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Barriers and Facilitators to Collecting Surgical Outcome Data in Low- and Middle-Income Countries

An International Survey

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Background: Perioperative data are essential to improve the safety of surgical care. However, surgical outcome research (SOR) from low- and middle-income countries (LMICs) is disproportionately sparse. We aimed to assess practices, barriers, facilitators, and perceptions influencing the collection and use of surgical outcome data (SOD) in LMICs.

Methods: An internet-based survey was developed and disseminated to stakeholders involved in the care of surgical patients in LMICs. The Performance of Routine Information Systems Management framework was used to explore the frequency and relative importance of organizational, technical, and behavioral barriers. Associations were determined using χ^2 and ANOVA analyses.

Results: Final analysis included 229 surgeons, anesthesia providers, nurses, and administrators from 36 separate LMICs. A total of 58.1% of individuals reported that their institution had experience with collection of SOD and 73% of these reported a positive impact on patient care. Mentorship and research training was available in <50% of respondent's institutions; however, those who had these were more likely to publish SOD (P = 0.02). Sixteen barriers met the threshold for significance of which the top 3 were the burden of clinical responsibility, research costs, and accuracy of medical documentation. The most frequently proposed solutions were the availability of an electronic data collection platform (95.3%), dedicated research personnel (93.2%), and access to research training (93.2%).

Conclusions: There are several barriers and facilitators to collection of SOD that are common across LMICs. Most of these can be addressed through targeted interventions and are highlighted in this study. We provide a path towards advancing SOR in LMICs.

Keywords: global surgery, surgical outcome data, sustainable development

INTRODUCTION

Perioperative complications lead to nearly 4 million deaths per year worldwide. This exceeds the global annual deaths from HIV, malaria, and tuberculosis combined (2.97 million).[1] While only 6% of all surgical procedures occur in the poorest third of the world, over half of the death and disability resulting from surgical procedures occurs in low- and middle-income countries (LMICs).[2] Additionally significant variability exists in all-cause perioperative morbidity and mortality within

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resource-constrained settings, with adults up to 3 times, and children 7 times more likely to die after emergency abdominal surgery in LMICs compared with high-income countries (HICs).[3–6]

HICs have improved perioperative outcomes through robust surgical quality improvement programs and auditing mechanisms.[7] These programs rely on the systematic collection of risk-adjusted surgical outcome data (SOD). Vast differences in infrastructure, materials, and healthcare workforce capacity make it difficult to translate HIC-based quality improvement initiatives to most LMIC settings.[1] Further, most LMICs lack systems to collect, analyze, and report risk-adjusted SOD.[1] This makes it challenging to employ data-driven methods for surgical quality improvement.

To improve surgical care in LMICs we need a better understanding of the current practices and challenges to collecting SOD. The aim of this study was to evaluate barriers, facilitators, perceptions, and attitudes of key stakeholders towards the collection of SOD in LMICs.

METHODS

We conducted an internet-based survey of stakeholders taking care of surgical patients in LMIC settings. This report is in accordance with the Checklist for Reporting Results of Internet E-Surveys.[8]

Survey Design

The authors (a combination of surgeons, anesthesiologists, administrators, and managers in both high-income and LMIC settings) developed the survey tool. We performed a review of the literature on barriers, facilitators, perceptions, and attitudes toward the collection of surgical outcomes or registry data.[9] We categorized findings using the Performance of Routine Information System Management (PRISM) framework.[10] The PRISM framework leverages the effectiveness and utility of the use of routine health information systems in data collection and analysis. It organizes variables into 3 major components: organizational, technical, and behavioral determinants. Additional input was sought after informal interviews with surgeons, anesthesiologists, nurses, and managers working in LMIC settings. We developed questions for demographics, current practices, barriers, facilitators, attitudes, and resource availability. These questions were designed with help from the University of Wisconsin Survey Center[11] and tested for clarity, focus, and interpretability to be in line with best practices (Supplemental Figure 1, http://links.lww.com/AOSO/A296). The electronic version of the survey was created using Qualtrics software (Qualtrics, Provo, UT). We used branch chains and skip logic to enhance survey efficiency. The survey tool was available in a mobile-friendly browser format. We pretested the final survey on 10 separate stakeholders from LMICs. The study PI interviewed stakeholders and edits were made iteratively to the questions and formatting of the survey design. The instrument was tested for content interpretability/clarity, technical functionality, and ease of use. The survey was translated into French and Spanish by native speakers of the language. The final survey was available in 3 languages. There was a total of 8 pages, other than the consent page with each page containing between 1 and 5 questions. Adaptive questioning was applied based on some responses to "current practices." No randomization of questions occurred.

