

Systematic Review of Surgical Literature from Resource-Limited Countries: Developing Strategies for Success

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Abstract

Background Injuries and surgical diseases are leading causes of global mortality. We sought to identify successful strategies to augment surgical capacity and research endeavors in low-income countries (LIC's) based on existing peer-reviewed literature.

Methods A systematic review of literature from or pertaining to LIC's from January 2002 to December 2011 was performed. Variables analyzed included type of intervention performed, research methodology, and publication demographics such as surgical specialty, partnerships involved, authorship contribution, place and journal of publication.

Findings A total of 2049 articles met the inclusion criteria between 2002 and 2011. The two most common study methodologies performed were case series (44 %) and case reports (18 %). A total of 43 % of publications were without outcome measures. Only 21 % of all publications were authored by a collaboration of authors from low-income countries and developed country nationals. The five most common countries represented were Nepal (429), United States (408), England (170), Bangladesh (158), and Kenya (134). Furthermore, of countries evaluated, Nepal and Bangladesh were the only two with a specific national journal.

Interpretation Based on the results of this research, the following recommendations were made: (1) Describe, develop, and stimulate surgical research through national peer-reviewed journals, (2) Foster centers of excellence to promote robust research competencies, (3) Endorse partnerships across regions and institutions in the promotion of global surgery, and (4) Build on outcome-directed research.

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Introduction

A substantial gap exists between surgical need and surgical service delivery in resource-limited settings. It is estimated that of the 234 million operations undertaken every year worldwide, only 3.5 % are performed in the care of the world's poorest which constitutes one third of the world's population [1]. This glaring disparity between the burden of surgical disease and existing surgical capacity in the resource-limited countries will make it impossible to achieve some of the millennium development goals and the lofty aspiration of the post-millennium development challenge. Multi-faceted approaches have been used to address this problem, ranging from providing surgical care by on-site surgical "missions" and clinical activity to more robust and more sustainable capacity building initiatives through educational and research endeavors by North–South partnerships [2–5].

Local home-grown improvements are primordial to surgical development as they are implemented and developed by those who truly understand the local environment, existing gaps, and the most efficient interventions necessary to address these gaps. In Ethiopia, the study and understanding by local researchers of the practices of local bone-setters lead to educational workshops which decreased gangrene incidence [6]. Nepalese researchers demystified the notion that advance surgical techniques are not suitable for LICs when they found that laparoscopic inguinal hernia repair was found to be as safe as traditional methods in their settings [7]. The LICs literature has numerous examples of local home-grown effort geared to improve capacity, and often, it is such leadership that will ensure the sustainability and success of such programs [8].

Peer-reviewed literature plays an important role in informing the design and development of global health. It promotes the understanding of recent trends and activities, dissemination of quality assessment and improvement measures through critical evaluation of practice algorithms and processes, identification of further interventions, and provision of networking opportunities. The result is enhanced individual and institutional competencies and ability to participate in related activities in a professional fashion with improved opportunities to address some of the challenges of global health.

The aim of this study was to evaluate the peer-reviewed global surgery literature relating to resource-limited settings to provide a glimpse at the processes by which these challenges are tackled: the design of intervention published (research, educational, and clinical), the quality of the research methodology, and paper demographics (partnerships involved, contributing institutions, location of study, place of publication). Based on the above analysis, we then sought to identify the challenges and successes in

providing recommendations for successful strategies to augment surgical capacity and research endeavors in resource-limited countries.

Methods

A systematic review of the literature was done to survey surgical endeavors implemented in resource-limited countries, specifically low-income countries (LIC). The preferred reporting items for systematic review and meta-analysis (PRISMA) flowchart and checklist were used to facilitate data reporting [9]. PUBMED was used to query the following key words: country's name, developing world, resource limited, under resourced, third world and surgery. Other searches were done with the cross-referencing method of selected papers. Countries included in the study were classified by the World Health Organization (WHO) [10] and by the World Bank [11] as having a gross national income per capita equal or less than 1025US\$ as of July 1st 2012. Papers included in the review qualified for all of the following criteria: pertaining to a LIC, pertaining to surgery or its subspecialties, published from January 1st 2002 to December 2011, written in French or English. The data were extracted independently by two investigators who surveyed the abstracts and papers of the search for inclusion in the review.

The items collected from the papers were publication demographics, epidemiologic methodology, outcomes measures, design of intervention, and type of partnership and sponsoring entities (Table 1).

