Telemedicine in Surgical Care in Low- and Middle-Income Countries: A Scoping Review

Eyitayo Omolara Owolabi¹ · Tamlyn Mac Quene¹ · Johnelize Louw¹ · Justine I. Davies¹,²,³ · Kathryn M. Chu¹,⁴

Accepted: 10 March 2022 / Published online: 15 April 2022 © The Author(s) under exclusive licence to Société Internationale de Chirurgie 2022

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 health care 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 was 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 chat (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 consultation (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-thirds 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.

Eyitayo Omolara Owolabi
owolabieo@sun.ac.za

1 Centre for Global Surgery, Department of Global Health, Faculty of Medicine and Health Sciences, Stellenbosch University, Francie Van Zijl Drive, Tygerberg, Cape Town 7505, South Africa

2 Institute of Applied Health Research, University of Birmingham, Birmingham, UK

³ Faculty of Health Sciences, Medical Research Council/Wits University Rural Public Health and Health Transitions Research Unit, University of Witwatersrand, Johannesburg, South Africa

⁴ Department of Surgery, University of Botswana, Gaborone, Botswana
Introduction

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 the 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 health care 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 the need for social distancing to minimize transmission, has accelerated the use of telemedicine for various health care 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 health care facilities have also been widely shown in HICs [15, 19, 20]. However, the surgical burden of disease, barriers to care, health care 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. Additional five 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 (Fig. 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.

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 five essential criteria for quality based on the appraisal checklist for their respective study designs. Sixty-seven (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%) (Fig. 2). The number of studies was not associated with the 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.

Time trend

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

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).
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).

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).

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 video-conferencing \((n = 2, 8.7\%)\).

**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. Another 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

![Geographical distribution of studies](image.png)
were conducted in China. A study by Abaza et al. reported similar findings to our study, with a 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 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 health care 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.

The 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 were 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-thirds 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.

Appendix 1: Search strategy

PubMed

#1 Telemedicine [MeSH Term]
#2 Title, Abstract and Keyword: ehealth OR electronic health OR telehealth OR mobile health OR mhealth OR telephone follow-up OR telecare OR telesurgery OR tele assistance OR telepresence OR remote consultation OR teleconsultation OR remote patient monitoring OR tele rehabilitation OR digital health
#3 #1 OR #2
#4 General surgery [MeSH Term]
#5 Title, Abstract and Keyword: surgery OR intraoperative OR preoperative OR postoperative OR surgical procedures
#6 #4 OR #5
#7 Developing countries [MeSH Terms]
Appendix continued

#8 Title Abstract Keyword: Afghanistan OR Guinea-Bissau OR Sierra Leone OR Burkina Faso OR Haiti OR Somalia OR Burundi OR Democratic People’s Republic of Korea OR South Sudan OR Central African Republic OR Liberia OR Sudan OR Chad OR Madagascar OR Syrian Arab Republic OR Democratic Republic of Congo OR Malawi OR Tajikistan OR Eritrea OR Mali OR Togo OR Ethiopia OR Mozambique OR Uganda OR The Gambia OR Niger OR Republic of Yemen OR Guinea OR Rwanda OR Angola OR Honduras OR Papua New Guinea OR Algeria OR India OR Philippines OR Bangladesh OR Kenya OR São Tome and Principe OR Benin OR Kiribati OR Senegal OR Bhutan OR Kyrgyz Republic OR Solomon Islands OR Bolivia OR Lao PDR OR Sri Lanka OR Cabo Verde OR Lesotho OR Tanzania OR Cambodia OR Mauritania OR Timor-Leste OR Cameroon OR Federated States of Micronesia OR Tunisia OR Comoros OR Moldova OR Ukraine OR Republic of Congo OR Mongolia OR Uzbekistan OR Côte d’Ivoire OR Morocco OR Vanuatu OR Djibouti OR Myanmar OR Vietnam OR Arab Republic of Egypt OR Nepal OR West Bank and Gaza OR El Salvador OR Nicaragua OR Zambia OR Eswatini OR Nigeria OR Zimbabwe OR Ghana OR Pakistan OR Albania OR Fiji OR Montenegro OR American Samoa OR Gabon OR Namibia OR Argentina OR Georgia OR North Macedonia OR Armenia OR Grenada OR Paraguay OR Azerbaijan OR Guatemala OR Peru OR Belarus OR Guyana OR Russian Federation OR Belize OR Indonesia OR Samoa OR Bosnia and Herzegovina OR Islamic Republic of Iran OR Serbia OR Botswana OR Iraq OR South Africa OR Brazil OR Jamaica OR St. Lucia OR Bulgaria OR Jordan OR St. Vincent and the Grenadines OR China OR Kazakhstan OR Suriname OR Colombia OR Kosovo OR Thailand OR Costa Rica OR Lebanon OR Tonga OR Cuba OR Libya OR Turkey OR Dominica OR Malaysia OR Turkmenistan OR Dominican Republic OR Maldives OR Tuvalu OR Equatorial Guinea OR Marshall Islands OR Venezuela OR RB Ecuador OR Mexico

#9 #7 OR #8
#10 #3 AND #6 AND #9
Limit to 2010–2021

Cochrane library: Similar search strategy used for PubMed was used on this database.

