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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.

References

1. Meara JG, Leather AJM, Hagander L, Alkire BC, Alonso N, Ameh EA, et al. Global Surgery 2030: Evidence and solutions for achieving health, welfare, and economic development. The lancet. 2015;386(9993):569-624.
2. The World Bank. World Bank Country and Lending Groups 2022 [cited 2022 January 20]. Available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups#:~:text=%EF%BB%BF%EF%BB%BF%20For%20the%20current,those%20with%20a%20GNI%20per.
3. Biccard BM, Madiba TE, Kluyts H-L, Munlemvo DM, Madzimbamuto FD, Basenero A, et al. Perioperative patient outcomes in the African Surgical Outcomes Study: a 7-day prospective observational cohort study. The Lancet. 2018;391(10130):1589-98.
4. Holmer H, Lantz A, Kunjumen T, Finlayson S, Hoyler M, Siyam A, et al. Global distribution of surgeons, anaesthesiologists, and obstetricians. The Lancet Global Health. 2015;3:S9-S11.
5. Ozgediz D, Jamison D, Cherian M, McQueen K. The burden of surgical conditions and access to surgical care in low-and middle-income countries. Bulletin of the World Health Organization. 2008;86:646-7.
6. Iddriss A, Shivute N, Bickler S, Cole-Ceesay R, Jargo B, Abdullah F, et al. Emergency, anaesthetic and essential surgical capacity in the Gambia. Bulletin of the World Health Organization. 2011;89:565-72.
7. World Health Organisation. Telemedicine: Opportunities and developments in member states 2010 [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. The role of telemedicine in postoperative care. Mhealth. 2018;4.
9. Harting MT, Wheeler A, Ponsky T, Nwomeh B, Snyder CL, Bruns NE, et al. Telemedicine in pediatric surgery. Journal of pediatric surgery. 2019;54(3):587-94.
10. Park ES, Boedeker BH, Hemstreet JL, Hemstreet GP. The initiation of a preoperative and postoperative telemedicine urology clinic. Medicine Meets Virtual Reality 18: IOS Press; 2011. p. 425-7.
11. Vyas KS, Hambrick HR, Shakir A, Morrison SD, Tran DC, Pearson K, et al. A systematic review of the use of telemedicine in plastic and reconstructive surgery and dermatology. Annals of plastic surgery. 2017;78(6):736-68.
12. Urquhart AC, Antoniotti NM, Berg RL. Telemedicine—an efficient and cost-effective approach in parathyroid surgery. The Laryngoscope. 2011;121(7):1422-5.
13. Bhaskar S, Bradley S, Chattu VK, Adisesh A, Nurtazina A, Kyrykbayeva S, et al. Telemedicine across the globe-position paper from the COVID-19 pandemic health system resilience PROGRAM (REPROGRAM) international consortium (Part 1). Frontiers in public health. 2020;8:644.
14. Chao GF, Li KY, Zhu Z, McCullough J, Thompson M, Claflin J, et al. Use of Telehealth by surgical specialties during the COVID-19 pandemic. JAMA surgery. 2021.
15. Maurice AP, Punnasseril JEJ, King SE, Dodd BR. Improving Access to Bariatric Surgery for Rural and Remote Patients: Experiences from a State-Wide Bariatric Telehealth Service in Australia. Obesity Surgery. 2020;30(11):4401-10.
16. Schroeder C. Pilot study of telemedicine for the initial evaluation of general surgery patients in the clinic and hospitalized settings. Surgery open science. 2019;1(2):97-9.
17. Tolone S, Gambardella C, Brusciano L, Del Genio G, Lucido FS, Docimo L. Telephonic triage before surgical ward admission and telemedicine during COVID-19 outbreak in Italy. Effective and easy procedures to reduce in-hospital positivity. International journal of surgery (London, England). 2020;78:123-5.
18. Wallace DL, Jones SM, Milroy C, Pickford MA. Telemedicine for acute plastic surgical trauma and burns. Journal of Plastic, Reconstructive & Aesthetic Surgery. 2008;61(1):31-6.
19. Gunter RL, Chouinard S, Fernandes-Taylor S, Wiseman JT, Clarkson S, Bennett K, et al. Current Use of Telemedicine for Post-Discharge Surgical Care: A Systematic Review. Journal of the American College of Surgeons. 2016;222(5):915-27.
20. Bullard TB, Rosenberg MS, Ladde J, Razack N, Villalobos HJ, Papa L. Digital images taken with a mobile phone can assist in the triage of neurosurgical patients to a level 1 trauma centre. Journal of telemedicine and telecare. 2013;19(2):80-3.
21. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. International journal of social research methodology. 2005;8(1):19-32.
22. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Annals of internal medicine. 2018;169(7):467-73.
23. Hong QN, Fàbregues S, Bartlett G, Boardman F, Cargo M, Dagenais P, et al. The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. Education for information. 2018;34(4):285-91.
24. Aoki L, Pereira IC, Matayoshi S. Comparative study between conventional camera images and smartphone images for eyelid tumor telediagnosis. Revista do Colegio Brasileiro de Cirurgioes. 2019;46(1).
25. Dogan I, Eroglu U, Ozgural O, Al-Beyati ESM, Kilinc MC, Comert A, et al. Visualization of superficial cerebral lesions using a smartphone application. Turkish Neurosurgery. 2018;28(3):349-55.
26. Latifi R, Mora F, Bekteshi F, Rivera R. Preoperative telemedicine evaluation of surgical mission patients: should we use it routinely? Bulletin of the American College of Surgeons. 2014;99(1):17-23.
27. Hughes C, Campbell J, Mukhopadhyay S, McCormack S, Silverman R, Lalikos J, et al. Remote digital preoperative assessments for cleft lip and palate may improve clinical and economic impact in global plastic surgery. Cleft Palate-Craniofacial Journal. 2017;54(5):535-9.

28. Iyengar K, Paul M, Iyengar SD, Klingberg-Allvin M, Essén B, Bring J, et al. Self-assessment of the outcome of early medical abortion versus clinic follow-up in India: a randomised, controlled, non-inferiority trial. The lancet Global health. 2015;3(9):e537-45.
29. Shalabi HT, Price MD, Shalabi ST, Rodas EB, Vicuña AL, Guzhñay B, et al. Mobile gastrointestinal and endoscopic surgery in rural Ecuador: 20 years' experience of Cinterandes. Surgical Endoscopy. 2017;31(12):4964-72.