The principal summary measure was a difference in means with a statistical significance defined as $p = <0.05$. Excel was used for data analysis for statistical significance using with Fisher's exact test.

Role of the funding source

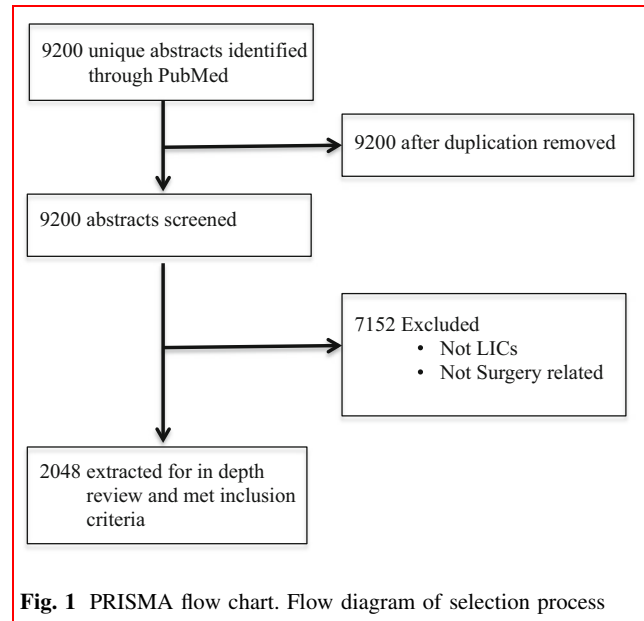
There was no outside funding source for this review.

Results

For the target period of 2002–2011, 9200 papers were identified through the database search. There were no additional records identified through other sources. Of the 9200 papers screened, 7152 were excluded based on pre-determined criteria. Papers that did not pertain to LICs and surgery and its subspecialties were excluded. A total of 2048 papers were included in the qualitative synthesis following the PRISMA flowchart. (Fig. 1) The papers that met the inclusion criteria were published in 460 peer-

Table 1 Data: collection variables for the study

Data collected
Publication demographics
Year of publication
Donor/sponsor nation
Host nation
Location of study
Origin of contributing authors
Journal of publication
Epidemiologic methodology
Review
Personal reflection
Case report
Case series
Cross-sectional study
Cohort
Randomized controlled trial
Cluster sampling and surveys
Cost analysis
Outcome measures
Evaluation of an intervention
Evaluation of an operator's performance anceperformance
Educational assessment
Patient outcomes
Economic evaluation
Design of intervention
Education
Research
Clinical
Surgical subspecialty
Anesthesia
Cardiac surgery
Dentistry
ENT/OMF
General surgery
Obstetric & gynecology
Ophthalmology
Orthopedic surgery
Plastic surgery
Neurosurgery
Urology
Trauma
Partnerships and sponsoring entities
Universities
Non-governmental organization
Governmental organization
Army ^a
Industries

^a Represent global military entities

reviewed journals around the globe. The papers were grouped by design of intervention performed and the majority were clinical papers (87 %), followed by research papers (11 %) and education papers (2 %).

The majority of studies performed in LIC were case series (45 %, $n = 918$) and case reports (18 %, $n = 370$), (Fig. 2). Randomized controlled trials (5 % $n = 93$), cohort studies (3 % $n = 52$), and cost analysis (1 %, $n = 24$) were among the research methods least utilized. A total of 43 % of publications were without outcome measures. Of the papers measuring outcomes, patient outcomes (88 %) was the most evaluated result, followed by evaluation of an intervention (6 %), economic evaluation (3 %), operator's performance (3 %), and educational assessment (1 %).

The different specialties represented are outlined in Fig. 3. The five most common specialties with surgical publication in the LICs were general surgery (28 %, $n = 564$), obstetrics and gynecology (14 %, $n = 283$), ophthalmology (11 %, $n = 218$), orthopedic surgery (10 %, $n = 196$), and ear nose and throat (8 %, $n = 160$). There was an upward trend in the absolute number of publications per specialty other than obstetric and gynecology, orthopedic surgery, anesthesia, cardiac surgery, and dentistry over the 10 evaluated years. General surgery, trauma, and plastic surgery exhibited the most increase in publication over time.