Scopus and web of science: These databases do not use Mesh Terms, keywords similar to those applied on PubMed were applied on these databases as shown below:

#1 (telemedicine OR ehealth OR “electronic health” OR telehealth OR “mobile health” OR mhealth OR “telephone follow-up” OR telecare OR telesurgery OR “tele assistance” OR telepresence OR “remote consultation” OR teleconsultation OR “remote patient monitoring” OR “tele rehabilitation” OR “digital health”)

#2 (“general surgery” OR preoperative OR intraoperative OR postoperative OR “surgical procedure”)

Appendix continued

#3 (“developing countries” OR Afghanistan OR “Guinea-Bissau” OR “Sierra Leone” OR “Burkina Faso” OR Haiti OR Somalia OR Burundi OR Korea OR “Democratic people’s republic of south Sudan” OR “Central African Republic” OR Liberia OR Sudan OR Chad OR Madagascar OR “Syrian Arab Republic” OR “Democratic Republic of Congo” OR Malawi OR Tajikistan OR Eritrea OR Mali OR Togo OR Ethiopia OR Mozambique OR Uganda OR “The Gambia” OR Niger OR “Republic of Yemen” OR Guinea OR Rwanda OR Angola OR Honduras OR “Papua New Guinea” OR Algeria OR India OR Philippines OR Bangladesh OR Kenya OR “Sao tomé and principe” OR Benin OR Kiribati OR Senegal OR Bhutan OR “Kyrgyz Republic” OR “Solomon Islands” OR Bolivia OR “Lao PDR” OR “Sri Lanka” OR “Cabo Verde” OR Lesotho OR “Timor-leste” OR Cameroon OR “Federated states of micronesia” OR Tunisia OR Comoros OR Moldova OR Ukraine OR “Republic of Congo” OR Mongolia OR Uzbekistan OR “Cote d’ivoire” OR Morocco OR Vanuatu OR Djibouti OR Myanmar OR Vietnam OR “Arab republic of Egypt” OR Nepal OR “West bank and Gaza” OR “El Salvador” OR Nicaragua OR Zambia OR Eswatini OR Nigeria OR Zimbabwe OR Ghana OR Pakistan OR Albania OR Fiji OR Montenegro OR American Samoa OR Gabon OR Namibia OR Argentina OR Georgia OR North Macedonia OR Armenia OR Grenada OR Paraguay OR Azerbaijan OR Guatemala OR Peru OR Belarus OR Guyana OR Russian Federation OR Belize OR Indonesia OR Samoa OR Bosnia and Herzegovina OR Islamic Republic of Iran OR Serbia OR Botswana OR Iraq OR South Africa OR Brazil OR Jamaica OR St. Lucia OR Bulgaria OR Jordan OR St. Vincent and the Grenadines OR China OR Kazakhstan OR Suriname OR Colombia OR Kosovo OR Thailand OR Costa Rica OR Lebanon OR Tonga OR Cuba OR Libya OR Turkey OR Dominica OR Malaysia OR Turkmenistan OR Dominican Republic OR Maldives OR Tuvalu OR Equatorial Guinea OR Marshall Islands OR Venezuela OR “RB Ecuador” OR Mexico)

#4 #1 AND #2 AND #3

African journal online (AJOL)

Keywords used for Scopus database were applied on AJOL to extract relevant studies.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00268-022-06549-2.

Author contribution EOO and KMC conceptualized the study. EOO, KC and JID developed the methodology. EOO, TM and JL screened and extracted the studies. EOO analysed the data and made the first draft. KC, JID, TM and JL revised the manuscript. All authors approved the final version of the manuscript.

Funding None.
Data availability Not applicable.

Declarations

Conflict of interest The authors declare that there is no conflict of interest.

Ethical approval The study made use of publicly available data; therefore, ethics approval was not required.