Eligible Participants

This was a convenience sample of healthcare personnel involved in any part of a surgical patient's care in LMICs. Eligible participants included administrators, anesthetists, anesthesia trainees, clinical officers and resident medical officers, nurses, surgeons, and surgical trainees. Participants were excluded from analysis if they declined consent, answered no survey questions, designated a high-income country as their primary place of work, or did not provide a primary country of work.

Survey Dissemination and Data Collection

This was an open survey. Responses were collected from April 1 to July 31, 2022. Short web links and QR codes were developed for simple access and ease of dissemination. Dissemination was via social media (Twitter, WhatsApp, and Instagram) and directed emails to authors' contacts and collaborators in LMICs and the leadership of surgical, anesthesia and nursing societies in multiple LMICs for dissemination on societal and institutional listservs. Email listservs of the GlobalSurg and American College of Surgeons Operation Giving Back were used. Social media advertisements and emails invited anyone with experience in managing surgical patients in an LMIC setting to participate. All questions were voluntary in nature and no incentives were offered. Participants were able to edit responses with a "back" button before final submission.

Data Analysis

Using unique IP addresses we calculated participation rates. In the final analysis, we included respondents who completed at least one section of the survey beyond the demographics page. IP addresses were used to assess multiple entries and survey responses were compared to remove true duplicates. We performed descriptive analysis using frequencies, means, and proportions. Proportions for the percentage of responses were visually depicted as bar charts. For analysis of barriers answer choices included "not at all," "a little," "somewhat," "very," and "extremely." To determine which barriers were the most relevant we quantified responses in a Likert scale fashion with "not at all" = 1 and "extremely" = 5. A mean value was calculated for each barrier. We designated a mean value of 2.5 as the threshold for categorization as a "relevant barrier" given that it ensures that barriers perceived as more than just a minor concern are considered. A total barrier score was calculated for each participant based on the sum of their Likert scale scores for each barrier question. One-way ANOVA was used to determine associations between these scores and demographics and resources. χ^2 tests were used to determine associations between categorical variables. Country income status was determined according to World Bank 2022 GNI data.[12] Stata/SE 17.0 was utilized for all analyses. Statistical significance was defined as $P < 0.05$.

Ethics and Data Integrity

This study was reviewed by the University of Wisconsin Institutional Review Board and granted an exemption for a minimal-risk survey. Consent was obtained before starting the survey and included the purpose, duration of the survey, investigators' names and contact information, as well as how the data would be stored and used. No personal identifying information was collected. Data from the survey was stored in secure servers with password-protected access only to the study team members.

RESULTS

A total of 513 individuals accessed the survey. Of these, 311 people completed at least one survey section beyond demographics. Of these respondents, 78 were excluded as they responded with a HIC as their primary place of work, 2 for lack of consent, and 2 that did not indicate their country of

practice. The final analysis included 44.6% of individuals who accessed the survey (N = 229) from 36 LMICs. Of the participants, 68 (29.7%) were based in low-income, 105 (45.9%) lower-middle-income, and 56 (24.5%) and upper-middle-income countries (Fig. 1 and Supplemental Figure 2, http://links.lww.com/AOSO/A296). Respondents most frequently belonged to Pakistan (50), Columbia (17), Ethiopia (17), and Nigeria (17). The most common role was a surgeon or surgical trainee (N = 168, 73.4%). Most participants worked in urban (85.9%), public (61.9%), and tertiary care (88.0%) hospitals (Supplemental Table 1, http://links.lww.com/AOSO/A296). A total of 81.2% (N = 186) completed 100% of the survey.

