



Assessment of resource capacity and barriers to effective practice of laparoscopic surgery in training hospitals affiliated with the College of Surgeons of East, Central and Southern Africa (COSECSA)

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Abstract

Background The adoption and accessibility of laparoscopy have been serious issues in countries with limited resources, and for varied reasons. This study assessed resource capacity and barriers to the effective practice of laparoscopic surgery in training hospitals affiliated with the College of Surgeons of East, Central and Southern Africa (COSECSA).

Methods A multi-country survey was conducted from January 2021 to October 2021 using a questionnaire distributed to surgeons in COSECSA hospitals located in 16 different countries. Available resources and surgical volume were assessed, and the barriers to routinely performing laparoscopy were determined.

Results Ninety-four surgeons working in 44 different hospitals from 16 countries participated in the survey. The majority of respondents were general surgeons ($n = 75$, 79.7%). Other specialties included urology ($n = 12$, 12.8%) and pediatric surgery ($n = 7$, 7.4%). Senior surgeons accounted for 60.6% of participants, more than 40% had a managerial position and approximately 20% were surgical trainees. Most respondents practiced in public hospitals ($n = 66$, 70.2%). A median of three surgeons per hospital performed laparoscopic surgery with, on average, two laparoscopic towers and two sets of laparoscopic instruments available. A median of 10 procedures was carried out per month. The cost of laparoscopic procedures and laparoscopic consumables were reported as being covered by some health insurance payments in 76.9% and 48.4% of cases, respectively. Cholecystectomy was the most commonly reported laparoscopic procedure performed. The five top barriers to performing laparoscopic surgery were: a lack of consumables, a limited quantity of equipment, a lack of skilled surgeons, the high cost of laparoscopic procedures and complicated cases. In addition, having access to skilled anesthesiologists and anesthesia equipment, carbon dioxide, a consistent electric power supply and equipment maintenance were cited as significant challenges.

Conclusion The practice of laparoscopy is currently limited in COSECSA countries due to a scarcity of skilled staff and the lack of a funding plan to make laparoscopic services accessible. Therefore, policymakers and stakeholders should take strategic measures to respond to this need.

Keywords Laparoscopic surgery · Global surgery · Sub-Saharan countries · Resources capacity · Barriers to laparoscopy

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Global Surgery, as defined by the Lancet Commission, is universal access to safe, affordable surgical and anesthesia care, when needed. Global Surgery saves lives, prevents disabilities and promotes economic growth. However, this is not the reality in Sub-Saharan Africa where 93% of the population have no access to safe, affordable surgical and anesthesia care, when needed [1, 2].

Laparoscopic surgery has revolutionized the practice of surgery in developed countries [3–5]. In essence, it represents a new era of technology-dependent surgical interventions, and to some extent its future progress depends on the development of interventional technologies and devices [3].

Recent studies have demonstrated the adoption of laparoscopy in Low- and Middle-Income Countries (LMICs) to be safe, feasible, and clinically beneficial [6–8]. However, on a worldwide basis, it faces many constraints and several outstanding issues need to be addressed, including the training of qualified staff, the assessment of competence, limited resources and resource allocation, limited equipment and maintenance capacity, lack of safe procedural guidelines and quality assurance [3].

The effort to integrate laparoscopy into the delivery programs of surgical services in low-resource settings has produced varying effects, resulting from the challenges inherent in a complex surgical program [9, 10]. Additionally, the widespread introduction of laparoscopic techniques in developed countries has emphasized the need for adequate training as operations that were straightforward open procedures may require considerable laparoscopic expertise, and this has raised questions about trainee surgeons acquiring adequate training [4].

The College of Surgeons of East, Central and Southern Africa (COSECSA) is a professional organization, founded in 1999, that fosters surgical education and training. The college currently includes 139 accredited hospitals in 14 Sub-Saharan countries: Botswana, Burundi, Ethiopia, Kenya, Malawi, Mozambique, Namibia, Rwanda, South Sudan, Sudan, Tanzania, Uganda, Zambia and Zimbabwe. A hospital is accredited by COSECSA after expressing interest in becoming a training site for surgeon candidates (selected by COSECSA). The organization assesses its capacity in terms of trainers, equipment and infrastructure; and subsequently certifies the hospital to become a COSECSA training site. The mission of COSECSA is to increase the accessibility of surgical services, especially to the rural populations of Africa, by standardizing and widening access to surgical training, skills and knowledge with a mandate to advance the science and practice of surgery in the region [11].