References

1. Meara JG, Leather AJM, Hagander L, Akliere BC, Alonso N, Ameh EA et al (2015) Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. Lancet 386(9993):569–624
2. The World Bank (2022) World Bank Country and Lending Groups [cited 2022 January 20]. Available from: https://data helpdesk.worldbank.org/knowledgebase/articles/906519-worldbank-country-and-lending-groups#:~:text=%EF%BB%BF%E2%80%9CFor%20the%20current,those%20with%20a%20GNI%20per
3. Biccard BM, Madiba TE, Kluys H-L, Munlemvo DM, Madzimbamuto FD, Basenero A et al (2018) Perioperative patient outcomes in the African surgical outcomes study: a 7 day prospective observational cohort study. Lancet 391(10130):1589–1598
4. Holmer H, Lantz A, Kunjummen T, Finlayson S, Hoyler M, Siyam A et al (2015) Global distribution of surgeons, anaesthesiologists, and obstetricians. Lancet Global Health 3:S9–S11
5. Ozgediz D, Jamison D, Cherian M, McQueen K (2008) The burden of surgical conditions and access to surgical care in low- and middle-income countries. Bull World Health Organ 86:646–647
6. Iddriss A, Shivute N, Bickler S, Cole-Ceesay R, Jargo B, Abdullah F et al (2011) Emergency, anaesthetic and essential surgical capacity in the Gambia. Bull World Health Organ 89:565–572
7. World Health Organisation (2010) Telemedicine: opportunities and developments in member states [cited 2021 14 August]. Available from: https://www.who.int/goe/publications/goe_telemedicine_2010.pdf
8. Williams AM, Bhatti UF, Alam HB, Nikolian VC (2018) The role of telemedicine in postoperative care. Mhealth 4:11
9. Harting MT, Wheeler A, Ponsky T, Nwomeh B, Snyder CL, Bruns NE et al (2019) Telemedicine in pediatric surgery. J Pediatr Surg 54(3):587–594
10. Park ES, Boedeker BH, Hemstreet JL, Hemstreet GP (2011) The role of telemedicine in postoperative care. Mhealth 4:11
11. Nyas KS, Hambrick HR, Shakir A, Morrison SD, Tran DC, Pearson K et al (2017) A systematic review of the use of telemedicine in plastic and reconstructive surgery and dermatology. Ann Plast Surg 78(6):736–768
12. Urquhart AC, Antoniotti NM, Berg RL (2011) Telemedicine— an efficient and cost-effective approach in parathyroid surgery. Laryngoscope 121(7):1422–1425
13. Bhaskar S, Bradley S, Chattu VK, Adisesh A, Nurtazina A, Kyyrkbyäeva S et al (2020) Telemedicine across the globe-position paper from the COVID-19 pandemic health system resilience PROGRAM (REPROGRAM) international consortium (Part 1). Front Public Health 8:644
14. Chao GF, Li KY, Zhu Z, McCullough J, Thompson M, Claflin J et al (2021) Use of telehealth by surgical specialties during the COVID-19 pandemic. JAMA Surg 156:620
15. Maurice AP, Punnasseril JEJ, King SE, Dodd BR (2020) Improving access to bariatric surgery for rural and remote patients: experiences from a state-wide bariatric telehealth service in Australia. Obes Surg 30(11):4401–4410
16. Schroeder C (2019) Pilot study of telemedicine for the initial evaluation of general surgery patients in the clinic and hospitalized settings. Surg Open Sci 1(2):97–99
17. Tolone S, Gamburgella C, Bruscianno L, Del Genio G, Lucido FS, Docimo L (2020) Telephonic triage before surgical ward admission and telemedicine during COVID-19 outbreak in Italy. effective and easy procedures to reduce in-hospital positivity. Int J Surg 78:123–125
18. Wallace DL, Jones SM, Milroy C, Pickford MA (2008) Telemedicine for acute plastic surgical trauma and burns. J Plast Reconstr Aesthet Surg 61(1):31–36
19. Gunter RL, Chouinard S, Fernandes-Taylor S, Wiseman JT, Clarkson S, Bennett K et al (2016) Current use of telemedicine for post-discharge surgical care: a systematic review. J Am Coll Surg 222(5):915–927
20. Bullard TB, Rosenberg MS, Ladde J, Razack N, Villalobos HJ, Papa L (2013) Digital images taken with a mobile phone can assist in the triage of neurosurgical patients to a level 1 trauma centre. J Telemed Telecare 19(2):80–83
21. Arkesey H, O’Malley L (2005) Scoping studies: towards a methodological framework. Int J Soc Res Methodol 8(1):19–32
22. Tricco AC, Lillie E, Zarin W, O’Brien KK, Colquhoun H, Levac D et al (2018) PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med 169(7):467–473
23. Hong QN, Fábregues S, Bartlett G, Boardman F, Cargo M, Dagenais P et al (2018) The mixed methods appraisal tool (MMAT) version 2018 for information professionals and researchers. Educ Inf 34(4):285–291
24. Aoki L, Pereira IC, Matayoshi S (2019) Comparative study between conventional camera images and smartphone images for eyelid tumor telediagnosis. Revista do Colegio Brasileiro de Cirurgios. https://doi.org/10.1590/0100-6991e-20192083
25. Dogan I, Erogulu U, Ozgural O, Al-Beyati ESM, Kilinc MC, Comert A et al (2018) Visualization of superficial cerebral lesions using a smartphone application. Turk Neurosurg 28(3):349–355
26. Latiﬁ R, Mora F, Bektashi F, Rivera R (2014) Preoperative telemedicine evaluation of surgical mission patients: should we use it routinely? Bull Am Coll Surg 99(1):17–23
