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Telemedicine in surgical care in low- and middle-income countries: a scoping review

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Abstract

Background: Access to timely and quality surgical care is limited in low- and middle-income countries (LMICs). Telemedicine, defined as the remote provision of healthcare using information, communication and telecommunication platforms have the potential to address some of the barriers to surgical care. However, synthesis of evidence on telemedicine use in surgical care in LMICs is lacking.

Aim: To describe the current state of evidence on the use and distribution of telemedicine for surgical care in LMICs.

Methods: This was a scoping review of published and relevant grey literature on telemedicine use for surgical care in LMICs, following the PRISMA extension for scoping reviews guideline. PubMed-Medline, Web of Science, Scopus and African Journals Online databases were searched using a comprehensive search strategy from 1 January 2010 to 28 February 2021.

Results: A total of 178 articles from 53 (38.7%) LMICs across 11 surgical specialties were included. The number of published articles increased from 2 in 2010 to 44 in 2020. The highest number of studies were from the World Health Organization Western Pacific region (n=73; 41.0%) and of these, most were from China (n=69; 94.5%). The most common telemedicine platforms used were telephone call (n=71, 39.9%), video chats (n=42, 23.6%) and WhatsApp/WeChat (n=31, 17.4%). Telemedicine was mostly used for post-operative follow-up (n=71, 39.9%), patient education (n=32, 18.0%), provider training (n=28, 15.7%) and provider-provider consultations (n=16, 9.0%). Less than a third (n=51, 29.1%) of the studies used a randomised controlled trial design and only 23 (12.9%) reported effects on clinical outcomes.

Conclusion: Telemedicine use for surgical care is emerging in LMICs, especially for post-operative visits. Basic platforms such as telephone calls and 2-way texting were successfully used for post-operative follow-up and education. In addition, file sharing and video chatting options were added when a physical assessment was required. Telephone calls and 2-way texting platforms should be leveraged to reduce loss to follow-up of surgical patients in LMICs and their use for pre-operative visits should be further explored. Despite these telemedicine potentials, there remains an uneven adoption across several LMICs. Also, up to two-third of the studies were of low to moderate quality with only a few focusing on clinical effectiveness. There is a need to further adopt, develop, and validate telemedicine use for surgical care in LMICs, particularly its impact on clinical outcomes.

Background

Surgery can ameliorate up to one-third of the global burden of disease, yet access to safe and quality surgical care is limited, especially in low- and middle-income countries (LMICs) [1]. According to the World Bank, low-income countries are those with a gross national income (GNI) per capita of $1,045 or less in 2020, lower middle-income countries are those with GNI per capita between $1,046 and $4,095, upper middle-income countries are those with GNI per capita of $4,096 and $12,695 while high-income countries (HICs) are those with a GNI per capita of $12,696 or more [2]. Compared to HICs, persons requiring surgery in LMICs experience longer delays to care and have worse peri-operative mortality [3]. These delays and poor peri-operative outcomes may result from multiple barriers including lack of surgical care providers, long travel distances to health facilities, and limited means of transportation [4-6]. Thus, efforts aimed at addressing these barriers could facilitate improvement in access to surgical care and outcomes in LMICs.

Telemedicine, defined as remote provision of healthcare services using information communication and technology platforms, is a rapidly evolving and expanding component of healthcare services [7]. It has the potential to address various barriers to healthcare provision by improving access to clinical services and facilitating continuity of care and education [7, 8]. Surgery was historically considered a specialty where face-to-face care was a necessity. However, telemedicine is increasingly utilized for various aspects of surgical care including patient and provider education [9-12]. In fact, the ongoing COVID-19 pandemic, and need for social distancing to minimize transmission, has accelerated the use of telemedicine for various healthcare services globally [13], including surgery [14].

Studies in HICs have demonstrated the use of telemedicine to triage persons with surgical conditions for in-person visits, reduce unnecessary transfers and provision of more timely care [15-18]. The potential of telemedicine to overcome some of the surgical barriers such as lack of access to surgical specialists and long travel distances to healthcare facilities have also been widely shown in HICs [15, 19, 20]. However, surgical burden of disease, barriers to care, healthcare infrastructure and resources, as well as technological advancement level in LMICs differ from that of HICs. Thus, available evidence from HICs cannot be directly translated to LMICs. Synthesis of evidence on the potential and extent of use of telemedicine for surgical care in LMICs is essential but lacking. Therefore, the objective of this review is to describe the current state of evidence about the use and distribution of telemedicine for surgical care in LMICs. These results can be used to identify aspects of telemedicine use for surgical care with strong available evidence, existing knowledge gaps and to provide direction for future studies.