This study aimed to assess the resource capacity and barriers to the effective practice of laparoscopic surgery in the COSECSA accredited hospitals, to determine the gaps and challenges, and to provide recommendations for the improvement of the system for future laparoscopic surgery programs.

Material and methods

Research method and setting

This was a cross-sectional study based on the experience of health professionals. The authors conducted a multinational survey from January 2021 to October 2021 using a structured questionnaire containing numerical scoring and close-ended questions. Open-ended questions were asked to

reveal the challenges and solutions for the practice and safety of laparoscopic surgery in LMICs. The questionnaire was distributed to surgeons in different accredited training hospitals in 16 countries using an online survey form. Implied consent was obtained from all the study participants when they registered on the web-based survey. The COSECSA Institutional Review Board (IRB) (IRB Registration Number: 00011122) approved this study.

Data collection

Questions focused on the capacity of the hospitals in terms of trained staff, equipment, instruments and surgical activities in laparoscopic surgery. The shortfalls, solutions and recommendations were identified in order to analyze the present practice of laparoscopic surgery in the respective hospitals to the widest possible extent.

Data analysis

Data were recorded using Microsoft Excel spreadsheets and exported to International Business Machines (IBM) Statistical Product and Service Solutions (SPSS) software platform version 25 for analysis. Descriptive data were used to generate frequencies and percentages for categorical variables. The median and interquartile range (IQR) were used to describe the central tendency and dispersion of continuous data, respectively.

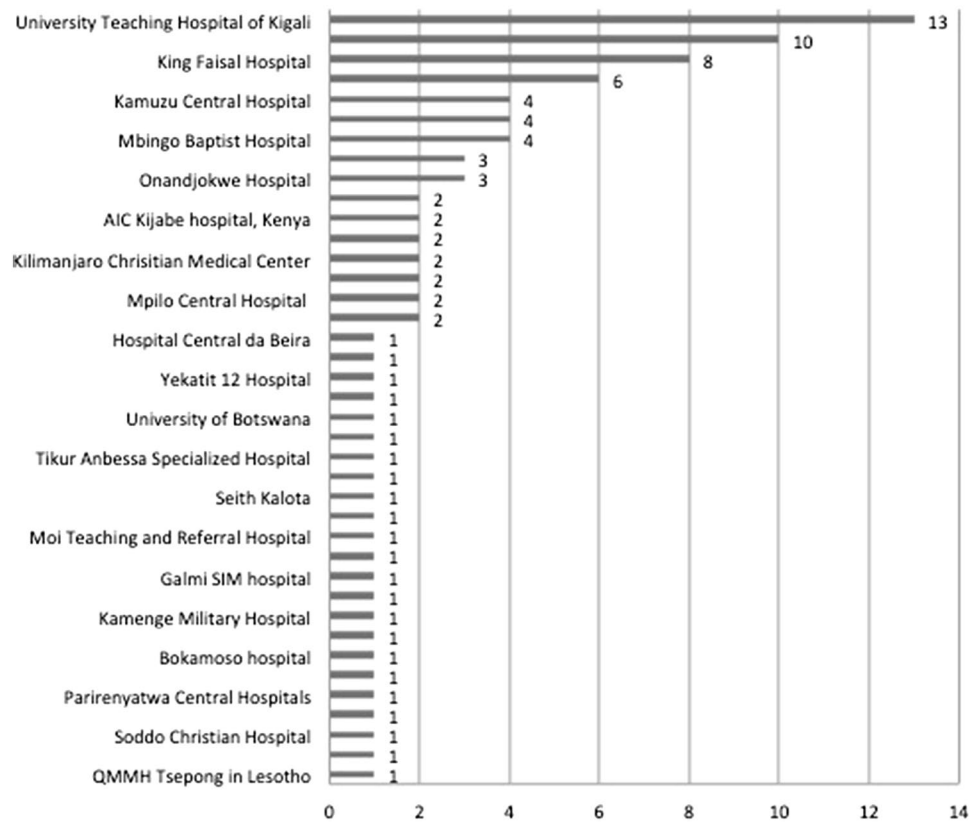
Results

Demographic characteristics

The target population was all Fellows in general surgery, urology and pediatric surgery working in the countries affiliated to COSECSA. The survey questionnaire was distributed to 291 surgeons via the COSECSA fellows email group and 100 (45.7%) responded; however, 6 were excluded due to an excessive lack of information and therefore 94 participants were considered. Interestingly, these participants represented all the countries affiliated to COSECSA (85.7%) with the exception of 2 (Sudan and South Sudan).