30. Utriyaprasit K, Moore SM, Chaiseri P. Recovery after coronary artery bypass surgery: Effect of an audiotape information programme. Journal of Advanced Nursing. 2010;66(8):1747-59.
31. Ambroise B, Benateau H, Prevost R, Traore H, Hauchard K, Dia H, et al. The contribution of telemedicine to humanitarian surgery. Journal of Cranio-Maxillofacial Surgery. 2018;46(8):1368-72.
32. Fan KL, Avashia YJ, Dayicioglu D, DeGennaro VA, Thaller SR. The Efficacy of Online Communication Platforms for Plastic Surgeons Providing Extended Disaster Relief. Annals of plastic surgery. 2014;72(4):457-62.
33. Furr MC, Larkin E, Blakeley R, Albert TW, Tsugawa L, Weber SM. Extending multidisciplinary management of cleft palate to the developing world. Journal of Oral and Maxillofacial Surgery. 2011;69(1):237-41.
34. Toefy Y, Skinner D, Thomsen S. "Please Don't Send Us Spam!" A Participative, Theory-Based Methodology for Developing an mHealth Intervention. JMIR mHealth and uHealth. 2016;4(3).
35. Phaff M, Aird J, Rollinson PD. Delayed implants sepsis in HIV-positive patients following open fractures treated with orthopaedic implants. Injury. 2015;46(4):590-4.
36. Uluer M, Sargin M, Akin F, Uluer E, Sahin O. A randomized study to evaluate post-dural puncture headache after cesarean section: Comparison with median and paramedian approaches. Nigerian Journal of Clinical Practice. 2019;22(11):1564-9.
37. Liu X, Wang Z, Ren H, Ren A, Wang W, Yang X, et al. Evaluating postoperative anal fistula prognosis by diffusion-weighted MRI. European Journal of Radiology. 2020;132.
38. Peng L, Ren L, Qin P, Su M. The impact of patient-controlled analgesia on prognosis of patients receiving major abdominal surgery. Minerva Anestesiologica. 2016;82(8):827-38.
39. Li P, Wang W, Liu Y, Zhong Q, Mao B. Clinical outcomes of 114 patients who underwent Gamma-knife radiosurgery for medically refractory idiopathic trigeminal neuralgia. Journal of Clinical Neuroscience. 2012;19(1):71-4.
40. Wei SY, Li Q, Li SK, Zhou CD, Li FY, Zhou Y. A new surgical technique of hymenoplasty. International Journal of Gynecology and Obstetrics. 2015;130(1):14-8.
41. Wang Q, Peng HL, He L, Zhao X. Reproductive outcomes after previous cesarean scar pregnancy: Follow up of 189 women. Taiwanese Journal of Obstetrics and Gynecology. 2015;54(5):551-3.
42. Gao Q, Yuan L, Wang WP, Shi H, Chen LQ. Factors influencing response enthusiasm to telephone follow-up in patients with oesophageal carcinoma after oesophagectomy. European Journal of Cancer Care. 2014;23(3):310-6.
43. Du M, Liu B, Li M, Cao J, Liu D, Wang Z, et al. Multicenter surveillance study of surgical site infection and its risk factors in radical resection of colon or rectal carcinoma. BMC Infectious Diseases. 2019;19(1).
44. Jiang QL, Huang XH, Chen YT, Zhang JW, Wang CF. Prognostic Factors and Clinical Characteristics of Patients with Primary Duodenal Adenocarcinoma: A Single-Center Experience from China. BioMed Research International. 2016;2016.
45. Jiang Y, Jia N, Zhu M, He Y, Che X, Lv T, et al. Comparison of survival and perioperative outcomes following simple and radical hysterectomy for stage II endometrial cancer: a single-institution, retrospective, matched-pair analysis. Journal of International Medical Research. 2019;47(9):4469-81.
46. Wang Y, Ma JX, Yin T, Han Z, Cui SS, Liu ZP, et al. Correlation Between Reduction Quality of Femoral Neck Fracture and Femoral Head Necrosis Based on Biomechanics. Orthopaedic Surgery. 2019;11(2):318-24.
47. Bian Y, Xiang Y, Tong B, Feng B, Weng X. Artificial intelligence-assisted system in postoperative follow-up of orthopedic patients: Exploratory quantitative and qualitative study. Journal of Medical Internet Research. 2020;22(5).

48. Wang S, Li Y, Fei M, Zhang H, Wang J. Clinical Analysis of the Effects of Different Anesthesia and Analgesia Methods on Chronic Postsurgical Pain in Patients With Uniportal Video-Assisted Lung Surgery. Journal of Cardiothoracic and Vascular Anesthesia. 2020;34(4):987-91.
49. Gushchin AG, Crum AV, Limbu BB, Quigley EP, Seward MS, Tabin GC. Simbu Ptosis: An Outreach Approach to Myogenic Ptosis in Eastern Highlands of Papua New Guinea-Experience and Results from a High-Volume Oculoplastic Surgical Camp. Ophthalmic Plastic and Reconstructive Surgery. 2017;33(2):139-43.
50. Tiwari D, Surianarayanan G, Sundararajan V, Karthikeyan P. Virtual Telephonic Follow-Up for Patients Undergone Septoplasty Amid the COVID Pandemic. Indian Journal of Otolaryngology and Head and Neck Surgery. 2020.
51. Wang X, Xu B, Liang H, Jiang S, Tan H, Wang X, et al. Distribution characteristics and factors influencing oral warfarin adherence in patients after heart valve replacement. Patient Preference and Adherence. 2018;12:1641-8.
52. Starr N, Gebeyehu N, Tesfaye A, Forrester JA, Bekele A, Bitew S, et al. Value and Feasibility of Telephone Follow-Up in Ethiopian Surgical Patients. Surgical Infections. 2020;21(6):533-9.
53. Babigumira JB, Barnhart S, Mendelsohn JM, Murenje V, Tshimanga M, Mauhy C, et al. Cost-effectiveness analysis of two-way texting for post-operative follow-up in Zimbabwe's voluntary medical male circumcision program. PLoS One. 2020;15(9 September).
54. Thakar S, Rajagopal N, Mani S, Shyam M, Aryan S, Rao AS, et al. 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. Neurosurgical Focus. 2018;44(5).