The origin of authors who conducted the research in LICs is depicted in Fig. 4. The five most common countries represented were Nepal (429), United States (408), England (170), Bangladesh (158), and Kenya (134). Authors from the four most common research producing LICs

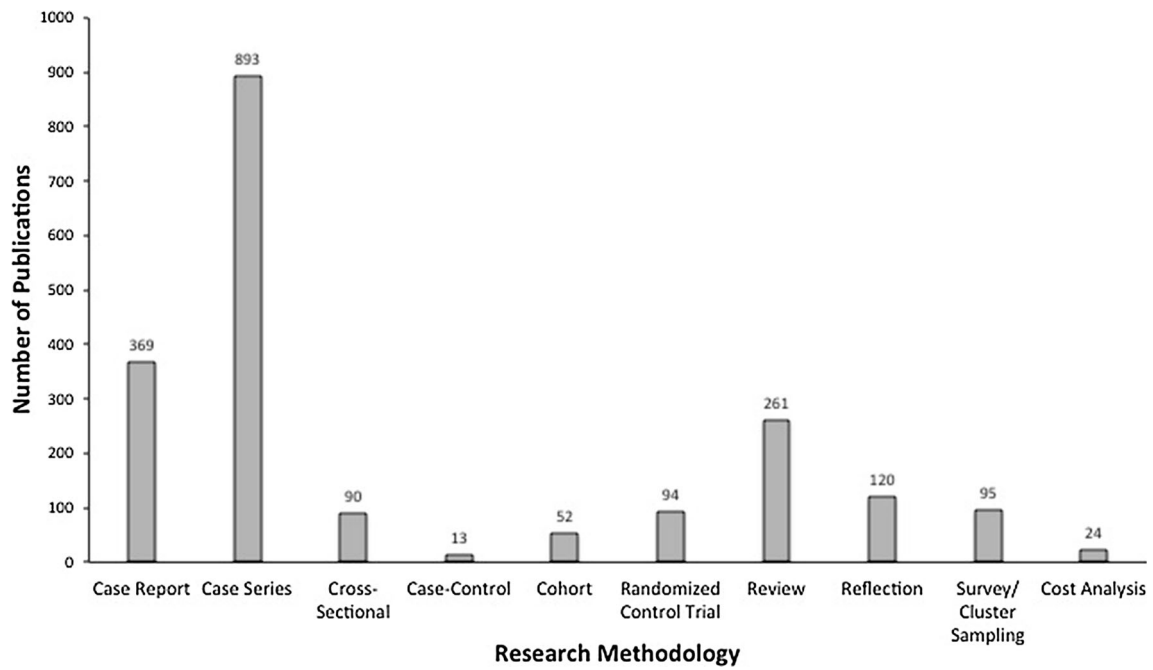


Fig. 2 Study methodology for papers evaluated

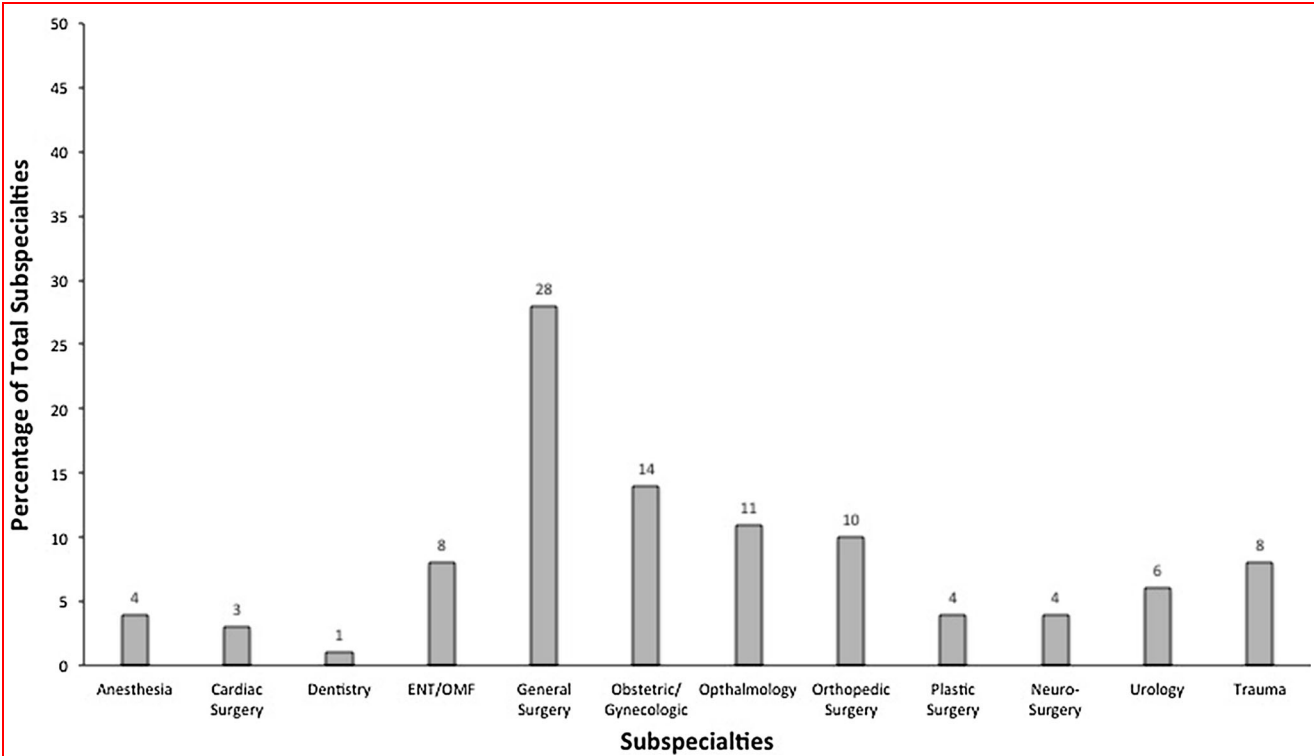


Fig. 3 Surgical subspecialties of papers studied

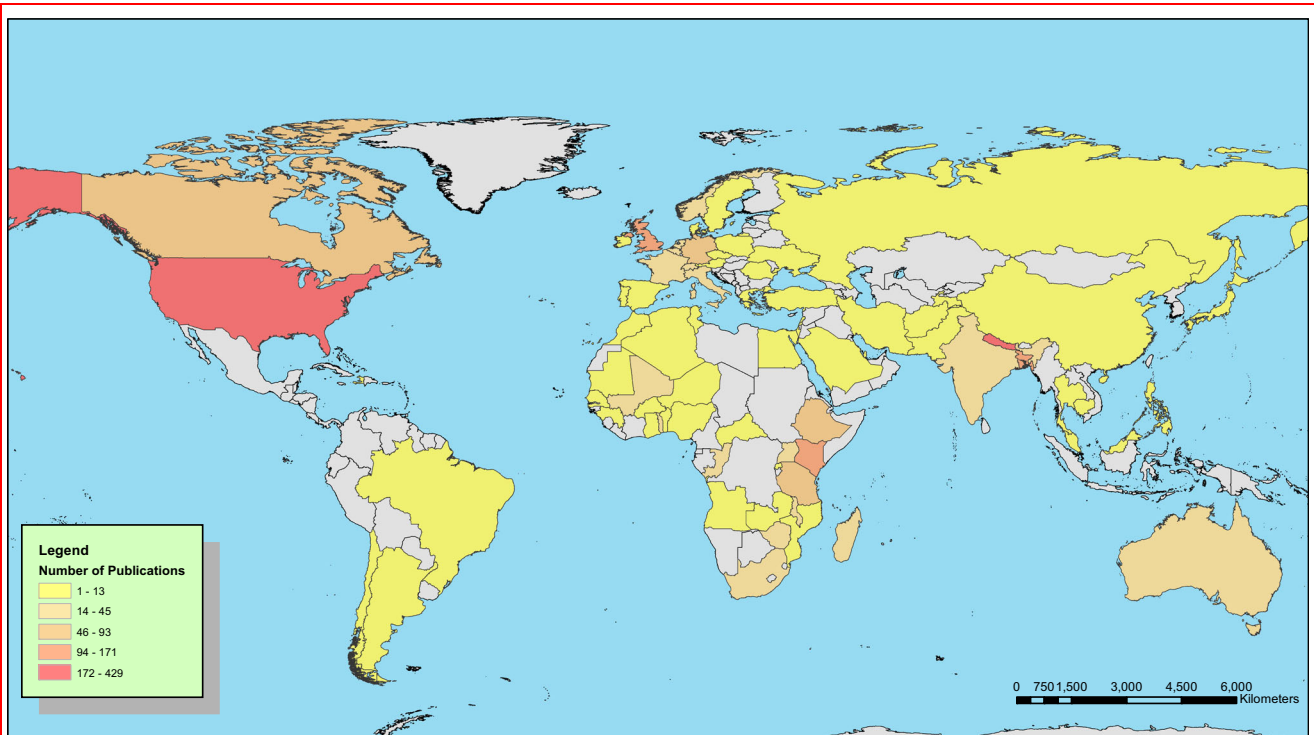


Fig. 4 Heat map: number of papers per country

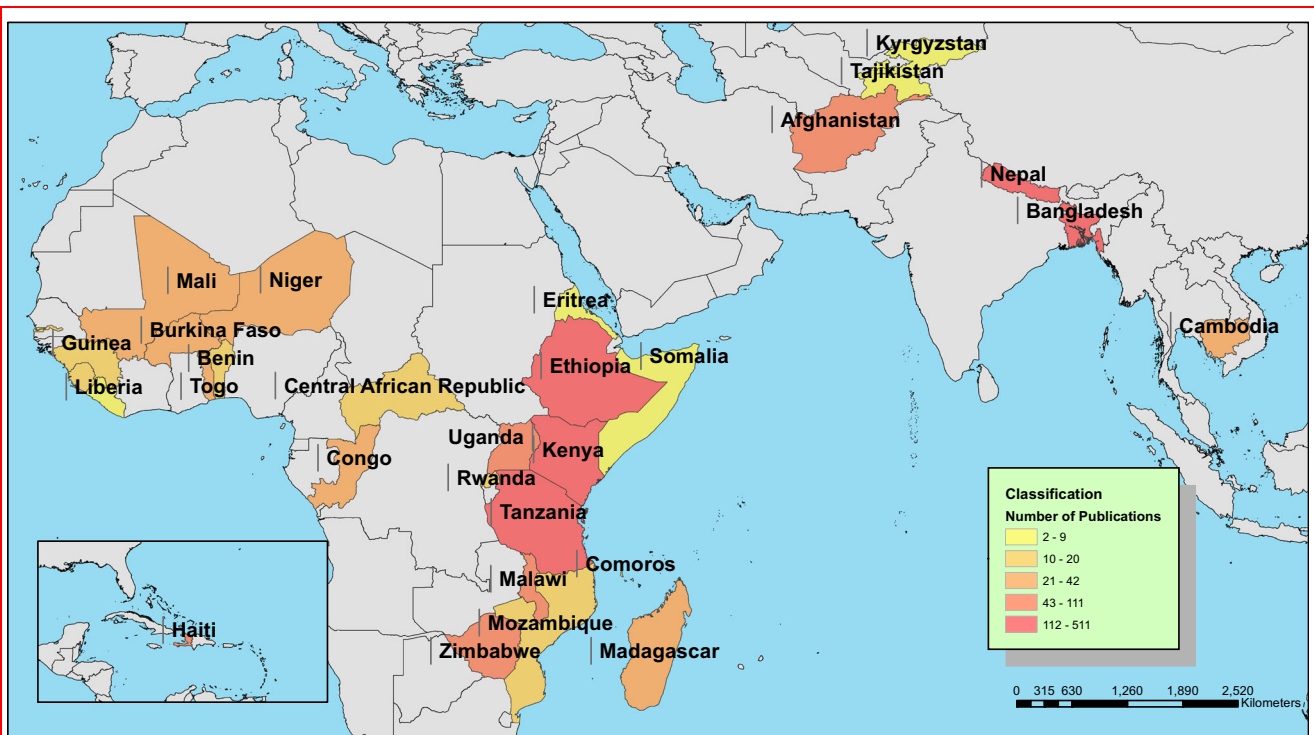


Fig. 5 Heat map: number of papers in LIC's

(Nepal, Bangladesh, Kenya, and Ethiopia) carried out 40 % of the total surgical research performed from 2002 to 2011. By contrast, authors from the four most common high-income countries: USA (408), England (170), Canada (68), and Germany (50), represented 34 % of the total surgical research performed from 2002 to 2011. The LICs where research was conducted is depicted in Fig. 5. The four most common LICs where research was conducted were Nepal (511), Kenya (226), Bangladesh (202), and Ethiopia (160).

Regarding authorship, 24 % of papers were written exclusively by foreign nationals from high-income countries, 55 % were written by authors from LICs only, and 21 % were authored by a collaboration of authors from LICs and high-income country nationals. When the most prolific LICs (Nepal, Kenya, and Bangladesh) were removed from this analysis, 37 % of research was performed without collaboration from local researchers. Furthermore, of countries evaluated, Nepal and Bangladesh were the only two with a specific national journal, while Eastern African countries had a regional specific journal.