27. Hughes C, Campbell J, Mukhopadhyay S, McCormack S, Silverman R, Lalikos J et al (2017) Remote digital preoperative assessments for cleft lip and palate may improve clinical and economic impact in global plastic surgery. Cleft Palate Craniofac J 54(5):535–539
28. Iyengar K, Paul M, Iyengar SD, Klingberg-Allvin M, Essén B, Bring J et al (2015) Self-assessment of the outcome of early medical abortion versus clinic follow-up in India: a randomised, controlled, non-inferiority trial. Lancet Global Health 3(9):e537–e545
29. Utriyaprasit K, Moore SM, Chaiseri P (2010) Recovery after operation on the aorta with and without endovascular assistance. J Thorac Cardiovasc Surg 139:565–572
30. Shalabi HT, Price MD, Shalabi ST, Rodas EB, Vicuña AL, Guzhiy B et al (2017) Mobile gastrointestinal and endoscopic medical abortion versus clinic follow-up in India: a randomised, controlled, non-inferiority trial. J Obstet Gynaecol Res 43(6):1422–1425
31. Ambroise B, Benateau H, Prevost R, Traore H, Hauchard K, Diah H et al (2018) The contribution of telemedicine to humanitarian surgery. J Cranio Maxillofac Surg 46(6):1368–1372
32. Fan KL, Avashia YJ, Daycicoglu D, DeGennaro VA, Thaller SR (2014) The efficacy of online communication platforms for plastic surgeons providing extended disaster relief. Ann Plast Surg 72(4):457–462
33. Furr MC, Larkin E, Blakeley R, Albert TW, Tsugawa L, Weber SM (2011) Extending multidisciplinary management of cleft palate to the developing world. J Oral Maxillofac Surg 69(1):237–241
34. Toey Y, Skinner D, Thomsen S (2016) “Please don’t send us spam!” a participative, theory-based methodology for developing an mHealth intervention. JMIR mHealth uHealth 4(3):e6041
35. Phaff M, Aird J, Rollinson PD (2015) Delayed implants sepsis in HIV-positive patients following open fractures treated with orthopaedic implants. Injury 46(4):590–594
36. Uluer M, Sargin M, Akin F, Uluer E, Sahin O (2019) A randomized study to evaluate post-dural puncture headache after cesarean section: Comparison with median and paramedian approaches. Niger J Clin Pract 22(11):1564–1569
37. Liu X, Wang Z, Ren H, Ren A, Wang W, Yang X et al (2020) Evaluating postoperative anal fistula prognosis by diffusion-weighted MRI. Eur J Radiol 132:109294
38. Peng L, Ren L, Qin P, Su M (2016) The impact of patient-controlled analgesia on prognosis of patients receiving major abdominal surgery. Minerva Anestesiologica 82(8):827–838
39. Li P, Wang W, Liu Y, Zhong Q, Mao B (2012) Clinical outcomes of 114 patients who underwent gamma-knife radiosurgery for medically refractory idiopathic trigeminal neuralgia. J Clin Neurosci 19(1):71–74
40. Wei SY, Li Q, Li SK, Zhou CD, Li FY, Zhou Y (2015) A new surgical technique of hymenoplasty. Int J Gynecol Obstet 130(1):14–18
41. Wang Q, Peng HL, He L, Zhao X (2015) Reproductive outcomes after previous cesarean scar pregnancy: follow up of 189 women. Taiwan J Obstet Gynecol 54(5):551–553
42. Gao Q, Yuan L, Wang WP, Shi H, Chen LQ (2014) Factors influencing response enthusiasm to telephone follow-up in patients with oesophageal carcinoma after oesophagectomy. Eur J Cancer Care 23(3):310–316
43. Du M, Liu B, Li M, Cao J, Liu D, Wang Z et al (2019) Multicenter surveillance study of surgical site infection and its risk factors in radical resection of colon or rectal carcinoma. BMC Infect Dis. https://doi.org/10.1186/s12879-019-0466-4
44. Jiang QL, Huang XH, Chen YT, Zhang JW, Wang CF (2016) Prognostic factors and clinical characteristics of patients with primary duodenal adenocarcinoma: a single-center experience from China. BioMed Res Int 2016:6491049
45. Jiang Y, Jia N, Zhu M, He Y, Che X, Lv T et al (2019) Comparison of survival and perioperative outcomes following simple and radical hysterectomy for stage II endometrial cancer: a single-institution, retrospective, matched-pair analysis. J Int Med Res 47(9):4469–4481
46. Wang Y, Ma JX, Yin T, Han Z, Cui SS, Liu ZP et al (2019) Correlation between reduction quality of femoral neck fracture and femoral head necrosis based on biomechanics. Orthop Surg 11(2):318–324
47. Bian Y, Xiang Y, Tong B, Feng B, Weng X (2020) Artificial intelligence-assisted system in postoperative follow-up of orthopedic patients: exploratory quantitative and qualitative study. J Med Internet Res 22(5):16896
48. Wang S, Li Y, Fei M, Zhang H, Wang J (2020) Clinical analysis of the effects of different anesthesia and analgesia methods on chronic postsurgical pain in patients with unipolar video-assisted lung surgery. J Cardiothorac Vasc Anesth 34(4):987–991
49. Gushchin AG, Crum AV, Limbu BB, Quigley EP, Seward MS, Tabin GC (2017) Simbu piosis: an outreach approach to myogenic piosis in eastern highlands of papua new guinea-experience and results from a high-volume oculoplastic surgical camp. Ophthalmic Plast Reconstr Surg 33(2):139–143
50. Tiwari D, Surianarayanan G, Sundararajan V, Karthikeyan P (2020) Virtual Telephonic follow-up for patients undergone septoplasty amid the COVID pandemic. Indian J Otolaryngol Head Neck Surg 73(1):30–32
