



## Review

# Current and future use of telemedicine in surgical clinics during and beyond COVID-19: A narrative review



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## ARTICLE INFO

## Keywords:

Telemedicine  
Telehealth  
Videoconference  
Outpatient  
Surgical clinic  
COVID-19

## ABSTRACT

**Introduction:** Telemedicine has emerged as a powerful tool in the delivery of healthcare to surgical patients and enhances clinician-patient encounters during all phases of patient care. Our study aims were: to review the current use and applicability of telemedicine; evaluate its suitability, safety and effectiveness in a surgical outpatient setting, particularly in the era of social distancing restrictions and provide insight into future applications.

**Methods:** Databases searched included: PubMed, OVID Medline, Embase, Scopus, Web of Science and review of reference lists. Key words used were “telemedicine”; “telehealth”; “videoconference”; “outpatient” and “surgical clinic”. For inclusion, articles required to be in English, published between 2000 and 2021, were in an outpatient surgical setting and if they had a focus during the COVID-19 pandemic.

**Results:** 335 articles were identified and screened, so that 63 articles were included in the review. Almost all articles were from Western countries (n = 60), mostly in surgical journals (n = 35) and from a range of sub-specialties, but pre-dominantly orthopaedics (n = 12) and general surgery (n = 7). The majority were original comparative studies where 31 studies directly compared telemedicine to in-person appointments and 14 papers focused on implementation during COVID-19.

**Discussion/conclusions:** Telemedicine has been safely used across various phases of surgical outpatient care, with its effectiveness evaluated by clinical outcomes, economics and user/provider satisfaction. Telemedicine has multiple accepted benefits including time efficiency, patient/healthcare cost savings and community access, but with reported limitations of clinical uncertainty, technology infrastructure requirements, cybersecurity vulnerabilities and healthcare regulatory restraints. These limitations are being overcome by accelerated implementation during COVID-19 via fast-tracked practice development. Further work is required via development of research protocols to refine the application of emerging telemedicine technologies and their applicability to different surgical sub-specialties.

## 1. Introduction

COVID-19 restrictions have challenged surgical outpatients; an important interface for provider-consumer interaction, where telemedicine is used as an adjunct for healthcare delivery. The World Health Organisation defines telemedicine as the mode for, “...the delivery of

health-care services, where distance is a critical factor, by all health-care professionals ... with the aim of advancing the health of individuals and communities” [1]. Its implementation into routine healthcare systems has been slow [2-4] due to challenges in financing development, technology and organisational infrastructure, as well as lack of legal guidelines, stringent healthcare regulatory policy and limited

**Abbreviations:** SMS, Short Message Service; PROMs, patient reported outcome measures; COSMIN, Consensus-based Standards for the selection of health Measurements Instruments; RCT, Randomised Control Trial.

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<https://doi.org/10.1016/j.amsu.2021.102378>

Received 22 April 2021; Accepted 28 April 2021

Available online 8 May 2021

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remuneration [5-10]. Nonetheless, with advances in technology, changes in practice demands in recent years and in particular social distancing restrictions, telemedicine has gained popularity with greater utilization in outpatient settings, including surgery [11]. A range of telemedicine modalities can be used separately, or in unison, by the patient and healthcare provider to optimise communication levels whilst located remotely from one another [12,13]. Telemedicine encompasses telephone, videoconferencing interaction, engagement of consumers remotely via advanced medical tablets in a ‘virtual exam room’ [14], through smartphone SMS and application technology [15-17], via established social media networks [18] or even access real-time diagnostic elements (such as remote video-otoscopy [19]). In surgical clinics, an appropriate means to substitute for key points of assessment is essential due to the interventional nature of surgery. Reports have evaluated surgical care in pre-operative assessment, post-operative monitoring, routine follow-up and monitoring of patient well-being [9,12,13]. There have been rapid advances in technology and studies confirm continued access to healthcare by the community [4,7,8, 11,18,20-23]. Despite initial challenges, protocol development and advancing sophistication in technologies have allowed rapid transition to online communication platforms [9,15,17,20]. The current universal uptake of telemedicine suggests longevity in its application to surgical care, as patients and providers become increasingly accustomed to its

use. Its application has provided insights into how new technologies can be instituted into modern medicine.

In this study, we review current evidence for the use of telemedicine in surgical outpatient clinics and in particular, investigate its utility during the COVID-19 pandemic. Our aims are to review aspects of surgical outpatient telemedicine, establish evaluation for effectiveness and explore new aspects of technologies that enable telemedicine use.

## 2. Methods

We took a narrative review with a systematic approach and sought to answer the question, “How has telemedicine been applied and evaluated in surgical outpatient clinics, particularly in an era of COVID-19 and what advances exist that will continue?” The search strategy was in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [24] (Fig. 1). Computerized literature searches of databases were performed on 20<sup>th</sup> August 2020 and updated 8<sup>th</sup> February 2021 using PubMed, OVID Medline, Embase, Scopus, Web of Science and review of reference lists. Key words used included: “telemedicine”; “telehealth”; “videoconference”; “outpatient” and “surgical clinic”. Combination of terms formed the search strategy (Appendix A) and articles were recorded. We screened each title and abstract of the articles according to inclusion criteria (Appendix B): articles in English,