55. Ashry AH, Alsawy MF. Doctor-patient distancing: an early experience of telemedicine for postoperative neurosurgical care in the time of COVID-19. Egyptian Journal of Neurology, Psychiatry and Neurosurgery. 2020;56(1).
56. Aiken AM, Wanyoro AK, Mwangi J, Mulingwa P, Wanjohi J, Njoroge J, et al. Evaluation of surveillance for surgical site infections in Thika Hospital, Kenya. Journal of Hospital Infection. 2013;83(2):140-5.
57. Nguhuni B, De Nardo P, Gentilotti E, Chaula Z, Damian C, Mencarini P, et al. Reliability and validity of using telephone calls for post-discharge surveillance of surgical site infection following caesarean section at a tertiary hospital in Tanzania. Antimicrobial resistance and infection control. 2017;6:43-.
58. Wang Y, Xu M, Li W, Mao Y, Da J, Wang Z. It is efficient to monitor the status of implanted ureteral stent using a mobile social networking service application. Urolithiasis. 2020;48(1):79-84.
59. Li C, Huang S, Su X, Zhang T, Jiang K. Monitoring of home recovery using the 317-nursing mobile application following day-case surgery in children: Perspectives from both nurses and patients. Medicine (United States). 2019;98(31).
60. Zhang QL, Huang ST, Xu N, Wang ZC, Cao H, Chen Q. 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. 2020.
61. Chen M, Li P, Lin F. Influence of structured telephone follow-up on patient compliance with rehabilitation after total knee arthroplasty. Patient Preference and Adherence. 2016;10:257-64.
62. Ding XX, Zhao LQ, Cui XG, Yin Y, Yang HA. Clinical observation of soft palate-pharyngoplasty in the treatment of obstructive sleep apnea hypopnea syndrome in children. World Journal of Clinical Cases. 2020;8(4):679-88.
63. Zhang C, Zhu K, Lin Z, Huang P, Pan Y, Sun B, et al. Utility of Deep Brain Stimulation Telemedicine for Patients With Movement Disorders During the COVID-19 Outbreak in China. Neuromodulation. 2020.
64. Li D, Zhang C, Gault J, Wang W, Liu J, Shao M, et al. 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. Stereotactic and Functional Neurosurgery. 2017;95(3):174-82.
65. Young S, Banza LN, Hallan G, Beniyasi F, Manda KG, Munthali BS, et al. Complications after intramedullary nailing of femoral fractures in a low-income country. Acta Orthopaedica. 2013;84(5):460-7.

66. Machado TMD, Santana RF, Vaqueiro RD, Santos CTBD, Alfradique de Souza P. Telephone follow-up of the elderly after cataract surgery. British Journal of Visual Impairment. 2020;38(2):184-95.
67. Li LL, Gan YY, Zhang LN, Wang YB, Zhang F, Qi JM. The effect of post-discharge telephone intervention on rehabilitation following total hip replacement surgery. International Journal of Nursing Sciences. 2014;1(2):207-11.
68. Rapp DE, Colhoun A, Morin J, Bradford TJ. Assessment of communication technology and post-operative telephone surveillance during global urology mission. BMC Research Notes. 2018;11(1).
69. Wang J, Tong Y, Jiang Y, Zhu H, Gao H, Wei R, et al. The effectiveness of extended care based on Internet and home care platform for orthopaedics after hip replacement surgery in China. Journal of clinical nursing (john wiley & sons, inc). 2018;27(21-22):4077-88.
70. Li L, Ma Z, Wang W. Influence of transitional care on the self-care ability of kidney transplant recipients after discharge. Annals of Palliative Medicine. 2020;9(4):1958-64.
71. Zheng X, Zhao J, Wang Z, Jia B, Zhang Z, Guo J, et al. Postoperative online follow-up improves the quality of life of patients who undergo extraction of impacted madibular third molars: a randomized controlled trial. Clinical Oral Investigations. 2020.
72. Wang QQ, Zhao J, Huo XR, Wu L, Yang LF, Li JY, et al. Effects of a home care mobile app on the outcomes of discharged patients with a stoma: A randomised controlled trial. Journal of Clinical Nursing. 2018;27(19-20):3592-602.
73. Xu LW, Vaca SD, Nalwanga J, Muhumuza C, Vail D, Lerman BJ, et al. Life After the Neurosurgical Ward in Sub-Saharan Africa: Neurosurgical Treatment and Outpatient Outcomes in Uganda. World Neurosurgery. 2018;113:e153-e60.
74. Feldacker C, Murenje V, Holeman I, Xaba S, Makunike-Chikwinya B, Korir M, et al. Reducing Provider Workload while Preserving Patient Safety: A Randomized Control Trial Using 2-Way Texting for Postoperative Follow-up in Zimbabwe's Voluntary Medical Male Circumcision Program. Journal of Acquired Immune Deficiency Syndromes. 2020;83(1):16-23.
75. Madsen C, Lough D, Lim A, Harshbarger RJ, Kumar AR. Cleft and craniofacial care during military pediatric plastic surgery humanitarian missions. Journal of Craniofacial Surgery. 2015;26(4):1097-101.
76. Zhang Z, Li F, Zhang H, Miao Z, Wei Y, Wang L, et al. Development and testing of a mobile phone app for risk estimation of gas volume expansion and intraocular pressure elevation in patients with intravitreous gas or air tamponade: Interobserver assessment study. JMIR mHealth and uHealth. 2019;7(6).
77. Pan Y, Chen H, Chen H, Jin X, Zhu Y, Chen G. Is electronic follow-up using a mobile phone application after mid-urethral sling placement feasible and efficient? World Journal of Urology. 2020.
78. Zhang P, Zhang YG, Liao LM, Shen JW, Yang YB, Zhang JZ, et al. Application of Internet+-based Tsinghua PINS Remote Tech to improve sacral neuromodulation programming procedure. International Urology and Nephrology. 2019;51(4):627-32.
79. Xu X, Cao Y, Luan X. Application of 4G wireless network-based systemfor remote diagnosis and nursing of stomal complications. International Journal of Clinical and Experimental Medicine. 2014;7(11):4554-61.
80. Shi Z, Jiang M, Zhao M, Zhang J, Zhang S, Li L, et al. A follow-up study on urodynamics of children after surgery for hypospadias. Chinese Journal of Pediatric Surgery. 2020;41(9):819-23.
81. Ma Y, Miao S, Zhou R, Zhang Q, Chen H, Liang Y. Application of Remote Deep Brain Stimulation Programming for Parkinson's Disease Patients. World Neurosurgery. 2021.