51. Wang X, Xu B, Liang H, Jiang S, Tan H, Wang X et al (2018) Distribution characteristics and factors influencing oral warfarin adherence in patients after heart valve replacement. Patient Prefer Adherence 12:1641–1648
52. Starr N, Gebeeyehu N, Tesfaye A, Forrester JA, Bekele A, Bitew S et al (2020) Value and feasibility of telephone follow-up in ethiopian surgical patients. Surg Infect 21(6):533–539
53. Babigumira JB, Barnhart S, Mendelsohn JM, Murembe V, Tshimanga M, Mauy C et al (2020) Cost-effectiveness analysis of two-way text for post-operative follow-up in Zimbabwe’s voluntary male circumcision program. PLoS ONE 15:e0239915
54. Thakar S, Rajagopal N, Mani S, Shyam M, Aryan S, Rao AS et al (2018) Comparison of telemedicine with in-person care for follow-up after elective neurosurgery: results of a cost-effectiveness analysis of 1200 patients using patient-perceived utility scores. Neurosurg Focus 44(5):E17
55. Ashry AH, Alsawy MF (2020) Doctor-patient distancing: an early experience of telemedicine for postoperative neurosurgical care in the time of COVID-19. Egypt J Neurol Psychiatry Neurosurg 56(1):1–8
56. Aiken AM, Wanyoro AK, Mwangi J, Mulingwa P, Wanjohi J, Njoroge J et al (2013) Evaluation of surveillance for surgical site infection following caesarean section at a tertiary hospital in Kenya. J Hosp Infect 83(2):140–145
57. Ngubuni B, De Nardo P, Gentilotti E, Chaula Z, Damian C, Mencarini P et al (2017) Reliability and validity of using telephone calls for post-discharge surveillance of surgical site infection following caesarean section at a tertiary hospital in Tanzania. Antimicrob Resist Infect Control 6:43
58. Wang Y, Xu M, Li W, Mao Y, Da J, Wang Z (2020) It is efficient to monitor the status of implanted ureteral stent using a mobile social networking service application. Urolithiasis 48(1):79–84
59. Li C, Huang S, Su X, Zhang T, Jiang K (2019) Monitoring of radium recovery using the 317-nursing mobile application following day-case surgery in children: perspectives from both nurses and patients. Medicine 98:31
60. Zhang QL, Huang ST, Xu N, Wang ZC, Cao H, Chen Q (2020) Application of remote follow-up via the WeChat platform for patients who underwent congenital cardiac surgery during the COVID-19 epidemic. Braz J Cardiovasc Surg 36(4):530–534
61. Chen M, Li P, Lin F (2016) Influence of structured telephone follow-up on patient compliance with rehabilitation after total knee arthroplasty. Patient Prefer Adherence 10:257–264
62. Ding XX, Zhao LQ, Cui XG, Yin Y, Yang HA (2020) Clinical observation of soft palate-pharyngoplasty in the treatment of obstructive sleep apnea hypopnea syndrome in children. World J Clin Cases 8(4):679–688
63. Zhang C, Zhu K, Lin Z, Huang P, Pan Y, Sun B et al (2020) Utility of deep brain stimulation telemedicine for patients with movement disorders during the COVID-19 outbreak in China. Neuromodulation 24:337–342
64. Li D, Zhang C, Gault J, Wang W, Liu J, Shao M et al (2017) Remotely programmed deep brain stimulation of the bilateral subthalamic nucleus for the treatment of primary parkinson disease: a randomized controlled trial investigating the safety
and efficacy of a novel deep brain stimulation system. Stereotact Funct Neurosurg 95(3):174–182
65. Young S, Banza LN, Hallan G, Beniyasi F, Manda KG, Munthali BS et al (2013) Complications after intramedullary nailing of femoral fractures in a low-income country. Acta Orthop 84(5):460–467
66. Machado TMD, Santana RF, Vaqueiro RD, Santos CTBD, Alfradique de Souza P (2020) Telephone follow-up of the elderly after cataract surgery. Br J Vis Impair 38(2):184–195
67. Li LL, Gan YY, Zhang LN, Wang YB, Zhang F, Qi JM (2014) The effect of post-discharge telephone intervention on rehabilitation following total hip replacement surgery. Int J Nurs Sci 1(2):207–211
68. Rapp DE, Colhoun A, Morin J, Bradford TJ (2018) Assessment of communication technology and post-operative telephone surveillance during global urology mission. BMC Res Notes. https://doi.org/10.1186/s13104-018-3256-2
69. Wang J, Tong Y, Jiang Y, Zhu H, Gao H, Wei R et al (2018) The effectiveness of extended care based on internet and home care platform for orthopedics after hip replacement surgery in China. J Clin Nurs 27(21–22):4077–4088
70. Li L, Ma Z, Wang W (2020) Influence of transitional care on the self-care ability of kidney transplant recipients after discharge. Ann Palliat Med 9(4):1958–1964
71. Zheng X, Zhao J, Wang Z, Jia B, Zhang Z, Guo J et al (2020) Postoperative online follow-up improves the quality of life of patients who undergo extraction of impacted mandibular third molars: a randomized controlled trial. Clin Oral Investig 25:993–999
72. Wang QQ, Zhao J, Hua XR, Wu L, Yang LF, Li JY et al (2018) Effects of a home care mobile app on the outcomes of discharged patients with a stoma: a randomised controlled trial. J Clin Nurs 27(19–20):3592–3602
73. Xu LW, Vaca SD, Nalwanga J, Muhumuza C, Vail D, Lerman BJ et al (2018) Life after the neurosurgical ward in Sub-Saharan Africa: neurosurgical treatment and outpatient outcomes in Uganda. World Neurosurg 113:153–160