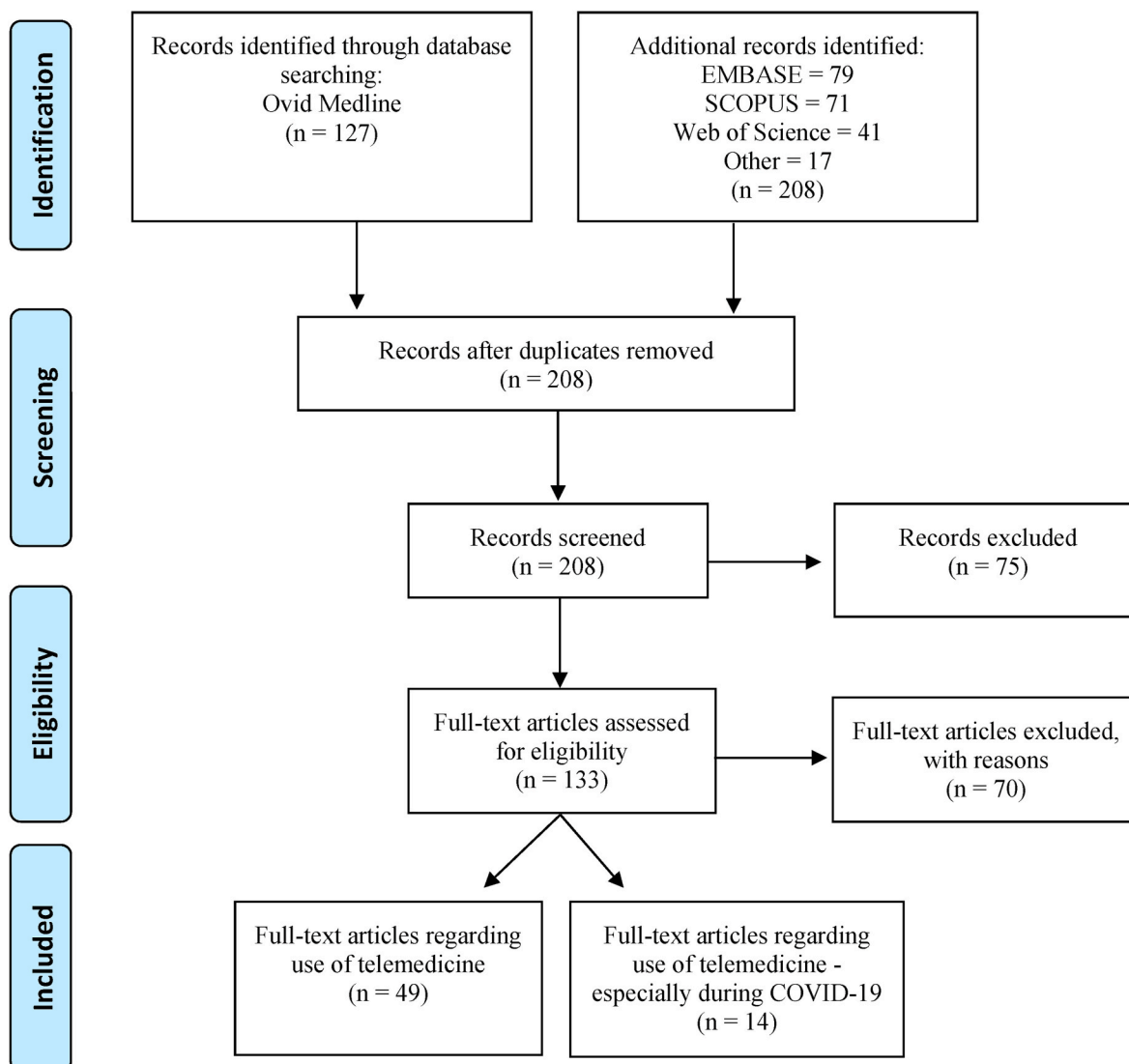


Fig. 1. PRISMA flow diagram of included papers (24).

published between 2000 and 2021, when telemedicine research was developing, and in an outpatient surgical setting. A subgroup of articles published after 2019 were collated for COVID-19 related telemedicine.

### 3. Results

Fig. 1 illustrates the PRISMA [24] flow chart of the process and results. A total of 335 initial studies were identified. After removing duplicates and screening, the abstracts of 133 studies were reviewed and the full text of 63 articles were included (Appendix C). Included articles summarised in Table 1 were mostly published between 2016 and 2021 (n = 47) and the authors were mainly from the United States (n = 30) and other Western countries (Australia (n = 4), Norway (n = 4), United Kingdom (n = 5)). They detailed a range of surgical sub-specialties, predominately orthopaedics (n = 12), general surgery (n = 7), paediatrics (n = 6) and neurosurgery (n = 6). 44 were original comparative studies, 13 were review papers and 7 were perspective pieces that included 2 position statement papers. 31 studies directly compared telemedicine to face-to-face outpatient appointments whilst 14 papers focused on the implementation of telemedicine during the COVID-19 pandemic.

### 4. Discussion

Our systematic approach has identified a range of published articles, mainly from Western countries and across surgical sub-specialties, that outline adaptation and innovation of telemedicine in surgical clinics. These challenge the current model for delivery of outpatient care with clear benefits for use and exciting future advances. However, there are limitations and areas that require development.