82. Lin Z, Zhang C, Zhang Y, Dai L, Voon V, Li D, et al. Deep brain stimulation telemedicine programming during the COVID-19 pandemic: Treatment of patients with psychiatric disorders. Neurosurgical Focus. 2020;49(6):1-5.
83. Pathak A, Sharma S, Sharma M, Mahadik VK, Lundborg CS. Feasibility of a mobile phone-based surveillance for surgical site infections in Rural India. Telemedicine and e-Health. 2015;21(11):946-9.
84. Yadav SK, Jha CK, Mishra SK, Mishra A. 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 journal of surgery. 2020;44(2):612-6.

85. Kiranantawat K, Sitpahul N, Taeprasartsit P, Constantinides J, Kruavit A, Srimuninnimit V, et al. The first Smartphone application for microsurgery monitoring: SilpaRamanitor. Plastic and Reconstructive Surgery. 2014;134(1):130-9.
86. Zhang JE, Wong FKY, You LM, Zheng MC, Li Q, Zhang BY, et al. Effects of Enterostomal Nurse Telephone Follow-up on Postoperative Adjustment of Discharged Colostomy Patients. Cancer Nursing. 2013;36(6):419-28.
87. Santana RF, Pereira SK, do Carmo TG, Freire V, Soares TDS, do Amaral DM, et al. Effectiveness of a telephone follow-up nursing intervention in postsurgical patients. International Journal of Nursing Practice. 2018;24(4):e12648.
88. Da Silva Schulz R, Santana RF, Dos Santos CTB, Faleiro TB, Do Amaral Passarelles DM, Hercules ABS, et al. Telephonic nursing intervention for laparoscopic cholecystectomy and hernia repair: A randomized controlled study. BMC Nursing. 2020;19(1).
89. Gong S, Shen WW. Telephone follow-up improves quality of life of postoperative patients with severe acute pancreatitis. Journal of Sichuan University (Medical Science Edition). 2011;42(5):712-5.
90. Demir B, Binnetoglu A, Kersin B, Mammadova U, Kucuk N. Could digital photography be an alternative to postoperative physical examination for pediatric tonsillectomy patients? International Journal of Pediatric Otorhinolaryngology. 2019;123:66-8.
91. Zhang Y, Zhang P, Tian X, Chen G, Li Y, Zhang Y, et al. 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 Journal of Urology. 2019;37(11):2481-92.
92. Padmanaban V, Johnston PF, Gyakobo M, Benneh A, Esinam A, Sifri ZC. Long-Term Follow-Up of Humanitarian Surgeries: Outcomes and Patient Satisfaction in Rural Ghana. Journal of Surgical Research. 2020;246:106-12.
93. Yu L, Zhu Y, Chen W, Bu H, Zhang Y. Incidence and risk factors associated with postoperative stroke in the elderly patients undergoing hip fracture surgery. Journal of Orthopaedic Surgery and Research. 2020;15(1).
94. Ashengo TA, Grund J, Mhlanga M, Hlophe T, Mirira M, Bock N, et al. Feasibility and validity of telephone triage for adverse events during a voluntary medical male circumcision campaign in Swaziland. BMC Public Health. 2014;14(1).
95. Dresser C, Periyanayagam U, Dreifuss B, Wangoda R, Luyimbaazi J, Bisanzo M. Management and Outcomes of Acute Surgical Patients at a District Hospital in Uganda with Non-physician Emergency Clinicians. World J Surg. 2017;41(9):2193-9.
96. Atasayar S, Demir SG. Determination of the Problems Experienced by Patients Post-Thyroidectomy. Clinical Nursing Research. 2019;28(5):615-35.
97. Tasa D, Eslami P, Dashti H, Toosi MN, Zarghami SY, Jafarian A. The successful management of thirty-six hepatopancreatobiliary surgeries under the intensive protective arrangements during the COVID-19 pandemic. Acta Biomedica. 2020;91(3):1-6.
98. Carrillo GM, Mesa ML, Burbano DV. Skills Required in the Care of Cancer Patients Who Undergo Surgery in the Hospital-Home Transition. J Cancer Educ. 2021.
99. Meltzer ME, Congdon N, Kymes SM, Yan X, Lansingh VC, Sisay A, et al. Cost and expected visual effect of interventions to improve follow-up after cataract surgery prospective review of early cataract outcomes and grading (precog) study. JAMA Ophthalmology. 2017;135(2):85-94.
100. Zhang QL, Xu N, Huang ST, Chen Q, Cao H. Effect of using the WeChat platform on the perioperative health education of parents of children who underwent transthoracic device closure of VSDs. Journal of Cardiothoracic Surgery. 2020;15(1).
101. Zhang JE, Wong FK, You LM, Zheng MC. A qualitative study exploring the nurse telephone follow-up of patients returning home with a colostomy. J Clin Nurs. 2012;21(9-10):1407-15.
102. Zheng Q, Yang L, Zeng B, Li J, Guo K, Liang Y, et al. Artificial intelligence performance in detecting tumor metastasis from medical radiology imaging: A systematic review and meta-analysis. EClinicalMedicine. 2021;31.
103. Chen J, Wang X, Qian H, Ye J, Qian J, Hua J. Correlation between common postoperative complications of prolonged bed rest and quality of life in hospitalized elderly hip fracture patients. Annals of Cardiothoracic Surgery. 2020;9(3):1125-33.

104. Lima JLDDA, De Aguiar RALP, Leite HV, Silva HHRM, De Oliveira WM, Sacramento JPTDC, et al. Surveillance of surgical site infection after cesarean section and time of notification. American Journal of Infection Control. 2016;44(3):273-7.
105. Dogan SN, Salt V, Korkmazer B, Arslan S, Islak C, Kocer N, et al. Intrathecal use of gadobutrol for gadolinium-enhanced MR cisternography in the evaluation of patients with otorhinorrhea. Neuroradiology. 2020;62(11):1381-7.
106. Giorgis AT, Alemu AM, Arora S, Gessesse GW, Melka F, Woldeyes A, et al. Results From the First Teleglaucoma Pilot Project in Addis Ababa, Ethiopia. Journal of Glaucoma. 2019;28(8):701-7.
107. Akkoyun I. The advantages of using photographs and video images in telephone consultations with a specialist in paediatric surgery. African Journal of Paediatric Surgery. 2012;9(2):128-31.