Methods

The methodological framework for scoping reviews by Arksey and O'Malley was utilized [21]. The reporting of the study findings was guided by Preferred Reporting Items for Systematic Reviews and Meta-analysis Extension for Scoping Review (PRISMA-ScR) [22].

Search Strategy

Peer-reviewed articles on the use of telemedicine in surgery in LMICs published from 1 January 2010 to 28 February 2021 were identified from five databases: PubMed-Medline, Scopus, Web of Science, Cochrane library, and African Journals Online. A search strategy was formulated in consultation with an experienced university medical librarian and the senior authors (JD and KC). The search strategy included a combination of Medical Search

Headings (MeSH) terms and keywords for the three key concepts: telemedicine, surgery, and LMICs. Keywords were derived from title, abstract and keywords of relevant studies identified during an initial preliminary review. Similar or different concepts were merged using Boolean operators “OR” and “AND”, respectively (Appendix 1). Lastly, references of identified reviews were hand-searched for additional articles.

Eligibility Criteria

Published studies on telemedicine by any surgical specialty and during any part of the patient care pathway in LMICs were included. All study types, including observational and experimental studies, qualitative, quantitative, and mixed-method studies were included. Case reports, commentaries, books, blog posts, conference abstracts, and studies focusing on robotic surgery (due to the complexities and limitations around its use in LMICs) were excluded. Studies that were not performed in a LMIC, and not written in English or where full-text translation using Google Translate was not possible, were also excluded.

Study selection

Duplicates were excluded after importing the studies into Covidence review software (Veritas Health Innovation, Melbourne, Australia). Titles and abstract screening for inclusion or exclusion were independently conducted by two reviewers. Where there were disagreements between the two reviewers, a consensus was reached with the opinion of a third reviewer. Studies included by the reviewers proceeded for full-text screening, following the same format.

Quality of evidence

The mixed method appraisal tool was adopted for the critical appraisal of the included studies. This validated tool is used to assess the methodological quality of interventional, observational, and qualitative studies, paying specific attention to the study objectives, design, sampling, data collection, results, and study limitations [23].

Data extraction and charting

Data from included studies were extracted into a standardized Microsoft Excel form by two independent reviewers with discrepancies in the extracted information resolved through discussion and consensus. Data extracted included study details such as the publication year, country, setting (rural, urban), aim, study design, study population, surgical specialty, and telemedicine platforms. Telemedicine platforms were categorized into telephone calls, video platforms (video calls/conferencing i.e. Zoom, Microsoft Teams, Skype), instant messaging (all forms of communications on WeChat and/or WhatsApp), texts (including SMS, 2-way texting, audio messages), emails, mHealth applications, and online communication platforms (web-based applications that facilitated blogging, image upload, private messaging). The types of study outcomes were also extracted including implementation (usability, feasibility, acceptability), health systems effectiveness (accuracy of consultation, waiting time, cost, cancellation rate), and clinical outcomes (length of stay, morbidity, mortality).

Data analysis

This was a scoping review and the volume of studies, and their characteristics were summarized using descriptive statistics in IBM Statistical Package for Social Science (SPSS) (IBM Corps, Armonk, New York, USA).

Results

The initial search yielded 5048 studies from which 179 duplicate studies were removed. Title and abstracts of 4869 articles were screened of which 4318 did not meet the eligibility criteria and were removed. Full-text screening was conducted on 551 articles of which 173 were included in the final data extraction. An additional 5 relevant studies were found through hand searching of references and by performing a Google search engine query using the study search terms. Finally, 178 articles were included (Figure 1). The total number of participants in the included studies in the review was 204 351. Detailed descriptions of the included studies can be found in Supplementary Table 1.