Publications from research in Nepal represented 25 % of total publications of surgical research in LICs. When compared to all LICs, Nepal had a higher proportion of randomized controlled trials (9 %) $p < 0.05$ and fewer review papers (6 %) $p < 0.05$ (Table 2). Furthermore, 85 % of the research was performed by local Nepali researchers alone, and 3 % by foreigners alone without contribution from local researchers. The majority (63 %) of papers were published in local Nepali journals while 37 % were published in international journals.

The entities performing the research are depicted on Table 3. The majority of the research involved universities (79 %) followed by non-governmental organization (8 %) and the military (5 %).

Discussion

This systematic review provides an evaluation of the published work in surgical activities in LICs and highlights some of the challenges and successes to developing surgical capacity and research in resource-limited settings. The importance of developing and describing surgical capacity in LICs has recently attained international attention due to efforts to reduce mortality, morbidity, and disability [12–14]. Furthermore, such activities provide an impetus for the critical evaluation of local surgical care practices, improvement in educational interventions, and quality assessment of partnership with high-income countries. The following recommendations stem from the findings in the systematic review and aim to provide guidelines for further development of global surgery in LICs.

Table 2 Publications from Nepal. Overview of research methodology and place of publications

Methodology	Publications	Percentage (%)
Case report	154	30
Case series	233	46
Cross-sectional	11	2
Case control	2	0.5
Cohort	4	1
Randomized controlled trial	44	9
Review	31	6
Reflection	14	3
Survey/cluster sampling	14	3
Cost analysis	4	1
Published in		
Local journals	324	63
International journals	187	37

Table 3 Entity performing research. List of entities overseeing the research projects

Entity	Publications	Percentage (%)
University	1788	79
Non-governmental organization	177	8
Government	71	3
Military	106	5
Hospital	105	5
Industry	7	0.5

Developing surgical research through national peer-reviewed journal

The surgical research capacity in LICs is underdeveloped and measures for its improvement are still largely overlooked. A survey of the 10 leading general surgery journals in 2003 showed that no publications originated from LICs; the majority originated from the United States and Europe [15]. Furthermore, recent review of surgical research in Africa found that only 40 % of papers originated from within African countries [16]. There was an uneven distribution among African countries where one nation, Nigeria, overwhelmingly dominated the number of publications. In the current review, Kenya, Nepal, and Bangladesh had published the overwhelming majority of papers in the LICs. Nepal and Bangladesh, have national peer-reviewed journal to disseminate their research findings, while Kenya channeled its publications through a regional African journal.

Surgeon's isolation, burden of practice, lack of research background, and funding have been proposed as possible barriers to publication in resource-limited setting [17]. These barriers often have convoluted layers with simple

solutions to enable an equal flow of research to and from LICs. An example of surgeon's isolation is the language barrier, which further estranges LICs researchers from the global surgical literature. However, some national journals provide additional stimulus to the development of research by publishing re-prints of internationally peer-reviewed research in local languages. Furthermore, the impact of a national peer-reviewed journal has yet to be given its proper standing in providing an outlet for scientists to express and develop their research acumen.

Research papers from Nepal represented a quarter of the total publications and overall had a higher proportion of research with higher level of evidence. Overall the majority of research papers were published in a Nepali national journal. It is unclear whether the presence of a journal was the stimulus for the production of a greater number studies using more robust methodology or if this was due to the presence of researchers and institutions that needed an outlet for their work. In countries such as Nepal, the higher number and proportion of robust research is likely a combination of the two. Promoting national journals in LICs, either independently through local associations or with partnerships and support from high-income countries, is an excellent means to foster an intellectual environment for aspiring and existing clinician-researchers.

Promotion of research competencies

The present study reveals that surgical research in LICs is generally not rigorous and is based on low evidence methodology, such as case reports, case series, reflections, and reviews represented more than 80 % of research. In addition, more than 40 % of this research was devoid of outcome measures. Recent international efforts in surgical delivery in low- and middle-income countries have focused on estimating and defining the global surgical burden of disease, measuring the quality and effects of surgical care, and performing cost effectiveness, and cost-benefit analyses [18–20]. However, as described in the present review, the evaluation of surgical care algorithm and interventions through anecdotal case reports and reflections are unlikely to produce any tangible changes in mortality, morbidity, and disability.