#### 4.1. Effective surgical outpatient care – key components

Surgical outpatients were quick to adapt the existing model of care in response to social distancing requirements [4,11]; key changes were outlined in position statements for surgical societies [25], leveraging on existing studies of telemedicine use. Strong infrastructure and

administrative support are required for effective telemedicine [25]. Providers and consumers require access to multiple channels of communication to be effective (e.g., telephone, video conference, digital/social media). For example, consent for procedures is an essential component of surgical patient care, of which the discussed information should be reinforced both via telemedicine modalities and preferably in-person prior to a procedure. For co-ordination, strong administration support ensures proper scheduling, information access and recording, review of investigations, management plans and effective follow up. Communication for enhanced teamwork between health care providers ensures streamlined co-ordinated care.

#### 4.2. Safety profile

The majority of articles clearly prove safety in post-operative follow up. Nine articles discussed the application of telemedicine in post-operative surgical outpatient care, concentrating on routine, low complexity surgical patients [9,13,17,22,26–30]. Good level of evidence for safety was reported in six comparative studies (including two randomised controlled trials), where post-operative follow-up in low-acuity, low-risk surgery was via telemedicine [9,13,26,27,30,31]. Where telemedicine appointment was used as an alternative, seven studies in a range of sub-specialties indicate that complication rates in low-operative risk surgical patients, show no statistical difference between in-person follow-up compared to telemedicine [9,13,27–29,32,33]. Furthermore, Sudan et al. extended the criteria to include routine post-operative follow-up of a cohort of bariatric patients -an intrinsically high-risk patient population [34]. All these studies were prior to COVID-19 and in Western countries where “safety net” in-person appointments could be scheduled as needed and patients had access to assessment (in the primary care setting or emergency departments) as required. Overall, these articles show clinical safety in telemedicine appointments in this population [9,26,28] and contend that healthcare resources may be better utilised if telemedicine replaced these consults for low-risk surgical patients [26,28].

**Table 1**  
General Characteristics of Identified Articles on the Use of Telemedicine in Surgical Outpatient Clinics (N = 63)

Year of Publication:	2000-2005 (n=5)	2006-2010 (n=6)	2011-2015 (n=5)	2016-2020 (n=47)
<b>Country of Origin:</b>	UK (n=5) Australia (n=4) Norway (n=4) Spain (n=3) Finland (n=3) Italy (n=3) Germany (n=2) Netherlands (n=2) India (n=2) Canada (n=1) Egypt (n=1) France (n=1) Ireland (n=1) Saudi Arabia (n=1)	Remainder from the USA (n=30)		
<b>Surgical Sub-specialty:</b>	Orthopaedics (n=12) General surgery (n=7) Paediatrics (n=6) Neurosurgery (n=6) Urology (n=4)	Vascular surgery (n=3) Cardiothoracic surgery (n=3) Gynaecology (n=3) Otolaryngology (n=3) Colorectal surgery (n=2)	Hand & upper extremity surgery (n=1) Maxillofacial (n=1) Anaesthesiology (n=1)	A review study with no speciality focus (n=10)
<b>Type of Journal:</b>	Surgical (n=35)	Health service research (n=19)	Educational (n=9)	
<b>Type of Article:</b>	Review (n=13)	Perspective piece (n=6)	RCT (n=12) Observational, retro-/prospective (n=20) Cohort, prospective (n=8) Pilot (n=3) Case report (n=1)	

#### 4.3. Effective telemedicine -screening is key

COVID-19 social distancing protocols determine key adjustments for telemedicine use as an effective adjunct [4,7,11,35]. At the onset of the pandemic, telemedicine triage criteria were developed to screen patient cases [4,36], which highlights that patient selection is a crucial component in effective telemedicine. Key elements included doctor and patient digital literacy and communication access, the purpose of the appointment (e.g., new, review, acute, emergency), availability of adequate investigations, requirement for in-person examinations (e.g., wound reviews), allied health availability and provision for a safety net face-to-face appointment if required. Further criteria for suitability included [13,26,27]: (1) stratifying patients according to their in-patient surgical course and need for hands-on intervention in their follow-up [26], (2) use of a scoring system based on individual complication risk and clinical evolution [27] and (3) use of patient demographics (age, first language, health literacy). In spite of established criteria, the majority of surgical outpatients were forced to run as telemedicine during widespread community circulation of COVID-19. Fortunately, there have been minimal reports of poor outcomes. The surgical outpatient-care model will continue to evolve with greater implementation of telemedicine as long-term data is reported.

#### 4.4. Telemedicine across surgical patient care -further application

Three articles reviewing the role of telemedicine across a range of surgical sub-specialities (Table 1) have found this to be a useful technology in the pre-operative, post-operative and long-term follow-up of surgical care [9,12,13]. Regarding pre-operative use of telemedicine and using subsequent in-person appointments as the control, a systematic review by Asiri et al. identified three studies where telemedicine was as accurate as conventional clinics for pre-operative diagnosis [12]. This is supported by Wood et al. who found that pre-operative assessments via videoconference were 95.9% accurate in diagnosis and management plans when in-person assessment was subsequently performed [10]. Importantly, there were no significant differences observed in achieving decisions for interventions [10,37]. Yen et al. details a more balanced approach in the form of a “hybrid system” in pre-operative anaesthetic assessment. This article used telemedicine guided screening questionnaires to stratify patients for ‘fitness’ for surgery, which then streamlined efficient use of medical staff during the in-person consultation [38]. On the other hand, some population groups may not be suitable for exclusive telemedicine. A retrospective review conducted by Laferriere et al. excluded telemedicine because of communication difficulties [39] for pre-operative evaluation in paediatric patients. Further enhancement of pre-operative care includes multi-disciplinary care meetings [11], performed virtually, which ensure adequate input from all sub-specialities. Efficiency is also improved as telemedicine can offer multidisciplinary team review for patients in a single telemedicine visit, aiding co-ordinated and convenient care [11,40,41]. Grenda et al. details how new patients in a lung cancer clinic were evaluated by the thoracic surgeon, medical oncologist and radiology oncologist in the same sitting via a ‘log-in, log-out’ manner [11].