108. den Hollander D, Mars M. Smart phones make smart referrals: The use of mobile phone technology in burn care - A retrospective case series. Burns. 2017;43(1):190-4.
109. Koparal M, Ünsal HY, Alan H, Üçkardeş F, Gülsün B. WhatsApp messaging improves communication in an oral and maxillofacial surgery team. International Journal of Medical Informatics. 2019;132.
110. Gulacti U, Lok U, Hatipoglu S, Polat H. An Analysis of WhatsApp Usage for Communication Between Consulting and Emergency Physicians. Journal of Medical Systems. 2016;40(6).
111. Morkel RW, Mann, du Preez G, du Toit J. Orthopaedic referrals using a smartphone app: Uptake, response times and outcome. SAMJ: South African Medical Journal. 2019;109:859-64.
112. Rockwell WT, Agbenorku P, Olson J, Hoyte-Williams PE, Agarwal JP, Rockwell WB. A model for university-based international plastic surgery collaboration builds local sustainability. Ann Plast Surg. 2015;74(4):388-91.
113. Wallis LA, Fleming J, Hasselberg M, Laflamme L, Lundin J. A Smartphone App and Cloud-Based Consultation System for Burn Injury Emergency Care. PLoS One. 2016;11(2):e0147253.
114. Bertani A, Launay F, Candoni P, Mathieu L, Rongieras F, Chauvin F. Teleconsultation in paediatric orthopaedics in Djibouti: Evaluation of response performance. Orthopaedics & Traumatology-Surgery & Research. 2012;98(7):803-7.
115. Hasselberg M, Wallis L, Blessing P, Laflamme L. A smartphone-based consultation system for acute burns - methodological challenges related to follow-up of the system. Glob Health Action. 2017;10(sup3):1328168.
116. Fuzaylov G, Anderson R, Knittel J, Driscoll DN. Global health: Burn outreach program. Journal of Burn Care and Research. 2015;36(2):306-9.
117. Martinez R, Rogers AD, Numanoglu A, Rode H. The value of WhatsApp communication in paediatric burn care. Burns. 2018;44(4):947-55.
118. Kauta NJ, Groenewald J, Arnolds D, Blankson B, Omar A, Naidu P, et al. WhatsApp Mobile Health Platform to Support Fracture Management by Non-Specialists in South Africa. Journal of the American College of Surgeons. 2020;230(1):37-42.
119. Shinn JR, Zuniga MG, Macharia I, Reppart J, Netterville JL, Jayawardena ADL. Community health workers obtain similar results using cell-phone based hearing screening tools compared to otolaryngologists in low resourced settings. International Journal of Pediatric Otorhinolaryngology. 2019;127.
120. Fonseca ASF, Goldenberg DC, Stocchero GF, Costa Luiz AV, Gemperli R. Validation of videoconference with smartphones in telemedicine facial trauma care: Analysis of concordance to on-site evaluation. Annals of plastic surgery. 2016;77(4):433-7.
121. Olldashi F, Latifi R, Parsikia A, Boci A, Qesteri O, Dasho E, et al. Telemedicine for Neurotrauma Prevents Unnecessary Transfers: An Update from a Nationwide Program in Albania and Analysis of 590 Patients. World Neurosurg. 2019;128:e340-e6.
122. McCullough MC, Kulber L, Sammons P, Santos P, Kulber DA. Google glass for remote surgical tele-proctoring in low- And middle-income countries: A feasibility study from Mozambique. Plastic and Reconstructive Surgery - Global Open. 2018;6(12).
123. Datta N, Macqueen IT, Schroeder AD, Wilson JJ, Espinoza JC, Wagner JP, et al. Wearable Technology for Global Surgical Teleproctoring. Journal of Surgical Education. 2015;72(6):1290-5.
124. Goldstein SD, Papandria D, Linden A, Azzie G, Borgstein E, Calland JF, et al. A pilot comparison of standardized online surgical curricula for use in low- and middle-income countries. JAMA Surgery. 2014;149(4):341-6.

125. Nagengast ES, Ramos MS, Sarma H, Deshpande G, Hatcher K, Magee WP, Jr., et al. Surgical education through video broadcasting. Journal of Craniofacial Surgery. 2014;25(5):1619-21.
126. Thapa A, Kc B, Shakya B. Cost Effective Use of Free-to-Use Apps in Neurosurgery (FAN) in Developing Countries: From Clinical Decision Making to Educational Courses, Strengthening Health Care Delivery. World Neurosurg. 2016;95:270-5.
127. Voelker HU, Poetzl L, Strehl A, Mueller-Hermelink HK, Stuefe A, Stauch G. Telepathological evaluation of paediatric histological specimens in support of a hospital in Tanzania. Afr Health Sci. 2020;20(3):1313-21.
128. Sanguansak T, Morley KE, Morley MG, Thinkhamrop K, Thuanman J, Agarwal I. Two-Way Social Media messaging in postoperative cataract surgical patients: Prospective interventional study. Journal of Medical Internet Research. 2017;19(12).
129. Odeny TA, Bailey RC, Bukusi EA, Simoni JM, Tapia KA, Yuhas K, et al. Effect of text messaging to deter early resumption of sexual activity after male circumcision for HIV prevention: A randomized controlled trial. Journal of Acquired Immune Deficiency Syndromes. 2014;65(2):e50-e7.
130. Abaza H, Marschollek M. mHealth application areas and technology combinations. Methods of information in medicine. 2017;56(S 01):e105-e22.
131. The Wall Street Journal. China Emerges as Global Tech, Innovation Leader 2019 [cited 2021 16 September]. Available from: https://deloitte.wsj.com/articles/china-emerges-as-global-tech-innovation-leader-01572483727.
132. Buvik A, Bugge E, Knutsen G, Småbrekke A, Wilsgaard T. Patient reported outcomes with remote orthopaedic consultations by telemedicine: a randomised controlled trial. Journal of telemedicine and telecare. 2019;25(8):451-9.
133. Canon S, Shera A, Patel A, Zamilpa I, Paddack J, Fisher PL, et al. A pilot study of telemedicine for post-operative urological care in children. Journal of telemedicine and telecare. 2014;20(8):427-30.
134. Hakim AA, Kellish AS, Atabek U, Spitz FR, Hong YK. Implications for the use of telehealth in surgical patients during the COVID-19 pandemic. The American Journal of Surgery. 2020;220(1):48-9.