Current Surgical Outcome Research Practices

Over half of respondents, 58.1% (N = 133), stated that their department had a system of collecting SOD. Of these, 30.8% (N = 41) had a paper-based system compared to 69.2% (N = 92) who utilized either an electronic or a mixture of both paper and electronic systems. Only 48.9% (N = 65) of participants that collected SOD had published their work. Most participants (72.9%, N = 97) with the ability to collect SOD reported that clinical care had been modified based on the data (Table 1). Neither publication of data nor use of a paper-based system was associated with hospital characteristics such as size, type (public, private, and military), rurality of location, or level of care ($P > 0.05$).

Facilitators

Mentorship and accessibility of research training were important facilitating factors; however, these were present less than 50% of the time (Fig. 2). Participants who reported having access to research training were more likely to publish results from their SOD ($P = 0.02$). Most participants (86.7%) responded that healthcare providers in their department had little or no protected time for research.

Resources

Computers were available at 92.2% (N = 176), Institutional Review Board at 74.4% (N = 142), and reliable internet connectivity in 69.6% (N = 133) (Fig. 3). Four key resources were found in less than half of the participant institutions: statistical support (48.2%, N = 92), access to a wide range of medical journals (46.1%, N = 88), a system for secure data storage (39.3%, N = 75), and dedicated research space (30.9%, N = 59). A minority (13.3%, N = 16) of participants reported that their departments received external funding for surgical outcome research (SOR).

Higher access to resources was associated with hospital setting and size (number of beds). Specifically, urban hospitals had better access to a range of medical journals compared to suburban and rural hospitals (50.6% vs 26.7% vs 0%, $P = 0.02$) and with librarian support (57.9%, 40.0%, 9.1% respectively, $P = 0.04$). Larger hospitals had better access to Institutional Review Board, librarian support, and more research mentorship ($P < 0.05$). Receipt of external funding was associated with improved access to resources including librarian support, systems for secure data storage, access to a range of medical journals, and dedicated research space (Supplemental Figure 3, http://links.lww.com/AOSO/A296). The presence of research space (72.3% vs 56.7%, $P = 0.019$) and a system for secure data storage (72% vs 51.9%, $P = 0.014$) were associated with a higher proportion of departments collecting SOD.

Barriers

Sixteen barriers were reported to be "relevant" (Fig. 4). Clinical responsibility had the highest average response score (3.73) followed by research-related costs (3.56) and accuracy of medical documentation (3.45). We found that the availability of protected time ($P = 0.027$) and research mentorship ($P = 0.003$) was associated with lower barrier scores.

Perceptions and Attitudes

Amongst participants who reported having a system of data collection in place most thought that SOR was valuable and necessary for data-driven decisions. Most (90.0%) participants were interested in SOR even without compensation. Few participants thought that SOR was a waste of time (Supplemental Table 2, http://links.lww.com/AOSO/A296). Results of participants reporting no system of data collection were similar (Supplemental Table 3, http://links.lww.com/AOSO/A296).

FIGURE 1. Map showing primary country of work for responders. Responses by country are on a spectrum. Values in increments of 10 are shown in the legend.

TABLE 1.

Current Practices of Institutions That Collect Surgical Outcomes Data

Question Current Practices	No. (%) of Respondents*
How many years has your department been collecting data? (N = 133)	
Less than 1	13 (9.8)
1–5	39 (29.3)
6–10	25 (18.8)
More than 10	56 (42.1)
What platform does your system use for data collection? (N = 133)	
Paper-based	41 (30.8)
Electronic	25 (18.8)
Mix of paper and electronic	67 (50.4)
How often is your surgical outcomes data reviewed? (N = 133)	
Weekly	9 (6.8)
Monthly	52 (39.1)
Quarterly	18 (13.5)
Twice a year	12 (9)
Annually	19 (14.3)
Less than annually	3 (2.3)
Don't know	20 (15)
Have you published results from your surgical outcomes? (N = 133)	
Yes	65 (48.9)
No	68 (51.1)
Has your department modified clinical care based on collected outcomes? (N = 133)	
Yes	97 (72.9)
No	7 (5.3)
Don't know	29 (21.8)

*For each question, percentages are based on the number of respondents.

workshops (93.2%), additional research resources (grant support, statistical software) (91.1%), academic institutional partnerships (91.1%), and digital health interventions (89.0%) (Fig. 5). On free text responses, recurring themes included improved access to quality mentorship (N = 5), national policies to encourage data collection such as mandated reporting or national surgical outcome registries (N = 13), improved compensation or incentive structures for individuals performing research (N = 9), and protected research time for physicians performing research (N = 6).