In the post-operative period beyond routine appointments, Williams et al. identified that telemedicine technologies were useful in monitoring and management of post-operative issues [9]. A systemic review by Lu et al. further explored the use of SMS and mobile application-based interventions to report and directly monitor post-operative symptoms [17]. This implementation of telemedicine permitted efficient symptom reporting and management, but also reminded patients to perform positive health-related activities, thus increasing treatment adherence and ultimately encouraged patient empowerment. Overall efficiency was also noted by Asiri et al. who

summarised four studies where a mobile video device-assisted reporting system was used by patients for wound assessment. This protocol improved post-operative follow-up decreasing the need for patients to attend ambulatory care for routine wound checks [12]. Machine learning and virtual reality are also being developed to assist with post-operative wound assessment [16].

Telemedicine has also shown utility in the management of long-term follow-up. Parkes et al. details an orthopaedic department initiative, whereby an automated web-based system electronically sent 3-monthly reminders to patients to complete PROMs [42], a system tailored for long-term (10–20 years) orthopaedic joint replacement follow-up. Similarly, this online-based patient follow-up was used in an RCT (n = 60) by Cullington et al. to monitor function and hearing for cochlear implants [43]. Urology clinics have used telemedicine screening for high-risk recurrent renal calculi patients and for patient behavioural and physiotherapy training for urinary incontinence [44]. All systems showed improved health outcomes due to the benefit of patient empowerment and self-management [43]. However, there remains limited research into telemedicine effectiveness in long-term surveillance of oncology surgical patients—a significant proportion of surgical outpatient clinic volumes.

#### 4.5. Evaluating the effectiveness of telemedicine: clinical outcome, economics & satisfaction

The aim of most telemedicine services is to improve delivery of clinical care; the degree to which this is achieved should be assessed to understand its value to improve healthcare services [2]. Al Dossary et al. systemic review (164 studies) revealed three methods of evaluation used in outpatient care: clinical outcomes, economics and satisfaction [2]. These three methods should be used for ongoing evaluation of future technologies.

Clinical outcomes of telemedicine compare in-person to telemedicine health outcomes and acceptability. The safety profile in low-risk surgery is well established [27,33,45,46] and can be enhanced by using standardised evaluation questionnaires [47], particularly in recognising complications. Viers et al. reviewed effectiveness of clinical outcomes from the clinician perspective, finding no difference in their RCT (n = 55) for provider-perceived quality of medical history, or therapeutic management between video-consultation and face to face 3-month follow-up [48]. The importance of availability of in-person appointments is noted when uncertainty in the clinical encounter exists [30,46,49].

For healthcare, economic evaluation assesses viability and sustainability of telemedicine services. This is mainly performed by a simple cost analysis of the service or by a cost minimisation analysis of the benefit obtained [2]. From a patient perspective, eleven studies showed significant savings relating to travel costs [28,31,34,50–52], loss of income due to missed work [48–50,53] and reduced time burden [13,45,51] -particularly for rural and remote communities. From the healthcare service perspective, six studies focus on effective reduction of overall cost, relating mainly to resource use and staff salary expenses [32,50,54] and estimated overall financial savings when studied retrospectively [10,39,55]. However, Al Dossary et al. suggests that systematic and rigorous economic assessment is required across multiple facets of service provision and across institutions, to encourage a more widespread adoption of telemedicine programs [2].

Satisfaction level evaluation of telemedicine also highlights effectiveness and quality of care. Consumer questionnaires and surveys have been used extensively to assess this, noting limitations to the validity of the tools used [2]. A systematic review by Barsom et al. compared questionnaires used in research for video-consultations and found a heterogeneous set of questions used to measure patient satisfaction

without robust validation processes in accordance to *COSMIN* criteria [3]. Nonetheless, 27 studies present overall favourability and high patient satisfaction across surgical sub-specialties [5–7,9,12–15,18,19,27,28,32–34,38,45–48,54,56–61]. In addition, clinician satisfaction has been reported in two systematic reviews with ease of use, convenience and efficiency evaluated positively [13,17]. However, a level of clinician dissatisfaction towards telemedicine is also reported, with three review studies highlighting a constant patient-to-provider connection entails significant provider work burden [15,18,62]. Greater clinician administrative work is also required, especially if away from clerical support (such as working from home). Further evaluation directly comparing different telemedicine modalities (e.g., SMS, mobile app., telephone, videoconference etc.) in surgical outpatient care via focus groups and surveys, would provide insight into suitability and benefit gained for the patient and clinician. The evaluation may focus on the effectiveness of communication during the patient-provider interaction, confidence and technology evaluation.