A total of 94 surgeons working in 44 hospitals located in 16 countries participated in the survey (Fig. 1). Table 1 shows that the majority of respondents were general surgeons ($n = 75$, 79.7%) and other specialties included urology ($n = 12$, 12.8%) and pediatric surgery ($n = 7$, 7.4%). Senior surgeons accounted for 60.6% of participants, more than 40% had a managerial position and approximately 20% were surgical trainees. In terms of the status of the hospital, the majority of respondents practiced in public hospitals ($n = 66$,

Fig. 1 Number of responders of Hospitals affiliated to COSECSA



70.2%) including 46.8% in university teaching hospitals and 39.4% in referral hospitals.

Hospital resources capacity and surgical volume

According to the respondents, the COSECSA hospitals had a median per hospital of 3 (1–15) surgeons practicing laparoscopic surgery, 2 (1–10) laparoscopic towers, and 2 (1–10) sets of laparoscopic instruments. An average of 10 (1–65) laparoscopic procedures per month was reported (Fig. 2). Regarding the laparoscopic procedures performed within the COSECSA hospitals, the majority of participants ($n=95.6\%$) reported that cholecystectomy is the commonest procedure performed. Considering the other procedures frequently performed, diagnostic laparoscopy (90.1%), appendectomy (80.2%), adhesiolysis (70.3%) and hernia repair (51%) completed the top 5 (Fig. 3). The participants declared that ($n=70, 76.9\%$) of laparoscopic procedures are covered by health insurance, while it only covers ($n=44, 48.4\%$) of laparoscopic consumables (Table 2).

Challenges and barriers to routinely performing laparoscopic surgery

Figure 4 shows the perceived barriers reported by the participants that prevent the routine performance of laparoscopic

surgery. The five top barriers cited included: a lack of consumables ($n=75, 79.8\%$), a limited availability of equipment ($n=70, 74.4\%$), a lack of skilled surgeons ($n=64, 68\%$), patients unable to afford laparoscopic surgery ($n=40, 42.5\%$) and complicated cases ($n=34, 36.2\%$). However, participants agreed, or strongly agreed, that a skilled anesthesia team ($n=29, 30.9\%$), anesthesia equipment ($n=19, 20.2\%$), CO₂ availability ($n=15, 16\%$), a consistent electrical power supply ($n=14, 14.9\%$) and equipment maintenance ($n=34, 45.7\%$) were among the most significant challenges when performing laparoscopic surgery (Table 3).

In terms of recommendations that could ameliorate laparoscopic practice, the participants proposed improvements in three specific areas: infrastructure and equipment (85%), the training of the surgical team (80.2%), and costs with health insurance cover of laparoscopic consumables (24.2%) (Fig. 5).

Discussion

The introduction of laparoscopic surgery in developed countries has revolutionized surgical practice with its superior advantages over open surgery in many surgical disciplines, however, its adoption in developing countries has been sporadic and minimal [4]. Although commonly

Table 1 Hospital and Professional profile of the participants

	n	%
Specialty		
General surgery & subspecialties	75	79.7
Pediatric surgery	7	7.4
Urology	12	12.8
Clinical position		
Senior consultant and above	28	29.8
Consultant	28	29.8
Junior consultant	19	20.2
Surgical trainee	19	20.2
Administrative position		
Hospital director	3	3.2
Clinical director	4	4.3
Program coordinator	18	19.1
Head of department	23	24.5
None	52	55.3
Hospital type		
District teaching	4	4.3
Non-teaching	4	4.3
Provincial teaching	5	5.3
Referral teaching	37	39.4
University teaching	44	46.8
Hospital ownership		
Public	66	70.2
Private	21	22.3
NGO	7	7.4

cited challenges include the apparent lack of resources and trained personnel [4, 5, 9, 10], recent studies have shown that these reported challenges might not be the only significant barriers and further investigations are recommended.