Effect of Country Income Level

Countries at higher income levels reported more resource availability including computers, internet connectivity, access to a range of medical journals, and a system for secure data storage (Fig. 6, $P < 0.05$). Income level was also associated with the system for data collection, with a completely electronic system available in 42.4% of low-income countries, 51.6% of lower-middle-income, and 57.1% of upper-middle-income countries ($P = 0.002$, Supplemental Figure 4, http://links.lww.com/AOSO/A296). Income level was not associated with perceived barriers, solutions, or perceptions (all $P > 0.05$).

DISCUSSION

In this survey of 229 key stakeholders from 36 LMICs, we identified several barriers, facilitators, and potential solutions to SOR in LMICs. We observed substantial homogeneity in our responses, demonstrating common challenges and solutions across countries and regions. Identified barriers spanned the different aspects described in the PRISM framework, including technical requirements (costs, data platform), behavioral (local interest), and environmental (clinical responsibility). Similar findings have been published in regard to the use of routine

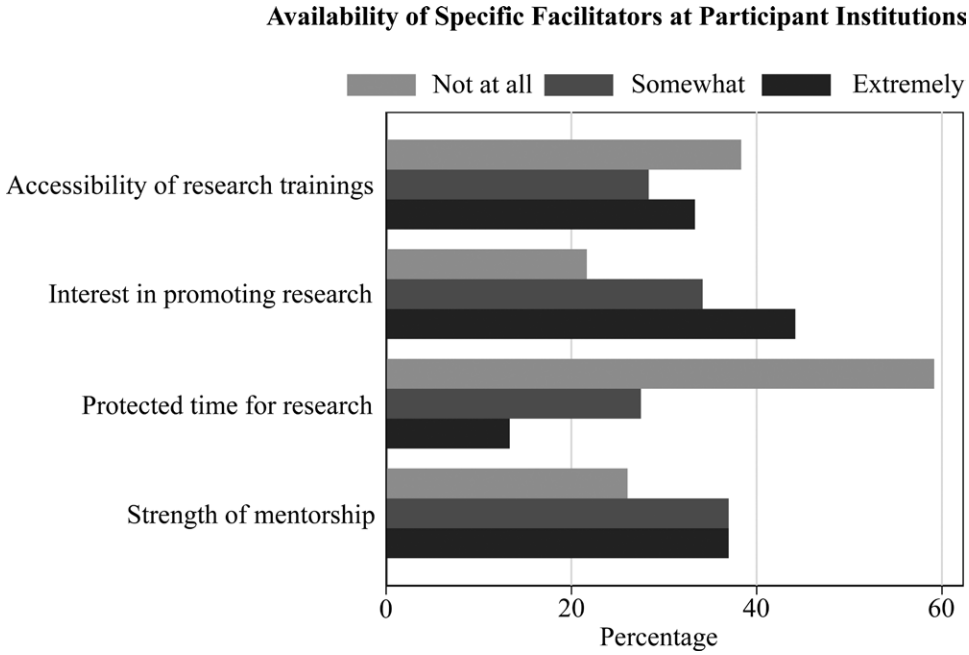

FIGURE 2. Bars represent the percentage of applicants answering "Not at all," "Somewhat," or "Extremely" to having specific facilitators available at their institution or department.