4.6. Benefits & limitations of telemedicine

As telemedicine continues to evolve and integrate into surgical outpatient care, the benefits and limitations (Table 2) will dictate its future applications (Table 3). Three studies report definitive improved efficiency in healthcare delivery [6,7,12], from factors such as reduced ‘cycle-time’ between patients and freeing up additional appointments without the need to expand physical capacity [6]. Regarding the duration of the appointment, video-consultation appears to be equivalent in time efficiency when compared to face-to-face consultations [48,63]. Remote consultations also permit specialist clinicians to access multiple locations, thus reducing travel time to physical spaces.

Healthcare services benefit from a potential annual saving amounting to €12,600, however, this benefit is only obtained with approximately 300 consultations per year via videoconference to offset the costs of implementing and running a videoconferencing system (€20,684) [50]. This value can be enhanced if additional telemedicine clinic slots are opened, generating increased revenue for the healthcare service [29]. The potential financial benefit of using telemedicine services for rural populations is significant. In a retrospective review of a ‘tele-paediatric’ service conducted in Queensland, Australia, a potential saving of AUD \$600,000 over a 5-year period was observed for the health service provider [55]. An effective telemedicine service may present a desirable solution to alleviate some financial burden that healthcare delivery to rural communities entails.

Effective telemedicine also offers the advantage of improved access

to healthcare – particularly to remote communities. A ‘hub and spoke’ healthcare system design is described by Laferriere et al. whereby a central specialist tertiary hospital (hub) connects to regional medical centres via a telemedicine service (spokes) [39]. For the past two decades, Veteran Affairs hospitals in the USA have studied the utility of telemedicine with this decentralised design of healthcare [9]. Both Sudan et al. and Dirnberger et al. found veterans experienced significantly reduced travel distance, time and costs –all of which improve access to healthcare [28,34]. It also brought expertise directly to patients, narrowing the gap between the provider and patient.

Nonetheless, the advantages of telemedicine are met with several limitations. Most notably, there has been little change to concerns of clinical barriers for complex patients who need examination or complex interaction [18,23,36,64]. “Unreliability” concerns with patients down-grading signs and symptoms via telephone consultation [56] remains a challenge as consultation via telephone is a popular mode of telemedicine used by clinician and patient, which may be improved with increased video-conferencing use. However, there may be appropriate adjuncts such as real-time investigations (such as video otoscopy in ENT patients) which may compensate for this [5]. Furthermore, there remains technology infrastructural and technological literacy challenges opposing widespread use of telemedicine, especially in developing countries [18]. Moreover, strict regulation, reimbursement concerns and cybersecurity vulnerabilities are noted as major barriers to universal uptake of telemedicine [2,9,13]. Nonetheless, the COVID-19 pandemic has seen drastic changes to the regulations governing telemedicine use, allowing for accelerated implementation [4,7,8,11]. Protocol development and adequate remuneration has eased implementation concerns.

With patients and hospital systems now well informed and accustomed to using telemedicine, now may be the time to consider permanent establishment of current temporary waivers for the use of telemedicine [40]. Once considered not appropriate for telemedicine [8,22], the pandemic has debunked the myth that telemedicine is unsafe for the management of surgical patients. This highlights the potential future benefits with greater use of telemedicine. The previous limitations of technology illiteracy and patient-provider willingness [18,20] in the community have been broken-down out of necessity by the pandemic.

4.7. Study strengths and limitations

The review provides a systematic and current assessment of the use of telemedicine in outpatient surgical care, from a patient and clinician perspective and includes a broad range of studies from different healthcare systems and for different surgical sub-specialties. Although

**Table 2**  
Benefits and limitations of telemedicine identified in the included articles.

Benefits:	Limitations:
Time Efficiency [6,7,11–13,26,40,41,46,48,56,63] Reduced Patient Cost & Time Savings [12,13,19,28,30,39,46,48–50,52,53]	Clinical Barriers e.g. diagnostic and management uncertainty [5,18,19,23,56] Technological Infrastructure: limitations in developing nations, low SES communities, ethnic background or in the elderly population [5,9,12,13,18–20,26,42,46]
Healthcare Service Cost Savings [5,9,10,32,50,55,62] Improved Access to Healthcare [5–7,12,28,34,39,52] Patient Empowerment & Engagement [15,17,20,43]	Strict Healthcare System Regulation [2,6,7,9,49] Remuneration Concerns [5,6,8,9,11,48,49] Cybersecurity Vulnerabilities [5,9,12,13,17,18,59]

**Table 3**  
Novel and future application of telemedicine technology.

Patient Use:	Clinician Use:
Wound monitoring via patient’s smart-phone camera [16] Innovative medical applications accessed via the patient’s smartphone [15,23]	Portable and wireless home-monitoring telemetry systems [5,36] Automated web-based follow-up systems, reminding patients for a review, with results sent directly back to the clinician [42]
Patient Empowerment and engagement with health-related activities [15,17,20,43] Simultaneous MDT consultations with patient/carer/support person [11,40,41]	GP and other community support group education and interaction [7,54] Clinician engagement with MDT members during a single consultation with the patient/carer/support person [11,40,41]
Opportunity for culturally appropriate and multilingual information distribution via smartphone applications	Reaching communities not speaking the predominant language of the country in a culturally sensitive way

this review was conducted via a systematic approach, grey literature databases, which may contain further studies, were excluded. Publication bias of favourable results exist in all reported studies. A quality analysis was not conducted. Selection bias for low-risk patients in many studies was noted.