135. Akoko L, Mwanga A, Chikawe M, Lutainulwa E, Ngoma D, Nshalla A, et al. Supervision and support in surgical practice using mobile platform: a case of mass hydrocele surgeries in remote regions. Mhealth. 2019;5:41.
136. Baatjes KJ, Keiller AV, Louw AJ, Van Rooyen M. Point-of-view technology to teach surgery. Clinical Teacher. 2020.
137. Nyamtema A, Mwakatundu N, Dominico S, Mohamed H, Shayo A, Rumanyika R, et al. Increasing the availability and quality of caesarean section in Tanzania. Bjog. 2016;123(10):1676-82.
138. Odeny TA, Bailey RC, Bukusi EA, Simoni JM, Tapia KA, Yuhas K, et al. Text Messaging to Improve Attendance at Post-Operative Clinic Visits after Adult Male Circumcision for HIV Prevention: A Randomized Controlled Trial. PLoS One. 2012;7(9).
139. Chaves RO, De Oliveira PAV, Rocha LC, David JPF, Ferreira SC, Santos ADASD, et al. An Innovative Streaming Video System with a Point-of-View Head Camera Transmission of Surgeries to Smartphones and Tablets: An Educational Utility. Surgical Innovation. 2017;24(5):462-70.
140. da Mata LRF, Azevedo C, Bernardes MFVG, Chianca TCM, Pereira MG, de Carvalho EC. Effectiveness of a home care teaching program for prostatectomized patients: A randomized controlled clinical trial. Revista da Escola de Enfermagem. 2019;53.
141. Mattos SD, Hazin SMV, Regis CT, de Araujo JSS, Albuquerque FCD, Moser L, et al. A telemedicine network for remote paediatric cardiology services in north-east Brazil. Bulletin of the World Health Organization. 2015;93(12):881-7.
142. Favaro ML, Gabor S, Souza DBF, Araújo AA, Milani ALC, Ribeiro Junior MAF. Quadratus Lumborum Block As A Single Anesthetic Method For Laparoscopic Totally Extraperitoneal (Tep) Inguinal Hernia Repair: A Randomized Clinical Trial. Scientific Reports. 2020;10(1).
143. Justicz N, Dusseldorp JR, Fuller JC, Leandre M, Jean-Gilles PM, Kim J, et al. Using Mobile Text and Media to Complement Teaching in a Facial Reconstruction Training Module in Haiti. Journal of Surgical Education. 2019;76(3):762-70.
144. Lopez-Magallon AJ, Saenz L, Gutierrez JL, Florez CX, Althouse AD, Sharma MS, et al. Telemedicine in Pediatric Critical Care: A Retrospective Study in an International Extracorporeal Membrane Oxygenation Program. Telemedicine and E-Health. 2018;24(7):489-96.

145. Nieto-Calvache AJ, López-Girón MC, Messa-Bryon A, Ceballos-Posada ML, Duque-Galán M, Ríos-Posada JGD, et al. Urinary tract injuries during treatment of patients with morbidly adherent placenta. Journal of Maternal-Fetal and Neonatal Medicine. 2019.
146. Sousa CS, Turrini RNT. Development of an educational mobile application for patients submitted to orthognathic surgery. Revista Latino-Americana de Enfermagem. 2019;27.
147. Bikmoradi A, Masmouei B, Ghomeisi M, Roshanaei G. Impact of Tele-nursing on adherence to treatment plan in discharged patients after coronary artery bypass graft surgery: A quasi-experimental study in Iran. International Journal of Medical Informatics. 2016;86:43-8.
148. Murad MF, Ali Q, Nawaz T, Zia N, Jehan F, Rafiq A, et al. Teleoncology: Improving Patient Outcome Through Coordinated Care. Telemedicine and E-Health. 2014;20(4):381-4.
149. Aydogdu O, Sen V, Yarimoglu S, Aydogdu C, Bozkurt IH, Yonguc T. The effect of additional telerounding on postoperative outcomes, patient and surgeon satisfaction rates in the patients who underwent percutaneous nephrolithotomy. Archivos Espanoles de Urologia. 2019;72(1):69-74.
150. Erdogan Z, Bulut H. Effectiveness of computer assisted training of patients undergoing lumbar disc herniation surgery. Turkish Neurosurgery. 2020;30(1):69-77.
151. Özalp Gerçeker G, Karayağız Muslu G, Yardimci F. Children's postoperative symptoms at home through nurse-led telephone counseling and its effects on parents' anxiety: A randomized controlled trial. Journal for Specialists in Pediatric Nursing. 2016;21(4):189-99.
152. Gülşen M, Akansel N. Effects of Discharge Education and Telephone Follow-up on Cataract Patients' Activities According to the Model of Living. Journal of Perianesthesia Nursing. 2020;35(1):67-74.
153. Güven B, Akyolcu N. Effects of Nurse-Led Education on Quality of Life and Weight Loss in Patients Undergoing Bariatric Surgery. Bariatric Surgical Practice and Patient Care. 2020;15(2):81-7.
154. Korkmaz S, Iyigun E, Tastan S. An Evaluation of the Influence of Web-Based Patient Education on the Anxiety and Life Quality of Patients Who Have Undergone Mammaplasty: a Randomized Controlled Study. Journal of Cancer Education. 2020;35(5):912-22.
155. Nemli A, Tekinsoy Kartin P. Effects of exercise training and follow-up calls at home on physical activity and quality of life after a mastectomy. Japan Journal of Nursing Science. 2019;16(3):322-8.
156. Kizilcik Özkan Z, Ünver S, Yildiz Findik Ü, Albayrak D, Fidan Ş. Effect of Short Message Service Use on Bowel Preparation Quality in Patients Undergoing Colonoscopy. Gastroenterology Nursing. 2020;43(1):89-95.
157. Sayin Y, Kanan N. Reasons for nursing telephone counseling from individuals discharged in the early postoperative period after breast surgery. Nursing forum. 2010;45(2):87-96.
158. Turk E, Karagulle E, Aydogan C, Oguz H, Tarim A, Karakayali H, et al. Use of telemedicine and telephone consultation in decision-making and follow-up of burn patients: Initial experience from two burn units. Burns. 2011;37(3):415-9.
159. Yanov Y, Kuzovkov V, Sugarova S, Levin S, Lilenko A, Kliachko D. Successful application and timing of a remote network for intraoperative objective measurements during cochlear implantation surgery. International Journal of Audiology. 2018;57(9):688-94.