This study aimed at estimating the resource capacity and identifying obstacles to the effective practice of laparoscopic surgery in the COSECSA region. The findings from this multi-country and multicentre survey showed that the resource capacity is insufficient, that the practice of laparoscopy is limited to basic procedures, and that the laparoscopic procedures and consumables are not covered in full by health insurance in different COSECSA-accredited hospitals. Five key barriers emerged from the data: (1) a lack of consumables, (2) a limited amount of equipment, (3) the unavailability of skilled surgeons, (4) unaffordable laparoscopic surgical services and (5) an absence of practice in complicated and advanced cases. Additionally, this study also identified important challenges that have not been adequately addressed in previous research writing on the barriers to the implementation of laparoscopic surgery in LMICs. These include: a lack of skilled anesthesia teams and anesthesia equipment, the reliable availability of CO₂, control of the electrical power supply and equipment maintenance. While the practice of laparoscopic surgery is generally quite limited in the COSECSA region, in some countries, especially in Kenya, minimal access surgery is acceptable to patients, and significantly favorable outcomes have been established in all cases undertaken [12].

The unavailability of skilled surgeons and a limited amount of equipment have been cited as barriers in this study, and these findings have also been reported by many previous authors citing the fact that the lack of appropriate personnel and the high cost involved in acquiring modern equipment are some of the challenges faced by laparoscopic surgery in developing countries [13, 14]. Other studies have reported that the lack of resources and education are only two of the potentially numerous challenges

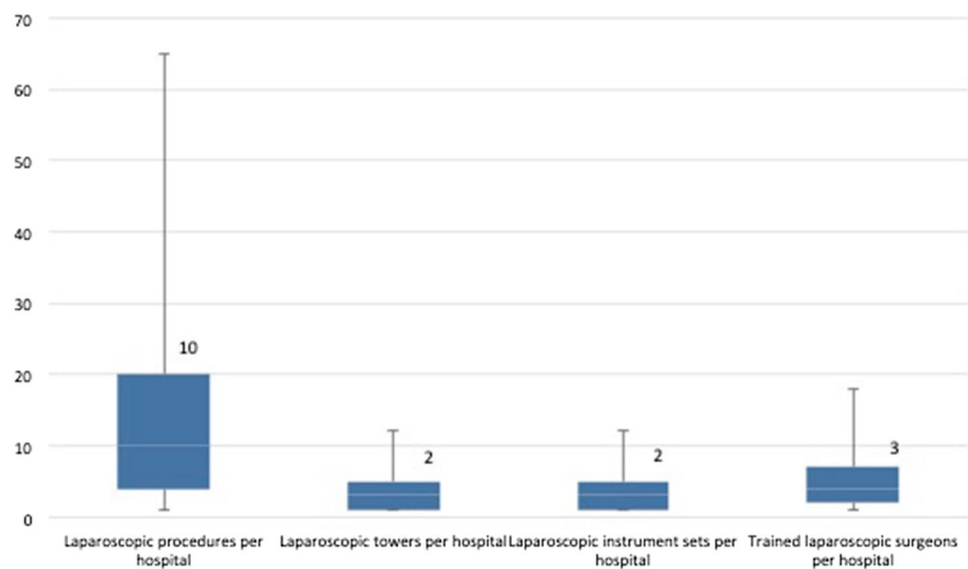
Fig. 2 Resources and performance at the Hospitals of respondents