Solutions

The most frequently suggested solutions were the availability of an electronic data collection platform (95.3%) followed by dedicated research personnel (93.2%), training sessions and

health information systems in LMICs.[13] We demonstrate that SOR is considered important and can be used to modify clinical practice. Keys to enhancing SOR in LMICs include the

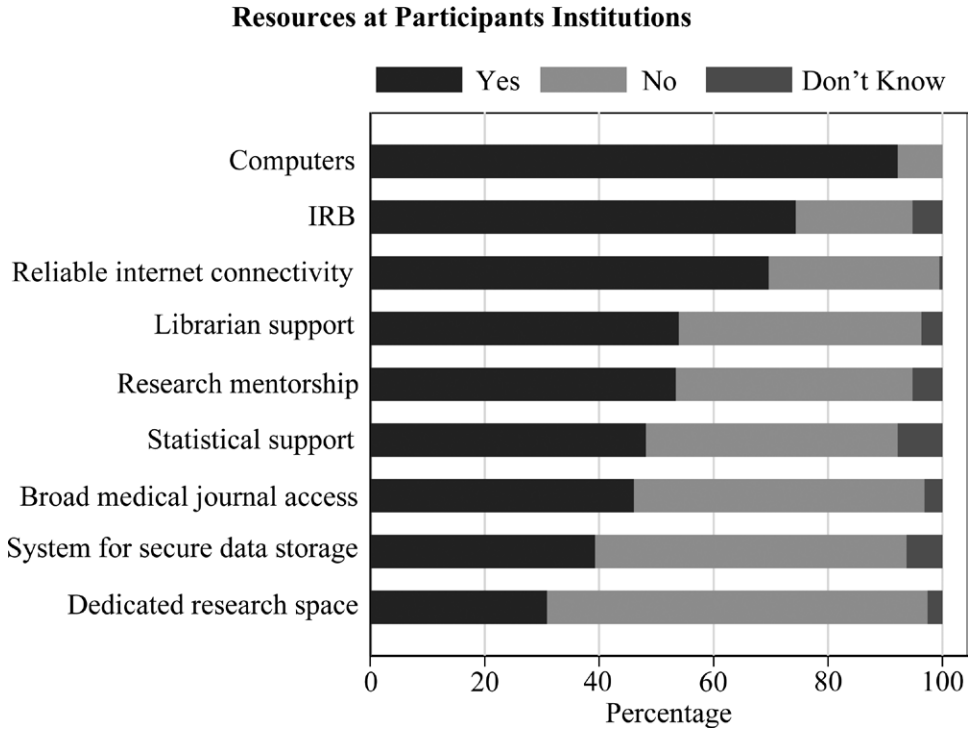

FIGURE 3. Bars represent the percentage of applicants answering "Yes," "No," or "Don't Know" to the availability of different resources at their institution or within their department.