74. Feldacker C, Murenje V, Holeman I, Xaba S, Makunike-Chikuni BS et al (2019) Application of internet-based Tsinghua PINs remote tech to improve sacral neuromodulation programming. Int Urol Nephrol 51(4):627–632
75. Madsen C, Lough D, Lim A, Harshbarger RJ, Kumar AR (2015) Feasibility and efficacy of a novel deep brain stimulation system. Stereotact Funct Neurosurg 93(1):207–211
76. Pan Y, Chen H, Chen H, Jin X, Zhu Y, Chen G (2020) Is electronic follow-up using a mobile phone application after mid-urethral sling placement feasible and efficient? World J Urol 39:863–869
77. Zhang P, Zhang YG, Liao LM, Shen JW, Yang YB, Zhang JZ et al (2019) Application of internet+based Tsinghua PINS remote tech to improve sacral neuromodulation programming procedure. Int Urol Nephrol 51(4):627–632
78. Xu X, Cao Y, Luan X (2014) Application of 4G wireless network-based system for remote diagnosis and nursing of stomal complications. Int J Clin Exp Med 7(11):4554–4561
79. Shi Z, Jiang M, Zhao M, Zhang J, Zhang S, Li L et al (2020) A follow-up study on urodynamics of children after surgery for hypospadias. Chin J Pediatr Surg 41(9):819–823
80. Ma Y, Miao S, Zhou R, Zhang Q, Chen H, Liang Y (2021) Application of remote deep brain stimulation programming for parkinson’s disease patients. World Neurosurg 147:e255–e261
81. Ma Y, Miao S, Zhou R, Zhang Q, Chen H, Liang Y (2021) Deep brain stimulation telemedicine programming during the COVID-19 pandemic: treatment of patients with psychiatric disorders. Neurosurg Focus 49(6):1–5
82. Pathak A, Sharma S, Sharma M, Mahadik VK, Lundborg CS (2015) Feasibility of a mobile phone-based surveillance for surgical site infections in rural India. Telemed e-Health 21(11):946–949
83. Yadav SK, Jha CK, Mishra SK, Mishra A (2020) Smartphone-based application for tele-follow-up of patients with endocrine disorders in context of a LMIC: a compliance, satisfaction, clinical safety and outcome assessment. World J Surg 44(2):612–616. https://doi.org/10.1007/s00268-019-05212-7
84. Pathak A, Sharma S, Sharma M, Mahadik VK, Lundborg CS (2015) Feasibility of a mobile phone-based surveillance for surgical site infections in rural India. Telemed e-Health 21(11):946–949
85. Kiranantawat K, Sitpahul N, Taeprasartsit P, Constantinides J, Kruavit A, Srimuninnimit V et al (2014) The first smartphone application for microsurgery monitoring: sipilaraminant. Plast Reconstr Surg 134(1):130–139
86. Zhang JE, Wong FK, You LM, Zheng MC, Li Q, Zhang BY et al (2013) Effects of enteroctalum nurse telephone follow-up on postoperative adjustment of discharged colostomy patients. Cancer Nurs 36(6):419–428
87. Santana RF, Pereira SK, Carmo TG, Freire V, Soares TDS, Amaral DM et al (2018) Effectiveness of a telephone follow-up nursing intervention in post-surgical patients. Int J Nurs Pract 24(4):e12648
88. Da Silva SR, Santana RF, Dos Santos CTB, Faleiro TB, Do Amaral Passarells DM, Hercules ABS et al (2020) Telephonic nursing intervention for laparoscopic cholecystectomy and hernia repair: a randomized controlled study. BMC Nurs. https://doi.org/10.1186/s12912-020-00432-y
89. Gong S, Shen WW (2011) Telephone follow-up improves quality of life of postoperative patients with severe acute pancreatitis. J Sichuan Univ 42(5):712–715
90. Demir B, Binnetoglu A, Kersin B, Mammadova U, Kucuk N (2019) Could digital photography be an alternative to postoperative physical examination for pediatric tonsillectomy patients? Int J Pediatr Otolarhinolaryngol 123:66–68
91. Zhang Y, Zhang P, Tian X, Chen G, Li Y, Zhang Y et al (2019) Remotely programmed sacral neuromodulation for the treatment of patients with refractory overactive bladder: a prospective randomized controlled trial evaluating the safety and efficacy of a novel sacral neuromodulation device. World J Urol 37(11):2481–2492
92. Padmanaban V, Johnston PF, Gyakob M, Benneh A, Esinam A, Sifiri ZC (2020) Long-term follow-up of humanitarian surgeries: outcomes and patient satisfaction in rural Ghana. J Surg Res 246:106–112
93. Yu L, Zhu Y, Chen W, Bu H, Zhang Y (2020) Incidence and risk factors associated with postoperative stroke in the elderly patients undergoing hip fracture surgery. J Orthop Surg Res 15(1):429
94. Ashengo TA, Grund J, MHLanga M, Hlope T, Mirira M, Bock N et al (2014) Feasibility and validity of telephone triage for adverse events during a voluntary medical male circumcision campaign in Swaziland. BMC Public Health 14(1):1–9
95. Dresser C, Periyanayagam U, Dreifuss B, Wangoda R, Luyimbazi J, Bisanzo M (2017) Management and outcomes of acute surgical patients at a district hospital in Uganda with non-physician emergency clinicians. World J Surg 41(9):2193–2199. https://doi.org/10.1177/1054773817729074
132. Buvik A, Bugge E, Knutsen G, Säbrekke A, Wilsgaard T (2019) Patient reported outcomes with remote orthopaedic consultations by telemedicine: a randomised controlled trial. J Telemed Telecare 25(8):451–459.