Fig. 3 Percentage of procedures performed using laparoscopy

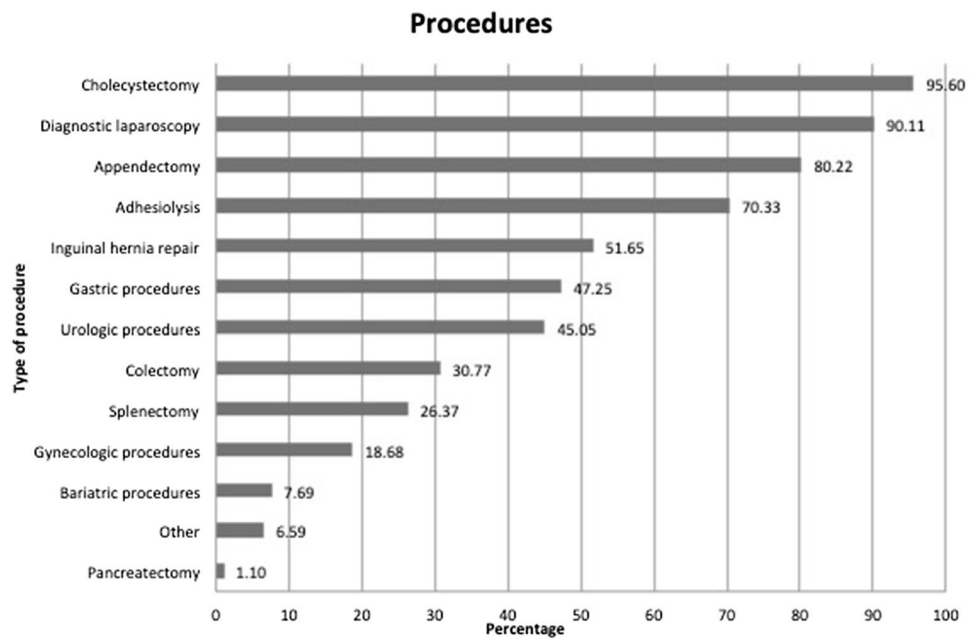


Table 2 Health insurance cover of laparoscopic procedures and consumables

	n	%
Laparoscopic procedures covered by health insurance in the hospital		
No	21	23.1%
Yes	70	76.9%
Laparoscopic consumables covered by health insurance in the hospital		
No	47	51.6%
Yes	44	48.4%

in the complex problem of the adoption of laparoscopic surgery in LMICs [15, 16].

In the literature some surgeons have reported that laparoscopic surgery is not done routinely in complicated cases, as they prefer to perform open surgery due to their lack of expertise in advanced laparoscopic surgery. According to other reports, laparoscopic surgery is a time-consuming approach and surgeons are less willing to practice more technically complicated cases [16], and only a limited number of surgeons perform complex and advanced laparoscopic surgery [17]. It has been reported that the expertise and skills