## 5. Conclusion

Telemedicine has emerged as a necessary and powerful tool in the delivery of safe [27,29,32], effective [18,22,32,63,65] healthcare to surgical patients. Studies have shown its role across all phases of surgical outpatient care. Its rapid implementation into surgical clinics has alleviated some of the challenges faced during COVID-19 and indicate its robust capabilities and future potential. Further work is required for the development of long-term data research protocols, to refine specific fields of telemedicine and their applicability to different surgical sub-specialties. In addition, more rigorous economic evaluation can determine the broad financial impact of implementing a routine telemedicine service in individual hospitals and across nationwide healthcare systems. As the pandemic extends for the unforeseeable future, the role of telemedicine will remain a vital component for continued healthcare delivery [21].

## Ethical Approval

No ethical approval was given.

## Sources of funding

No sources of funding.

## Author contribution

Thomas McMaster: Conceptualization, Data curation, Formal analysis, Investigation, Writing - original draft preparation, Writing - review & editing. Dr. Timothy Wright: Validation, Writing - review & Editing. Mr. Krinal Mori: Conceptualization, Validation, Visualization, Writing -

review & editing. Dr. Wanda Stelmach: Conceptualization, Validation, Visualization, Writing - review & editing. Dr. Henry To: Conceptualization, Formal analysis, Methodology, Project administration, Supervision, Validation, Writing - original draft preparation, Writing - review & editing.

## Consent

N/a.

## Registration of Research Studies

1. Name of the registry:  
N/a
2. Unique Identifying number or registration ID:  
N/a
3. Hyperlink to your specific registration (must be publicly accessible and will be checked):  
N/a

## Guarantor

Guarantor: Dr. Henry To

## Provenance & peer review

Not commissioned; externally peer reviewed.

## Declaration of competing interest

None.

## Acknowledgements

None.

## APPENDIX. A: Search Strategy

### PubMed 20/08/2020

- |   |                    |
|---|--------------------|
| 1. ((telemedicine) OR (telehealth) OR (videoconference))<br>• Between dates: 2000-2020<br>• Limited search to RCTs, reviews or systematic reviews | 7,608 results      |
| 2. AND ((out-patient) OR (outpatient) OR (out patient))   | <b>675 results</b> |
| 3. AND ((surg* clinic))   | <b>82 results</b>  |

### PubMed Updated Search 08/02/2021

- |  |                   |
|--|-------------------|
| 1. (((telemedicine) OR (telehealth) OR (videoconference)) AND ((out-patient) OR (outpatient) OR (out patient))) AND ((surg* clinic))<br>• Between 2020-2021<br>• Limited search to RCTs, reviews or systematic reviews | <b>40 results</b> |
|--|-------------------|

### Ovid Medline 20/08/2020

- |   |  |
|---|--|
| 1. (telemedicine OR telehealth OR videoconference OR econsultation).mp. | <b>31383 results</b>                                 |
| 2. (out-patient) OR (outpatient) OR (out patient).mp                    | <b>151153 results</b>                                |
| 3. ((surgery or surgical) and clinic).mp.                               | <b>38828 results</b>                                 |
| 4. 1 AND 2 AND 3  | <b>41 results</b>                                    |
| 5. 1 AND 2 AND 3<br>• Between dates: 2000-2020<br>• Only English        | <b>39 results</b><br><br>(10 duplicates with Pubmed) |

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PubMed 20/08/2020	
1. ((telemedicine) OR (telehealth) OR (videoconference)) • Between dates: 2000-2020 • Limited search to RCTs, reviews or systematic reviews	7,608 results
EMBASE 20/08/2020	
1. (telemedicine OR telehealth OR videoconference).mp.	38675 results
2. (out-patient) OR (outpatient) OR (out patient).mp	336044 results
3. ((surgery or surgical) and clinic).mp.	75005 results
4. 1 AND 2 AND 3	83 results
5. 1 AND 2 AND 3 • Between dates: 2000-2020 • Only English	79 results
SCOPUS 20/08/2020	
1. telemedicine OR telehealth OR videoconference	47,968 results
2. "out-patient" OR outpatient OR "out patient"	272,949 results
3. surgery or surgical and clinic	55,020 results
4. 1 AND 2 AND 3	81 results
5. 1 AND 2 AND 3 • Limited to medicine articles and reviews • Between dates: 2000-2020 • Only English	71 results
Web of Science 20/08/2020	
1. TI=(telemedicine OR telehealth OR videoconference ) • Combined with: OR AB=(telemedicine OR telehealth OR videoconference )	20,460 results
2. TI=(out-patient OR outpatient OR out patient) • Combined with: OR AB=(out-patient OR outpatient OR out patient)	467,203 results
3. TI=((surgery or surgical) and clinic) • Combined with: OR AB=((surgery or surgical) and clinic)	25,739 results
4. 1 AND 2 AND 3	46 results
5. 1 AND 2 AND 3 • Limited to articles, reviews and proceeding papers • Between dates: 2000-2020 • Only English	41 results

**B: Inclusion & Exclusion criteria**

Inclusion Criteria:	Exclusion Criteria:
Telehealth	Telementoring
Telemedicine	In patients
Surgery	Procedures using telemedicine/robotics
Surgeons	Non-operative related outpatient care e.g. diabetic foot
Outpatient	Physicians
English language	Allied health services
Years: 2000–2021	Protocol studies
<b>Subgroup Inclusion Criteria:</b>	
COVID-19	
Coronavirus	
Year: 2019–2021	

