will require building human capacity and restructuring medical education. A longitudinal, established approach should be taken for educational courses, and it will be important for the broader surgical community to partner with local teams to "train the trainers." Many have seen success with the SAGES Fundamentals of Laparoscopic Surgery (FLS) program [13, 14, 32, 33]. In Mongolia, more than 315 Mongolian practitioners received laparoscopic training over 9 years (2005–2013), and laparoscopic cholecystectomy surpassed open cholecystectomy as the primary method for gallbladder removal at a national scale [32]. Lectures, workshops, laboratory-based trainers, makeshift trainer boxes, and animal models can be used to build skills outside of the operating room [34–38]. Competency based training with and pre- and post-test evaluations and a designated number of procedures should be required for graduation [39, 40]. Finally, continuing medical education and maintenance of certification will help ensure consistent surgical quality nationwide.

Limitations

Retrospective logbook reviews are susceptible to error, as logbooks are not kept in a standard fashion across hospitals and handwritten logs are prone to inaccuracy or case omission. This may have caused an underestimation of the actual case volume. Additionally, it is unclear whether respondents' identification of cost as a less significant barrier reflects a lack of cost-awareness among interviewees or reflects cost as a non-barrier. If individuals are unfamiliar with the operational details and health system

financing, either is possible. However, the presence of unused, functional equipment and materials at the institutions alludes to cost being a less significant issue. Finally, nursing needs analysis and a detailed cost-effectiveness analysis were beyond the scope of our study.

Conclusion

A paucity of trainers and lack of formal laparoscopy curricula—not cost—were perceived as the most significant obstacles to increasing laparoscopy case volume. The broader surgical community is called to partner with Rwandan teams and other LMICs to expand the current workforce, "train the trainers," and advise on training curricula. A quality surgical education plan should involve simulation, low-cost training adaptations, adequate operative exposure, competency based evaluation, and maintenance of certification. Overall, there is a tremendous opportunity to improve surgical safety, cost-effectiveness, and professional development in Rwanda with laparoscopy. Our study findings invite the surgical community to invest in this form of health system strengthening.

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Compliance with ethical standards

Conflicts of interest Faith Robertson BS, Zeta Mutabazi MD, Patrick Kyamanywa MD, Georges Ntakiyiruta MD, Sanctus Musafiri MD, PhD, Tim Walker MD, Emmanuel Kayibanda MD, Constance Mukabatsinda MD John Scott MD, MPH, and Ainhua Costas-Chavarri MD, MPH have no conflicts of interest or financial ties to disclose.

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