160. Agrawal R, Mishra SK, Mishra A, Chand G, Agarwal G, Agarwal A, et al. Role of telemedicine technology in endocrine surgery knowledge sharing. Telemedicine and e-Health. 2014;20(9):868-74.
161. Balachandran R, Kappanayil M, Sen AC, Sudhakar A, Nair SG, Sunil GS, et al. Impact of the International Quality Improvement Collaborative on outcomes after congenital heart surgery: A single center experience in a developing economy. Annals of Cardiac Anaesthesia. 2015;18(1):52-7.
162. Bansal M, Singh S, Maheshwari P, Adams D, McCulloch ML, Dada T, et al. Value of interactive scanning for improving the outcome of new-learners in transcontinental tele-echocardiography (VISION-in-Tele-Echo) study. Journal of the American Society of Echocardiography. 2015;28(1):75-87.
163. Chandrasinghe PC, Siriwardana RC, Kumarage SK, Munasinghe BNL, Weerasuriya A, Tillakaratne S, et al. A novel structure for online surgical undergraduate teaching during the COVID-19 pandemic. BMC Medical Education. 2020;20(1).
164. Dadlani R, Mani S, A.u JG, Mohan D, Rajgopalan N, Thakar S, et al. The impact of telemedicine in the postoperative care of the neurosurgery patient in an outpatient clinic: A unique

perspective of this valuable resource in the developing world - An experience of more than 3000 teleconsultations. World Neurosurgery. 2014;82(3):270-83.
165. Joshi SS, Murali-Krishnan S, Patankar P, Choudhari KA. Neurosurgical referral service using smartphone client WhatsApp: preliminary study at a tertiary referral neurosurgical unit. British Journal of Neurosurgery. 2018;32(5):553-7.
166. Khanna V, Sambandam SN, Gul A, Mounasamy V. "WhatsApp"ening in orthopedic care: a concise report from a 300-bedded tertiary care teaching center. Eur J Orthop Surg Traumatol. 2015;25(5):821-6.
167. Mayadevi M, Thankappan K, Limbachiya SV, Vidhyadharan S, Villegas B, Ouyoung M, et al. Interdisciplinary Telemedicine in the Management of Dysphagia in Head and Neck. Dysphagia. 2018;33(4):474-80.
168. Srivastava V, Pandey V, Tiwari P, Patel S, Ansari MA, Shukla VK. Utility of Real-Time Online Teaching During COVID Era Among Surgery Postgraduates. Indian Journal of Surgery. 2020;82(5):762-8.
169. Sultania M, Muduly DK, Balasubiramaniyan V, Imaduddin M, Ephraim R, Chaudhary I, et al. Impact of the initial phase of COVID-19 pandemic on surgical oncology services at a tertiary care center in Eastern India. Journal of Surgical Oncology. 2020;122(5):839-43.
170. Suryaningtyas W, Wahyuhadi J, Turchan A, Subagio EA, Parenrengi MA, Apriawan T, et al. Neurosurgery at the epicenter of the COVID-19 pandemic in Indonesia: Experience from a Surabaya academic tertiary hospital. Neurosurgical Focus. 2020;49(6):1-8.
171. Uddin MN, Islam FMA. Psychometric evaluation of the modified Kessler seven-item version (K7) for measuring psychological distress using Rasch analysis: A cross-sectional study in a rural district of Bangladesh. BMJ Open. 2020;10(2).
172. Uemura M, Kenmotsu H, Tomikawa M, Kumashiro R, Yamashita M, Ikeda T, et al. Novel, high-definition 3-D endoscopy system with real-time compression communication system to aid diagnoses and treatment between hospitals in Thailand. Asian J Endosc Surg. 2015;8(2):139-47.
173. Wantanakorn P, Harintajinda S, Chuthapisith J, Anurathapan U, Rattanatamrong P. A New Mobile Application to Reduce Anxiety in Pediatric Patients Before Bone Marrow Aspiration Procedures. Hospital pediatrics. 2018;8(10):643-50.
174. Cheng C, Ho RTH, Guo Y, Zhu M, Yang W, Li Y, et al. Development and feasibility of a mobile health-supported comprehensive intervention model (CIMmH) for improving the quality of life of patients with esophageal cancer after esophagectomy: Prospective, single-arm, nonrandomized pilot study. Journal of Medical Internet Research. 2020;22(8).
175. Davis MC, Can DD, Pindrik J, Rocque BG, Johnston JM. Virtual Interactive Presence in Global Surgical Education: International Collaboration Through Augmented Reality. World Neurosurgery. 2016;86:103-11.
176. Dong X, Yi X, Gao D, Gao Z, Huang S, Chao M, et al. The effects of the combined exercise intervention based on internet and social media software (CEIBISMS) on quality of life, muscle strength and cardiorespiratory capacity in Chinese postoperative breast cancer patients:a randomized controlled trial. Health and Quality of Life Outcomes. 2019;17(1).
177. Dong X, Yi X, Ding M, Gao Z, McDonough DJ, Yi N, et al. A longitudinal study of a multicomponent exercise intervention with remote guidance among breast cancer patients. International Journal of Environmental Research and Public Health. 2020;17(10).
178. Dong X, Sun G, Zhan J, Liu F, Ma S, Li P, et al. Telephone-based reminiscence therapy for colorectal cancer patients undergoing postoperative chemotherapy complicated with depression: a three-arm randomised controlled trial. Supportive Care in Cancer. 2019;27(8):2761-9.
179. Feng S, Liang Z, Zhang R, Liao W, Chen Y, Fan Y, et al. Effects of mobile phone WeChat services improve adherence to corticosteroid nasal spray treatment for chronic rhinosinusitis after functional endoscopic sinus surgery: a 3-month follow-up study. European Archives of Oto-Rhino-Laryngology. 2017;274(3):1477-85.
180. Ferraris KP, Golidtum JP, Zuñiga BKW, Bautista MCG, Alcazaren JC, Seng K, et al. Recapitulating the Bayesian framework for neurosurgical outpatient care and a costbenefit analysis of telemedicine for socioeconomically disadvantaged patients in the Philippines during the pandemic. Neurosurgical Focus. 2020;49(6):1-9.

181. Hou J, Yang R, Yang Y, Tang Y, Deng H, Chen Z, et al. The effectiveness and safety of utilizing mobile phone-Based programs for rehabilitation after lumbar spinal surgery: Multicenter, Prospective randomized controlled trial. JMIR mHealth and uHealth. 2019;7(2).