**C: Summary Table of Included Articles (N = 63)**

Author:	Year: Country:	Name of Journal:	Journal Type:	Study Design:	Surgery sub-specialty:	Sample size (n = ):)	Objective:	Outcome:	Keywords:
AlDossary et al.	2017 Australia	International Journal of Medical Informatics	Medical Informatics	Systematic review	N/a	N/a	To identify peer-reviewed publications of deployed telemedicine services in hospital facilities; and to report, and appraise, the methodology used to evaluate these services	137 telemedicine services identified. 49.3% assessed their services from three evaluation perspectives: clinical outcomes, economics and satisfaction. Whilst remaining 50.6% described their service without reporting any evaluation measures. Limited information in all studies regarding a structured planning strategy	Telemedicine; Telehealth; Hospital services; Evaluation; Planning
Ajibade et al.	2020 UK	Journal of Cardiac Surgery	Surgical	Systematic review	Cardiothoracic surgery	N/a	This systematic review aims to evaluate the extent to which TM may be able to support cardiac and vascular surgery patients in the COVID-19 era.	The use of virtual consultations and remote monitoring is feasible and best placed to support these patients via triaging and postoperative monitoring. However, TM can be limited by the need of sophisticated technological requirement and patients' educational and know-how computer literacy level.	Cardiac; Coronavirus; COVID-19; Surgery; Telemedicine; Vascular
Ashry et al.	2020 Egypt	The Egyptian Journal of Neurology, Psychiatry and Neurosurgery	Clinical neuroscience	Prospective, cohort study	Neurosurgery	30	To evaluate the effectiveness and safety of telemedicine visits in providing postoperative care of neurosurgical patients.	Virtual outpatient clinics seem to be a safe and effective way of postoperative care especially in the time of the COVID-19 pandemic.	COVID-19; Telemedicine; Postoperative
Asiri et al.	2018 Saudi Arabia	Acta Informatica Medica	Medical Informatics	Systematic review	N/a	N/a	To investigate the broad range of telemedicine technologies used in surgical care.	The use of telemedicine in preoperative assessment and diagnosis, evaluation after surgery and follow-up visits to be beneficial. Patients reported benefits to using telemedicine such as avoiding unnecessary trips to hospitals, saving time and reducing the number of working days missed.	Telemedicine; surgical procedure; satisfaction; monitoring.
Augestad et al.	2020 Norway	British Journal of Surgery	Surgical	RCT	Colorectal	110	To compare QoL and resource use in patients with a stoma followed up by TC or in the surgical outpatient clinic.	Telemedicine follow-up by stoma nurses did not improve the QoL of patients but decreased the readmission rate and burden of travel.	Not listed
Balzarro et al.	2020 Italy	Urology	Surgical	Prospective, cohort study	Gynaecological surgery	420	To determine the feasibility, reliability and patient satisfaction of telephonic follow-up in women treated for stress urinary incontinence (SUI) or pelvic organ prolapse (POP): Patient Home-Office-Novel-Evaluation (PHONE) study.	Due to the wrongly interpretation of de-novo urge urinary incontinence as a recurrence of SUI, a telephone interview may lose reliability in case of reported incontinence. Thus, telephone follow up was feasible and reliable in women not reporting incontinence. In patients treated for POP the phone interview was a valid tool only in case of no-prosthetic surgery due to the absence of extrusion in these cases.	Not listed
Barsom & Jansen et al.	2020 Netherlands	Surgical Endoscopy	Surgical	Observational, prospective	Colorectal	50	To compare the attitude and satisfaction with VC amongst patients suffering from colorectal cancer and their treating surgeons at the outpatient surgical care clinic in a tertiary referral centre	Based on patient preference, VC is equivalent to a F2F consultation in terms of patient satisfaction and perceived quality of care. Shared decision making is preferred with regard to which contact modality is used during follow up. For easy uptake in other environments it is to be recommended to facilitate VC using the electronic patient portal.	Video consultation; Satisfaction; Virtual visit; Surgery; Telemedicine; Colorectal cancer; eHealth; Patient preference; Shared decision making.
	2020 Netherlands				N/a	N/a			