133. Canon S, Shera A, Patel A, Zamilla I, Paddock J, Fisher PL et al (2014) A pilot study of telemedicine for post-operative urological care in children. J Telemed Telecare 20(8):427–430.

134. Hakim AA, Kellish AS, Atabek U, Spitz FR, Hong YK (2020) Implications for the use of telehealth in surgical patients during the COVID-19 pandemic. Am J Surg 230(1):48–49.

135. Akoko L, Mwanga A, Chikawe M, Lutainulwa E, Ngoma D, Hakim AA, Kellish AS, Atabek U, Spitz FR, Hong YK (2020) Effectiveness of telemedicine and telephone follow-up on cataract patients’ activities according to the model of living. J Perianesth Nurs 35(1):67–74.

136. Nemli A, Tekinsoy KP (2019) Effects of exercise training and telephone counseling and its effects on parents’ anxiety: a randomised controlled trial. J Spec Pediatr Nurs 21(4):189–199.

137. Nyamtema A, Mwakatundu N, Ngoma D, Nemli A, Tekinsoy KP (2019) Effects of exercise training and telephone counseling and its effects on parents’ anxiety: a randomised controlled trial. J Spec Pediatr Nurs 21(4):189–199.

138. Chaves RO, De Oliveira PAV, Rocha LC, David JPF, Ferreira SC, Santos ADASD et al (2017) An innovative streaming video system with a point-of-view head camera transmission of surgeries to smartphones and tablets: an educational utility. Surg Innov 24(5):462–470.

139. de Mata LRF, Azevedo C, Bernardes MFVG, Chianca TCM, Pereira MG, de Carvalho EC (2019) Effectiveness of a home care teaching program for prostatectomized patients: a randomised controlled clinical trial. Revista da Escola de Enfermagem 53(3):03421.

140. Mathis AD, Hazin SMV, Regis CT, de Araujo JSS, Albuquerque FCD, Moser L et al (2015) A telemedicine network for remote paediatric cardiology services in north-east Brazil. Bull World Health Organ 93(12):881–887.

141. Favaro ML, Gabor S, Souza DBF, Araujo AA, Milani ALC, Rocha Junior MAF (2020) Quadratus lumborum block as a single anesthetic method for laparoscopic totally extraperitoneal (Tep) inguinal hernia repair: a randomized clinical trial. Sci Rep. https://doi.org/10.1038/s41598-020-65604-x.

142. Justicz N, Dusseldorp JR, Fuller JC, Leandre M, Jean-Gilles PM, Kim J et al (2019) Using mobile text and media to complement teaching in a facial reconstruction training module in Haiti. J Surg Educ 76(3):762–770.

143. Lopez-Magallon AJ, Saenz L, Gutierrez JL, Florez CX, Althouse AD, Sharma MS et al (2018) Telemedicine in pediatric critical care: a retrospective study in an international extracorporeal membrane oxygenation program. Telemed e-Health 24(7):489–496.

144. Nieto-Calvache AJ, López-Girón MC, Messa-Bryon A, Ceballos-Posada ML, Duque-Galán M, Rios-Posada JGD et al (2019) Urinary tract injuries during treatment of patients with morbidity adherent placenta. J Matern Fetal Neonatal Med 34:3140–3146.

145. Sousa CS, Turrini RNT (2019) Development of an educational mobile application for patients submitted to orthognathic surgery. Rev Lat Am Enfermagem. https://doi.org/10.1590/1518-8345.2904.3143.

146. Bikmoradi A, Masmouei B, Ghomeisi M, Roshanaei G (2016) Impact of tele-nursing on adherence to treatment plan in discharged patients after coronary artery bypass graft surgery: a quasi-experimental study in Iran. Int J Med Inf 86:43–48.

147. Murad MF, Ali Q, Nawaz T, Zia N, Jehan F, Rafiq A et al (2014) Teleoncology: improving patient outcome through coordinated care. Telemed e-Health 20(4):381–384.

148. Aydogdu O, Sen V, Yarimoglu S, Aydogdu C, Bozkurt IH, Yonguc T (2019) The effect of additional teleconsulting on postoperative outcomes, patient and surgeon satisfaction in the patients who underwent percutaneous nephrolithotomy. Arch Esp Urol 72(1):69–74.

149. Erdogan Z, Bulut H (2020) Effectiveness of computer assisted telemedicine in the training of patients undergoing lumbar disc herniation surgery. Turk Neurosurg 30(1):69–77.

150. Özalp Gerçekler G, Karayayız Muslu G, Yardımcı F (2016) Children’s postoperative symptoms at home through nurse-led telephone counseling and its effects on parents’ anxiety: a randomised controlled trial. J Spec Pediatr Nurs 21(4):189–199.

151. Gülşen M, Akansel N (2020) Effects of discharge education and telephone follow-up on cataract patients’ activities according to the model of living. J Perianesth Nurs 35(1):67–74.

152. Güven B, Akyolcu N (2020) Effects of nurse-led education on quality of life and weight loss in patients undergoing bariatric surgery. Bariatr Surg Pract Patient Care 15(2):81–87.

153. Korkmaz S, Iyigun E, Tastan S (2020) An evaluation of the influence of web-based patient education on the anxiety and quality of life of patients who have undergone mammaplasty: a randomised controlled study. J Cancer Educ 35(5):912–922.

154. Lin CY, Lin C (2019) Effects of exercise training and follow-up calls at home on physical activity and quality of life after a mastectomy. Jpn J Nurs Sci 16(3):322–328.