182. Huang G, Crooms R, Chen Q, Congdon N, He M. Compliance with follow-up after cataract surgery in Rural China. Ophthalmic Epidemiology. 2012;19(2):67-73.
183. Huang J, Luo Q, Tan Q, Lin H, Qian L, Lin X. Initial experience of robot-assisted thoracoscopic surgery in China. International Journal of Medical Robotics and Computer Assisted Surgery. 2014;10(4):404-9.
184. Li HL, Chan YC, Huang JX, Cheng SW. Pilot Study Using Telemedicine Video Consultation for Vascular Patients' Care During the COVID-19 Period. Annals of Vascular Surgery. 2020;68:76-82.
185. Li M, Zhang M, Wang H, Pan X, Wu W, Zhang Q, et al. The efficacy of internet-based intervention on quality of life for patients with chronic post-surgical pain. Iranian Journal of Public Health. 2016;45(12):1604-9.
186. Lin H, Chen W, Luo L, Congdon N, Zhang X, Zhong X, et al. Effectiveness of a short message reminder in increasing compliance with pediatric cataract treatment: a randomized trial. Ophthalmology. 2012;119(12):2463-70.
187. Liu J, Zheng X, Chai S, Lei M, Feng Z, Zhang X, et al. Effects of using WeChat-assisted perioperative care instructions for parents of pediatric patients undergoing day surgery for herniorrhaphy. Patient Education and Counseling. 2018;101(8):1433-8.
188. Liu J, Zheng X, Zhang X, Feng Z, Song M, Lopez V. The Evidence and Future Potential of WeChat in Providing Support for Chinese Parents of Pediatric Patients Undergoing Herniorrhaphy. Journal of Transcultural Nursing. 2020;31(2):114-20.
189. Qiu Y, Liu Y, Ren W, Qiu Y, Ren J. Internet-Based and Mobile-Based General Practice: Cross-Sectional Survey. J Med Internet Res. 2018;20(9):e266.
190. Qiu Y, Zhang YF, Zhu LR, He JS, Tan JY, Tan ND, et al. Impact of COVID-19 on the Healthcare of Patients With Inflammatory Bowel Disease: A Comparison Between Epicenter vs. Non-epicenter Areas. Frontiers in Medicine. 2020;7.
191. Qu J, Du J, Rao C, Chen S, Gu D, Li J, et al. Effect of a smartphone-based intervention on secondary prevention medication prescriptions after coronary artery bypass graft surgery: The MISSION-1 randomized controlled trial. Am Heart J. 2021;237:79-89.
192. Shen Y, Fang Y, Wu D, Bai J, Lin Y. Application of WeChat-assisted peri-operative care in children with congenital megacolon. Journal of Paediatrics and Child Health. 2020;56(10):1551-6.
193. Shen Z, Zheng F, Zhong Z, Ding S, Wang L. Effect of peer support on health outcomes in patients with cardiac pacemaker implantation: a randomized, controlled trial. Nursing & health sciences. 2019;21(2):269-77.
194. Wong IYH, Ni MY, Wong IOL, Fong N, Leung GM. Saving sight in China and beyond: the Lifeline Express model. BMJ global health. 2018;3(4).
195. Xia L. The Effects of Continuous Care Model of Information-Based Hospital-Family Integration on Colostomy Patients: a Randomized Controlled Trial. Journal of Cancer Education. 2020;35(2):301-11.
196. Xin Y, Li X, Du J, Cheng J, Yi C, Mao H. Efficacy of telephone follow-up in children tonsillectomy with day surgery. Indian journal of pediatrics. 2019;86(3):263-6.
197. Xu L, Jonas JB, Cui TT, You QS, Wang YX, Yang H, et al. Beijing Eye Public Health Care Project. Ophthalmology. 2012;119(6):1167-74.
198. Yang K, Jin L, Li L, Zeng S, Wei R, Li G, et al. Interventions to promote follow-up after trabeculectomy surgery in rural southern China: A randomized clinical trial. JAMA Ophthalmology. 2016;134(10):1135-41.
199. Ye J, Zuo Y, Xie T, Wu M, Ni P, Kang Y, et al. A telemedicine wound care model using 4G with smart phones or smart glasses: A pilot study. Medicine (United States). 2016;95(31).
200. Ye Y, Wang J, Xie Y, Jiang H, Zhong J, He X, et al. Global Teleophthalmology with the Smartphone for Microscopic Ocular Surgery. Eye and Contact Lens. 2016;42(5):275-9.
201. Yu C, Liu C, Du J, Liu H, Zhang H, Zhao Y, et al. Smartphone-based application to improve medication adherence in patients after surgical coronary revascularization. American Heart Journal. 2020;228:17-26.

202. Zhang YF, Qiu Y, He JS, Tan JY, Li XZ, Zhu LR, et al. Impact of COVID-19 outbreak on the care of patients with inflammatory bowel disease: A comparison before and after the outbreak in South China. Journal of Gastroenterology and Hepatology. 2020.
203. Zhou K, Li J, Li X. 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 Research and Treatment. 2019;178(1):95-103.
204. Zhou K, Wang W, Zhao W, Li L, Zhang M, Guo P, et al. Benefits of a WeChat-based multimodal nursing program on early rehabilitation in postoperative women with breast cancer: a clinical randomized controlled trial. International Journal of Nursing Studies. 2020;106:103565-.
205. Zou Q, Zhang G, Liu Y. Health Education Using Telephone and WeChat in Treatment of Symptomatic Uterine Myoma with High-Intensity Focused Ultrasound. Medical science monitor basic research. 2018;24:127-33.
206. Lovecchio F, Riew GJ, Samartzis D, Louie PK, Germscheid N, An HS, et al. Provider confidence in the telemedicine spine evaluation: results from a global study. European Spine Journal. 2020.
207. Marttos AC, Jr., Moscardi MFJ, Fiorelli RKA, Pust GD, Ginzburg E, Schulman CI, et al. Use of telemedicine in surgical education: A seven-year experience. American Surgeon. 2018;84(8):1252-60.
208. Sciarra AMP, Croti UA, Batigalia F. Information technology implementing globalization on strategies for quality care provided to children submitted to cardiac surgery: International Quality Improvement Collaborative Program-IQIC. Brazilian Journal of Cardiovascular Surgery. 2014;29:89-92.