Figure 1: PRISMA-ScR flowchart of the search and study selection process

Characteristics of the included study

Of the 178 included studies, 174 (97.8%) were quantitative, 3 (1.7%) were qualitative, and 1 (0.5%) used mixed methods. Of the quantitative studies, 88 (50.3%) were prospective observational, 51(29.1%) were randomised controlled trials (RCT), 25 (14.3%) were retrospective observational, and 11 (6.3%) were non-randomised trials.

Quality of evidence of included studies

Of the 178 included studies, only 57 (32.0%) met all the 5 essential criteria for quality based on the appraisal checklist for their respective study designs. 67 (37.6%) studies lacked one essential component while 54 (30.3%) studies lacked 2 or more of the essential components.

Geographical distribution of studies

The highest number of studies were from the World Health Organization (WHO) Western Pacific region (n=73; 41.0%) and of these, most were from China (n=69; 94.5%). The Eastern Mediterranean region had the lowest number of studies (n=5; 2.8%) (Figure 2). The number of studies was not associated with country population. Some populous countries like Russia and Nigeria had fewer studies compared to less populous countries like Turkey and South Africa which had a higher number of studies.

Figure 2: Geographical distribution of studies

Time trend

The number of publications increased over time, with the highest number of published studies recorded in 2020 (Figure 3).

Figure 3: Number of published studies distributed by year

Telemedicine platforms

The three most common forms of technology used were: telephone call (n=71; 39.9%), video (n=42; 23.6%), and instant messaging (n=31; 17.4%) (Table 1).

Table 1: Telemedicine platforms used in surgical care in low- and middle-income countries

Surgical specialties

Telemedicine was used by 11 surgical specialties. The most common five were general surgery (n=35; 19.7%), surgical oncology (n=21; 11.8%), paediatric surgery (n=18; 10.1%), neurosurgery (n=18; 10.1%), and plastic and reconstructive surgery (n=16; 9.0%) (Table 2).

Table 2: Surgical specialties involved in studies on surgical telemedicine use in low- and middle- income countries

Telemedicine uses in surgery in LMICs

Telemedicine was used in surgery for clinical care, appointment reminders, patient education, and provider training. Clinical care included pre-operative assessment (n=10, 5.6%) [24-33], post-operative assessment (n=71, 39.9%) [34-105], and provider-provider consultations (n=16, 9.0%) [106-121] (Table 3).

Table 3: Uses of telemedicine in surgery in low- and middle-income countries

Outcomes

About half (n=97, 54.5%) of the studies only reported implementation outcomes, including feasibility, usability and satisfaction with various telemedicine platforms. Some studies reported health system effectiveness (or process measures) such as surgery cancellations (n=1, 0.6%), cost saving (n=6, 3.4%), follow-up rate (n=11, 6.2%), length of hospital stay (n=1, 0.6%) and unnecessary referrals (n=7, 3.9%). Only 22 (12.3%) studies reported clinical effectiveness; 2(1.1%) on mortality, 5 (2.8%) on morbidity, and 16 (9.0%) on patient anxiety, depression, or quality of life (Table 4).

Of the 23 studies that reported clinical effectiveness, 16 (69.5%) adopted a RCT design, 4 (17.4%) prospective descriptive, 1 (4.3%) non-randomised trial, 1 (4.3%) before and after and 1 (4.3%) retrospective descriptive design. The most common platforms used for these studies were telephone call (n=10, 43.5%), WeChat (n=6, 26.1%), internet/web-based platform (n=4, 17.4%) and videoconferencing (n=2, 8.7%).

Table 4: Study outcomes

Limitations of telemedicine use

Twenty-five (13.7%) studies reported limitations to telemedicine for surgical care in LMICs. These included internet bandwidth, network instability and coverage [69, 78, 82, 122-124], high costs of technology set-up [55, 125], and safety, privacy and confidentiality concerns

[117, 118, 126]. Poor image quality for asynchronous (where information transmission and response do not take place in real-time) telemedicine [127], inability to confirm delivery of information by SMS recipients [128, 129], and time zone differences for international collaborations and mentoring [31] were additional limitations that were reported. Other highlighted limitation was the inferiority of remote versus in-person physical examination [77, 81].