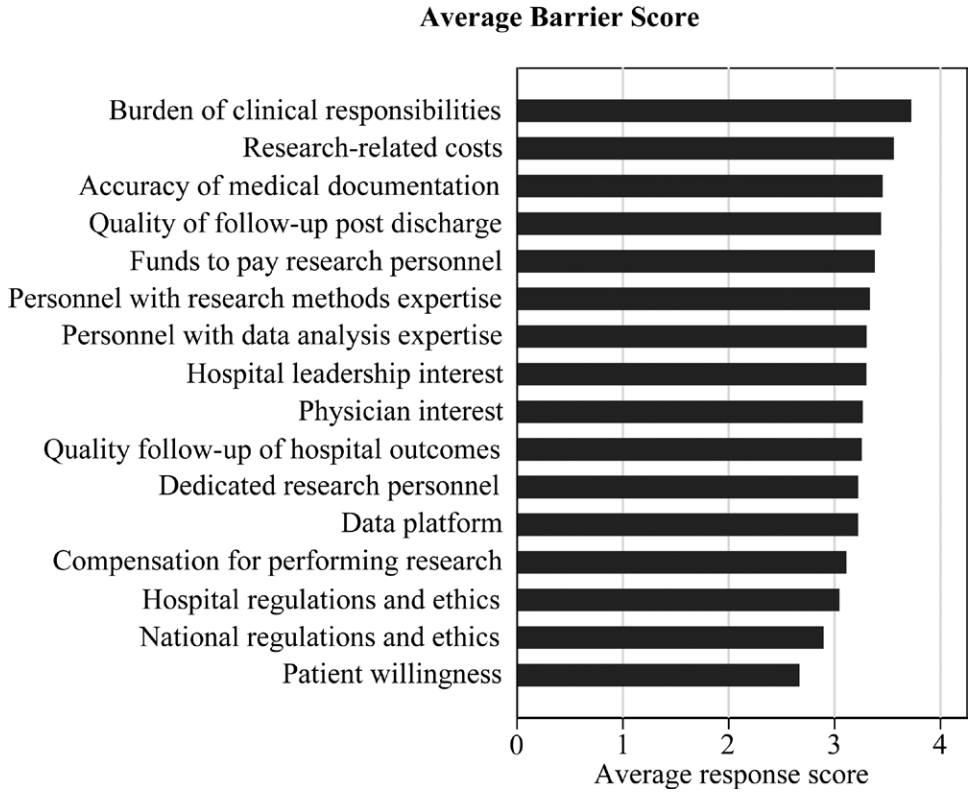

FIGURE 4. Average score is given to each barrier from participants.

availability of dedicated research personnel, electronic systems for standardized data collection, protected time for research, and enhanced research training and mentorship. Several of these can be achieved with strategic partnerships using minimal resources.

As previously shown, barriers to SOR are multifactorial. While no single intervention exists to cover all barriers, some thoughtful targeted solutions can be inferred from this work. A common issue was the presence of a secure data storage system for the collection of SOD. We found that the presence of

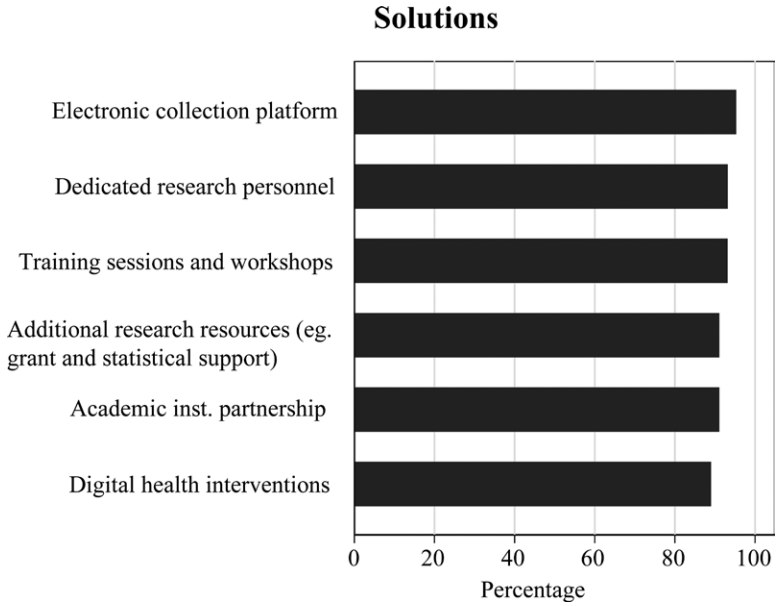

FIGURE 5. Bars represent the proportion of respondents who agreed that the solution presented would be beneficial.