155. Kızılcık Özkaran Z, Unver S, Yıldız Findik Ü, Albayrak D, Fidan Ş (2020) Effect of short message service use on bowel preparation quality in patients undergoing colonoscopy. Gastroenterol Nrs 43(1):89–95.

156. Sayin Y, Kanan N (2010) Reasons for nursing telephone counseling from individuals discharged in the early postoperative period after breast surgery. Nurs Forum 45(2):87–96.

157. Turk E, Karagulle E, Aydogdu C, Oguz H, Tarim A, Karakayali H et al (2011) Use of telemedicine and telephone consultation in decision-making and follow-up of burn patients: initial experience from two burn units. Burns 37(3):415–419.

158. Yanov Y, Kuzovkov V, Sugarova S, Levin S, Lilenko A, Kliachko D (2018) Successful application and timing of a remote network for intraoperative objective measurements during cochlear implantation surgery. Int J Audiol 57(9):688–694.

159. Agrawal R, Mishra SK, Mishra A, Chand G, Agarwal G, Agarwal A et al (2014) Role of telemedicine technology in endocrine surgery knowledge sharing. Telemed e-Health 20(9):688–784.

160. Balachandran R, Kappanayil M, Sen AC, Sudhakar A, Nair SG, Sunil GS et al (2015) Impact of the international quality improvement collaborative on outcomes after congenital heart surgery: a single center experience in a developing economy. Ann Card Anaesth 18(1):52–57.

161. Bansal M, Singh S, Maheshwari P, Adams D, McCulloch ML, Dada T et al (2015) Value of interactive scanning for improving the outcome of new-learners in transcontinental tele-echocardiography (VISION-in-Tele-Echo) study. J Am Soc Echocardiogr 28(1):75–87.

162. Chandrasinghe PC, Srisanghe BNL, Weerasuriya A, Tillakaratne S et al (2020) A novel structure for online surgical undergraduate teaching during the COVID-19 pandemic. BMC Med Educ 20(1):1–7.

163. Dadlani R, Mani S, Au JG, Mohan D, Rajgopalan N, Thakar S et al (2014) The impact of telemedicine in the postoperative care of the neurosurgery patient in an outpatient clinic: a unique
195. Xia L (2020) The effects of continuous care model of information-based hospital-family integration on colostomy patients: a randomized controlled trial. J Cancer Educ 35(2):301–311
196. Xin Y, Li X, Du J, Cheng J, Yi C, Mao H (2019) Efficacy of telephone follow-up in children tonsillectomy with day surgery. Indian J Pediatr 86(3):263–266
197. Xu L, Jonas JB, Cui TT, You QS, Wang YX, Yang H et al (2012) Beijing eye public health care project. Ophthalmology 119(6):1167–1174
198. Yang K, Jin L, Li L, Zeng S, Wei R, Li G et al (2016) Interventions to promote follow-up after trabeculectomy surgery in rural southern China: a randomized clinical trial. JAMA Ophthalmol 134(10):1135–1141
199. Ye J, Zuo Y, Xie T, Wu M, Ni P, Kang Y et al (2016) A telemedicine wound care model using 4G with smart phones or smart glasses: a pilot study. Medicine 95(31):e4198
200. Ye Y, Wang J, Xie Y, Jiang H, Zhong J, He X et al (2016) Global teleophthalmology with the smartphone for microscopic ocular surgery. Eye Contact Lens 42(5):275–279
201. Yu C, Liu C, Du J, Liu H, Zhang H, Zhao Y et al (2020) Smartphone-based application to improve medication adherence in patients after surgical coronary revascularization. Am Heart J 228:17–26
202. Zhang YF, Qiu Y, He JS, Tan JY, Li XZ, Zhu LR et al (2020) Impact of COVID-19 outbreak on the care of patients with inflammatory bowel disease: a comparison before and after the outbreak in South China. J Gastroenterol Hepatol 36:100–709
203. Zhou K, Li J, Li X (2019) Effects of cyclic adjustment training delivered via a mobile device on psychological resilience, depression, and anxiety in Chinese post-surgical breast cancer patients. Breast Cancer Res Treat 178(1):95–103
204. Zhou K, Wang W, Zhao W, Li L, Zhang M, Guo P et al (2020) Benefits of a WeChat-based multimodal nursing program on early rehabilitation in postoperative women with breast cancer: a clinical randomized controlled trial. Int J Nurs Stud 106:103565
205. Zou Q, Zhang G, Liu Y (2018) Health education using telephone and WeChat in treatment of symptomatic uterine myoma with high-intensity focused ultrasound. Med Sci Monit Basic Res 24:127–133
206. Lovecchio F, Riew GJ, Samartzis D, Louie PK, Germscheid N, An HS et al (2020) Provider confidence in the telemedicine spine evaluation: results from a global study. Eur Spine J 30:2109–2123
207. Marttos AC Jr, Moscardi MFJ, Fiorelli RKA, Pust GD, Ginzburg E, Schulman CI et al (2018) Use of telemedicine in surgical education: a seven-year experience. Am Surg 84(8):1252–1260
208. Sciarra AMP, Croti UA, Batigalia F (2014) Information technology implementing globalization on strategies for quality care provided to children submitted to cardiac surgery: international quality improvement collaborative program-IQIC. Braz J Cardiovasc Surg 29:89–92

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.