The improvement of surgical research capacity can only be built sustainably by training basic and clinical investigators, by establishing institutional competencies and through meaningful funding to implement durable interventional studies. Such a strategy enables institutions and individuals in LICs to participate in robust research related activities. Bangladesh is a unique country with centers like The International Center for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) with a research model with tremendous academic productivity. [21] While the ICDDR

focuses mostly on communicable diseases, this serves as an excellent model for the promotion of robust research activities in the field. Similar training programs need to be directed specifically for surgical research and use rigorous scientific methodology to answer clinical and scientific questions with clear predetermined outcomes measures. The implementation of such centers of excellence (COE) focusing on leadership, mentorship, best practices, education, research, quality assurance, and improvement is an excellent paradigm to improve research and practice competencies. Within these centers, the implementation of regional and national databases is not only essential for a better understanding of surgical epidemiology, activities, and outcomes, but also provides an important template for training in robust research methodology.

Partnerships and global networking

Building strong partnerships and collaborations are imperative to achieve the above goals. Based on the results presented, we recognize that there is significant room for improving our collaborative efforts. In fact, unilateral authorship representation from donor nations continues to plague global surgical publications. Across all LICs, more than 20 % of published papers were performed by foreigners without any representative authorship from local researchers. It would be quite surprising if such work is truly completed independently without any local support. In addition, such practice reflects failure to embrace the importance of partnerships and the principles of collaboration. In an effort to curb this trend, some high-impact journals have disallowed publications of papers without authorship from the partner institutions in LICs [22]. While providing a significant barrier to unilateral foreign authorship in LICs, we must strive to engage in true partnerships based on respect and mutual benefit where local health professionals lead program implementation and development based on local needs. In fact, this must be done not only from a publication standpoint, but also for partnerships for local ground level activities. Partnerships should engage in creating COE's where knowledge-sharing among collaborating entities will inevitably lead to the success of the COE.

Such a collaborative approach may be further promoted by global surgical conferences that include adequate participation from partnership institutions in LICs. Such a forum encourages exchange of ideas and provides networking opportunities. These global conferences should not only emphasize the quality of the research but also provide a climate to foster academic partnerships [23, 24]. Furthermore, training opportunities for research fellows, future leaders, and scientists would potentially enhance the development of surgical research in LICs.

Outcome measures

When papers were reviewed to determine if outcome measures were investigated, 43 % had no outcome measures reported. While outcome measures are often difficult to obtain in resource-limited settings, without them it is difficult to objectively assess the impact of the interventions performed. It is, therefore, imperative that we strive for improved reporting of outcome measures whenever possible. While reduction in disease-related morbidity and mortality in the population are the goal of most interventions, the attainment of such goals may be difficult to measure and take a long time to realize. These considerations do not preclude investigators from performing short-term outcome assessments, such as quantitative and qualitative program evaluations for quality control and improvement.

Limitations

While this study focuses solely on surgical output in published peer-reviewed literature from LICs in French or English, it is likely that the search did not encompass the entirety of surgical publications. Undeniably, many papers are published in journals that are not included on PubMed and we may have missed a small percentage of studies in the WHO Global Health library, however, we obtained a significant portion of peer-reviewed journals from LIC. Although all papers were categorized according to predetermined criteria, there is an undeniable minimal amount of overlap between some of the categories. The papers were placed only in the most appropriate category and not duplicated. Nonetheless, it is our hope, that this systematic review will serve as the most readily available account of partnerships, research, and educational programs described in the accessible literature, and that such information illuminates the huge deficit that exists in surgical capacity in resource-limited settings.

Summary

This systematic review of publications related to surgical interventions in resource-limited countries represents a distillation of the published literature within the realm of global surgery. It highlights current research activities and approaches and enables the formulation of recommendations to stimulate the development of global surgery in LICs. Four observations stem from our evaluation of the survey: (1) Describe, develop, and stimulate surgical research through national peer-reviewed journals, (2) Foster centers of excellence to promote robust research

competencies, (3) Endorse partnerships across countries and institutions in the promotion of global surgery, and (4) Build on outcome-directed research. While these are merely recommendations for addressing some of the gaps in global surgery, they serve as important principles for true capacity building in resource-limited countries.

Conflict of interest There were no conflicts of interest.

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