Fig. 4 Barriers to the routine performance of laparoscopic surgery

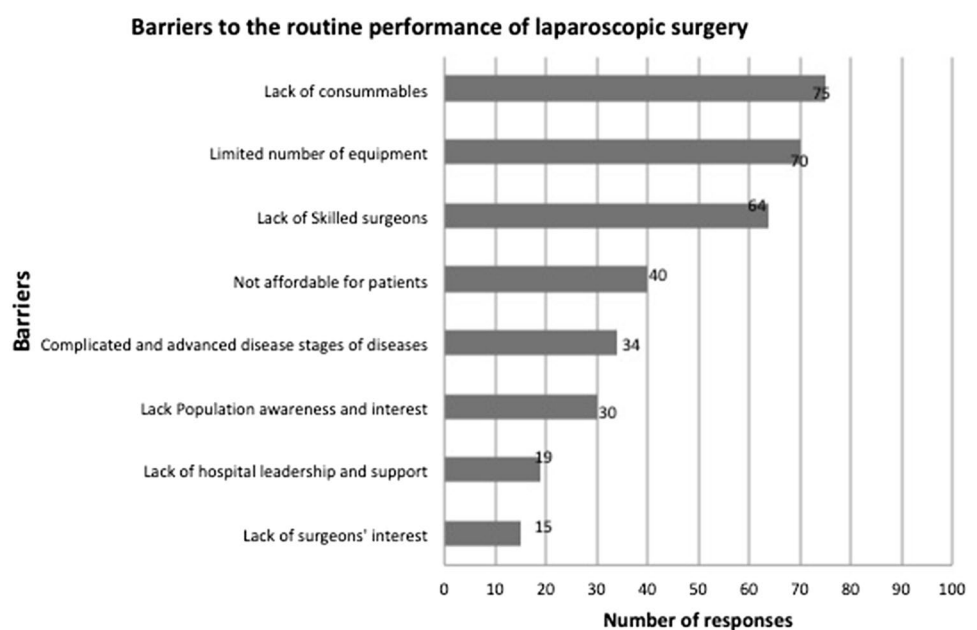
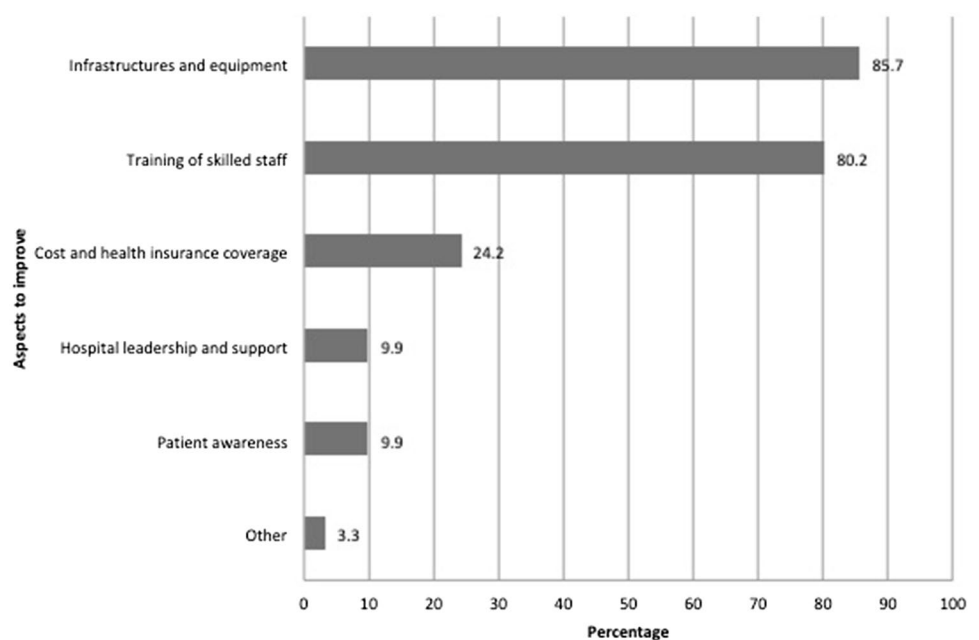


Table 3 Perception of respondents to laparoscopic surgery challenges in their hospital

	n	%
Is shortage of anesthesia-trained staff a concern for the performance of laparoscopic procedures in your hospital?		
Strongly disagree	16	17.0
Disagree	25	26.6
Neutral	24	25.5
Agree	20	21.3
Strongly agree	9	9.6
Is lack of anesthesia equipment a concern for the performance of laparoscopic procedures in your hospital?		
Strongly disagree	20	21.3
Disagree	36	38.3
Neutral	19	20.2
Strongly agree	2	2.1
Agree	17	18.1
Is CO2 availability a problem in your hospital?		
Strongly disagree	22	23.4
Disagree	37	39.4
Neutral	20	21.2
Agree	12	12.8%
Strongly Agree	3	3.2%
Is the electric power supply a problem in the running of surgical activities in your hospital ?		
Strongly disagree	38	40.4
Disagree	42	44.7
Neutral	4	4.3
Agree	10	10.6
Is the maintenance of medical equipment a problem in the running of surgical activities in your hospital		
Strongly disagree	11	11.7
Disagree	19	20.2
Neutral	21	22.3
Agree	33	35.1
Strongly Agree	10	10.6

Fig. 5 Aspects to improve laparoscopic surgery in Hospitals

associated with a change in practice were found to play a greater role in the adoption of laparoscopy than has been reported in the current literature [16].

The high cost of laparoscopic services and the lack of availability of laparoscopic consumables are among the top five barriers cited by the participants in this study, and these findings are similar to many studies that have been carried out in LMICs [18, 19], with some authors questioning whether the benefits are justifiable when even basic supplies are scarce [16]. In many sub-Saharan countries the pricing for the patient and/or for their health insurance separates the cost of surgery, drugs and the consumables or equipment that has been used. For example, in Rwanda the public health system covers a surgical intervention such as “colonic resection” but does not systematically cover laparoscopic staplers if they are used, because they are expensive. Some private health insurance may cover consumables, but only a limited number of patients have private health insurance. However, the economic situation of these countries is not homogeneous and several powerful incentives exist to encourage LMIC hospitals to adopt laparoscopic surgery [10, 16]. Farrow et al. also found that poor access to training, laparoscopic equipment, equipment maintenance and consumables were among the obstacles barring access to laparoscopy in developing countries [17].