Discussion

This scoping review appraised evidence on the use of telemedicine for surgical care in LMICs. The volume of studies identified demonstrates that telemedicine in surgery is emerging in LMICs. However, less than a third of the studies were effectiveness studies adopting RCT design and only a few assessed clinical effectiveness. This corroborates a previous report from 2017 highlighting the scarcity of effectiveness studies of mHealth interventions in LMICs compared to HICs [130]. Although process and implementation measures are important, to truly show the benefit of mHealth interventions requires demonstration of improved or at least not worsened clinical outcomes. Therefore, more studies demonstrating the clinical effectiveness of telemedicine in surgery in LMICs are needed to inform evidence-based practice and appropriate health system responses.

In addition, studies were found in 53 (39%) of the 137 LMICs, with an unequal distribution within and across geographic regions. In this review, 41% of the studies were from the WHO Western Pacific region and 95% of those were conducted in China. A study by Abaza et al reported similar findings to our study, with significant concentration of studies in Asian countries [130]. There are several factors that could have contributed to the high usage of telemedicine for surgical care in China which include a higher rate of internet penetration, or the regulated cost of internet subscriptions [131]. Perhaps increasing internet access and regulating and reducing the cost of internet subscriptions may further encourage the adoption of telemedicine for surgical care in other LMICs.

Telemedicine usage in LMICs included provider-to-provider consultations, provider's education, and remote patient assessments through simple technologies such as telephone calls, video conferencing and instant messaging. However, similar to what has been found in HICs, telemedicine was most commonly used for post-operative patient follow-up [132, 133]. Remote patient follow-up is increasingly being adopted as a strategy to reduce healthcare facility traffic and to prevent unnecessary travel by patients. In 2020, remote post-operative follow-up increased in both HICs [134] and LMICs due to the COVID-19 pandemic, evidenced by the volume of studies during this year. Future studies should further explore the clinical effectiveness of remote post-operative patient follow-up. Also, studies on the implementation and effectiveness of telemedicine use for pre-operative visits and providers' education are required.

Lack and uneven distribution of surgical providers are significant barriers to surgical care in LMICs [4]. Our findings demonstrate that various telemedicine modalities were used to create regional and international platforms for provider education and clinical care. Communications between providers within and across countries can help clinicians deliver improved patient care. However, more studies demonstrating the clinical effectiveness of regional and international remote consultations and collaborations are needed in LMICs to inform evidence-based practice.

Strengths and limitations

Our conclusions on the extent of use of telemedicine for surgical care in LMICs was based on published studies. However, not all LMIC institutions publish their telemedicine practices. We did not assess the full text of some studies due to language restrictions and unavailability of full text. Also, studies focusing on robotic surgery were excluded. Therefore, we may have underestimated the scope and reach of surgical telemedicine in LMICs. Studies were of uneven geographical distribution; thus, the findings of this study may not be generalizable to all LMIC settings. Likewise, two studies were translated by google translate which may influence the accuracy of some findings. However, to the best of our knowledge, this scoping review is the first of its kind to describe telemedicine use in surgical care in LMICs. Our results can be used to inform future research and surgical health system strengthening.

Conclusion

This scoping review showed that telemedicine use for surgical care is emerging in LMICs, especially for post-operative visits. Basic platforms such as telephone calls and 2-way texting were successfully used for post-operative follow-up and education. In addition, file sharing and video chatting options were added when a physical assessment was required. Telephone calls and 2-way texting platforms such as WhatsApp and WeChat are easy-to-use, cheap and accessible and should be leveraged to reduce loss to follow-up of surgical patients in LMICs. There is a need to further explore the use and effectiveness of these basic platforms for pre-operative visits. Despite these telemedicine potentials, there remains an uneven adoption across several LMICs, evidenced by the unequal geographical distribution of studies. Likewise, up to two-third of the studies were of low to moderate quality with only a few focusing on clinical effectiveness. The ongoing COVID-19 pandemic presents a pressing context to further adopt, develop, and validate telemedicine use for surgical care in LMICs, particularly its impact on clinical outcomes.

Authors' contributions

EOO and KC conceptualized the study. EOO, KC and JD developed the methodology. EOO, TM and JL screened and extracted the studies. EOO analysed the data and made the first draft.

KC, JD, TM and JL revised the manuscript. All authors approved the final version of the manuscript.

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Availability of data and materials

Not applicable.

Conflict of interest

None declared.

Ethics and dissemination

The study used publicly available data, so no ethics approval was required.

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