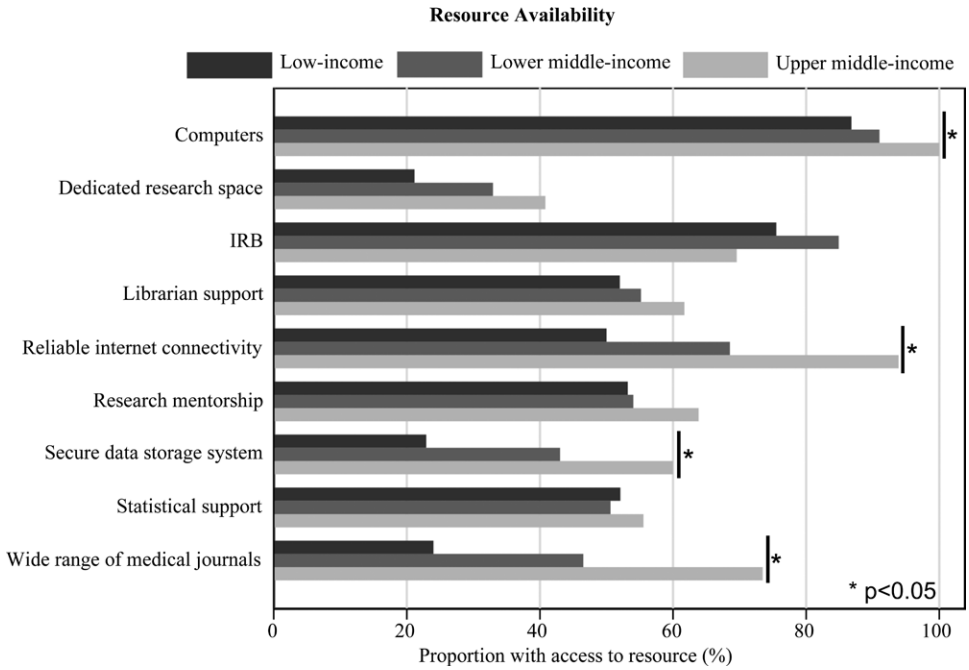

FIGURE 6. Effect of country income level on resource availability.

such a system was associated with increased collection of SOD. Additionally, the most popular proposed solution was creating an electronic data collection platform. This suggests that the implementation of electronic systems for data storage may be a promising intervention in LMICs. With modern cloud computing technology, and mHealth-based data collection software these solutions are very possible, even with limited resources.[14] For example the Research Electronic Data Capture (REDCap) system has been utilized in a number of LMICs.[15] REDCap is a secure, web-based software utilized for database creation and management.[16] With REDCap 1 can collect data through a mobile device without internet access. Data can then be uploaded at a later date. Another area of potential intervention identified through the survey is formal research training for faculty and residents in SOR methodology and quality improvement. In our study, we found that in departments that collected data, the presence of research training increased the odds of publication. While this is just 1 form of output from data collection it aligns with other studies that show that data collection can have an immediate impact on scientific output.[17]

While outcome research for general surgery has been sparse in LMICs, other fields have leveraged this data to take strides in improving quality of healthcare in under-resourced areas. For example, in 2007 the International Quality Improvement Collaborative for congenital heart surgery was founded in Pakistan to collect outcome data and guide quality improvement efforts in LMICs. One study found that implementation of the International Quality Improvement Collaborative decreased surgical site infections and sepsis from 30% to 1% and mortality decreased from 9% to 6%.[17] While the feasibility of outcomes

research in LMICs is often questioned, some groups have shown that multinational and multi-institutional collection of surgical outcomes in LMICs is feasible.[18] Further, in our study we found that 72.9% of participants whose departments collected SOD modified clinical practice based on this data, highlighting the impact that SOR can have on the medical system. Overall, perceptions towards SOR were very positive. A high proportion of positive attitudes is likely a result of some selection bias inherent to such survey-based study designs. However, our previous review also found that 75% of surgical researchers were motivated to take part in SOR.[9] There is increasing awareness of the value of SOR amongst surgical researchers in LMICs and a willingness to promulgate it further. This is critical as it suggests that physician willingness is likely not the rate-limiting step for improving SOD collection.

The results of this study should be understood in the context of its limitations. First, self-selection bias is a concern when utilizing a survey-based approach. Providers who are more likely to have positive attitudes towards SOR are more likely to complete the survey. The positive perceptions and attitudes are likely overstated in our survey. Second, it is possible that multiple people from the same hospital responded to the survey, and results may be skewed towards these hospitals with multiple responses. Third, convenience sampling was employed, which can further lead to selection bias. However, we have a high number of responses from a diverse set of countries, and we consider the impact of this bias to be small. Most responses were from urban tertiary centers and results and smaller rural hospitals are under-represented and may have a separate set of challenges and potential solutions. Finally, most respondents to the survey were surgeons from tertiary care centers; thus, the results of this study may not be generalizable to the experience of other professionals such as data collectors, reporters, or administrators.

In conclusion, this study is the first large-scale survey of stakeholders in LMICs regarding SOR. Our study shows that while perceptions and attitudes are positive towards SOR, notable challenges include clinical responsibilities, cost, and documentation accuracy. Stakeholder buy-in, electronic documentation and data management systems, and strategic loco-regional and global partnerships can help drive surgical research capacity and data collection despite the monetary challenges faced. Implementation of data collection systems should be developed within the geographic context and tailored through the lens of local barriers.

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