Laparoscopic consumables are prohibitively expensive and unaffordable for many patients in developing countries. The results of this study have shown that laparoscopic services and consumables are not fully covered in full by health insurance, and a significant number of COSECSA countries do not have community health insurance to cover these costly procedures and consumables. Even in countries where health insurance covers the services provided, this is done through private health insurance that is equally inaccessible to patients from lower socio-economic classes. This situation requires adaptation strategies for financing including the implementation of policies for community health insurance cover and also strategic partnerships with pharmaceutical firms for cost reduction, thus allowing easier access to services.

The results of this study also show that there are still other challenges that prevent surgeons from embracing laparoscopic surgery in their routine surgery; this includes insufficient anesthesia staff and anesthesia equipment, and the maintenance of medical equipment. It is crucial that the complete surgical team including surgeons, anesthesiologists and nurses, should be trained in the principles and practical aspects of laparoscopic surgery. The practice of laparoscopic surgery requires specialized knowledge and skills for surgeons and nurses, both to work directly with this technological approach and to interact effectively on an interprofessional level with other members of the surgical team [20]. Additionally, the maintenance of laparoscopic

equipment, which requires both additional time and knowledge, discourages surgeons from committing to this technology [16]. Knowledge of the instruments used is essential when performing laparoscopic surgery, therefore the training and practice of laparoscopic surgery in LMICs could be improved and made more widely available through post-graduate medical education [10].

Pneumoperitoneum using CO₂ is known to be common and very essential as a prerequisite to operating safely in laparoscopic surgery. The lack of accessibility to CO₂ has not yet been sufficiently discussed in the literature as being a common obstacle to laparoscopy; it is a costly undertaking in LMICs, and some authors have proposed the development and use of “gasless” laparoscopy in LMICs as an alternative for countries with a shortage [10, 21].

Although sub-Saharan countries face many surgical challenges, laparoscopic surgery is particularly beneficial and can be feasible and safe. However, innovation and coping strategies are required to sustain the practice of laparoscopy in these countries [22] while local adaptation techniques have facilitated cost reduction [23]. There has been an improvement in the acceptance of laparoscopic procedures among patients [23] and surgeons have shown a real need and interest in increasing the implementation of laparoscopic practice in the COSECSA region [17].

Limitations

Two COSECSA countries were not represented in our study, notably Sudan and South Sudan; conversely, Rwanda was over-represented as 15% of the questionnaires were answered by Rwandese surgeons, undoubtedly due to the geographic location of the principal investigator. However, the authors limited this bias by presenting the results as median, as the responses were not symmetrically distributed.

The accuracy of responses cannot be verified as the survey was carried out online. It involved a limited number of hospitals, namely 44, but given that COSECSA has 139 accredited hospitals this is a significant proportion.

Conclusion and recommendations

The practice of laparoscopic surgery in the COSECSA region is currently limited. Common barriers to laparoscopic surgery include unaffordable services and consumables, unavailability of skilled surgeons, a lack of access to appropriate equipment, the inaccessibility of CO₂, and the need for the maintenance of laparoscopic equipment. Taking these issues into account, the best initial targets for intervention to improve access to laparoscopy in COSECSA countries would be the following:

- Capacity building in terms of the surgical workforce (including surgeons, anesthesiologists, nurses, and biomedical engineers) by creating specific laparoscopic training programs and the progressive integration of laparoscopic training in existing postgraduate surgical studies, but also in routine surgical practice.
- Policymakers and hospital administrators should set up innovation and adaptation strategies to support the practice of laparoscopy, by creating a collaborative framework with manufacturers and pharmaceutical companies to facilitate the acquisition of low-cost laparoscopic equipment, instruments, and consumables; to permit affordable access to services but also a clear plan for the maintenance of medical equipment.
- An increase in public and patient awareness of the procedure could also be a driver for the policymakers, showing that there is a demand for the service.

These strategies would improve patient acceptance of laparoscopic procedures and encourage surgeons to adopt laparoscopic practice.

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Declarations

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