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Author:	Year: Country:	Name of Journal:	Journal Type:	Study Design:	Surgery sub-specialty:	Sample size (n = ):)	Objective:	Outcome:	Keywords:
Barsom & van Hees et al.		International Journal of Technology Assessment in Health Care	Medical Informatics	Systematic review			Critically appraises, summarizes, and compares available questionnaires in order to identify the most suitable questionnaire for qualitative outcome research using VC in clinical outpatient care	Although high-quality studies on measurement properties of these questionnaires are scarce, the questionnaire developed by Mekhjian has the highest methodological quality achieving validity on internal consistency and the use of a large sample size. Moreover, this questionnaire can be used across healthcare settings.	Video consultation; Survey; Questionnaire; Patient satisfaction; Telemedicine.
Bator et al.	2015 Canada	Journal of Paediatric Surgery	Surgical	Observational, prospective	Paediatric urological & general surgery	1032	To assess costs that families incur visiting an outpatient paediatric surgical clinic, and family attitudes toward telemedicine alternatives.	Many families face high costs related to routine outpatient clinical visits, and there is a substantial willingness by them to access telemedicine alternatives, rather than the traditional face-to-face clinical visit.	Cost; Burden; Paediatrics; Surgery; Urology; Telemedicine
Buvik & Bergmo et al.	2019 Norway	Journal of Medical Internet Research	Medical Informatics	RCT	Orthopaedics	389	To examine the cost-effectiveness of an orthopaedic videoconferencing service between the University Hospital of North Norway and a regional medical centre in a remote community located 148 km away.	Providing video-assisted orthopaedic consultations to a remote clinic in Northern Norway, rather than having patients travel to the specialist hospital for consultations, is cost-effective from both a societal and health sector perspective. This conclusion holds as long as the activity exceeds 151 and 183 patient consultations per year, respectively.	Telemedicine; orthopaedics; videoconferencing; remote consultation; outpatients; randomized controlled trial; economic evaluation; cost-effectiveness analysis; QALY
Buvik & Bugge et al.	2016 Norway	BMC Health Services Research	Health services Research	RCT	Orthopaedics	400	To study the quality of planned remote orthopaedic consultations by help of videoconference.	This study supports the argument that it is safe to offer video-assisted consultations for selected orthopaedic patients. We did not find any serious events related to the mode of consultation. Further assessments of the economic aspects and patient satisfaction are needed before we can recommend its wider application.	Telemedicine; Videoconference; Orthopaedic; Outpatient clinic consultation; Randomised; Physicians; Safety; Evaluation
Buvik & Bugge et al.	2019 Norway	Journal of Telemedicine and Telecare	Medical Informatics	RCT	Orthopaedics	389	We compared patient-reported health outcomes and satisfaction between video-assisted remote and standard face-to-face orthopaedic consultations.	Did not observe any difference in patient-reported satisfaction and health (EQ-5D/EQ-VAS) between videoassisted and standard consultations. Moreover, a significantly high proportion of patients selected video-assisted remote consultation as their next consultation, thus strengthening the findings of this study.	Telemedicine; patient satisfaction; remote consultations; outpatients; videoconference; randomised controlled trial; orthopaedic; quality of life
Chen et al.	2014 USA	Journal of surgical research	Surgical	Observational, retrospective	General surgery	418	To evaluate the utility of routine postoperative visits after appendectomy and cholecystectomy and to determine access to mobile technology as an alternative platform for follow-up.	Routine in-person follow-up after surgery consumes significant time and resources for patients and healthcare systems but has little impact on patient care. Most of the work done in the clinic is administrative and could be completed using mobile technology.	Cholecystectomy; Appendectomy; Mobile health; Technology; Quality follow-up; Mobile; Electronic communication
Cremades et al.	2020 Spain	The American Journal of Surgery	Surgical	RCT	General surgery	200	To compare conventional vs telemedicine follow-up in a General Surgery department in order to evaluate its impact before its final implementation.	No differences were found in clinical outcomes (P = 0.832) or patient satisfaction (P = 0.099). Telemedicine is a good complementary service to facilitate follow-up management in selected	General surgery; Telemedicine; Follow-up studies

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Cullington et al.	2018 UK	BMJ Open	Health services Research	RCT	otolaryngology	60	To assess the feasibility of comparing a remote care pathway with the standard pathway in adults using cochlear implants.	patients from a General Surgery department. Personalised remote care for long-term follow-up is feasible and acceptable, leading to more empowered patients	Not listed
Dadlani et al.	2014 India	World Neurosurgery	Surgical	Observational, retrospective	Neurosurgery	1500	We discuss the role of telemedicine in developing countries and retrospectively analyse the clinical data in more than 1500 patients and 3000 teleconsultations during a period of 6 years. We address the financial implications, psychosocial factors, and several other factors.	In developing countries, especially those where the rural masses are separated from tertiary care centres by vast geographic distances, this technology can play exceptional economic and psychosocial roles in the management of the postoperative neurosurgical patient.	Neurosurgery; Outpatient; Postoperative; Socioeconomic; Teleconsultation; Telemedicine
Daggubati et al.	2020 USA	World Neurosurgery	Surgical	Narrative review	Neurosurgery	N/a	To summarize the necessary capabilities and recommendations for the incorporation of telemedicine in outpatient surgical neuro-oncology sparked by the COVID-19 pandemic.	Telemedicine, pushed to prominence during this COVID-19 pandemic, is a powerful and possibly preferential tool for the future of outpatient neurooncological care.	Brain tumour; Coronavirus; COVID-19; Neuro-oncology; Telehealth; Telemedicine
DeAntonio et al.	2019 USA	Journal of Paediatric Surgery	Surgical	Pilot study	Paediatric general surgery	24	To assess the utilization of a handheld telemedicine (TM) device in the postoperative care of paediatric surgical patients.	These preliminary data suggest safe and effective care with high care giver and physician satisfaction can be provided by utilizing TM in the postoperative care of paediatric surgical patients.	Telemedicine; Paediatric surgery; Postoperative
De Biase et al.	2020 USA	Mayo Clinic Proceedings	Educational	Observational, retrospective	Neurosurgery	315	To describe telemedicine utilization in neurosurgery at a single tertiary institution to provide outpatient care during the coronavirus disease 2019 (COVID-19) pandemic, with 315 telemedicine visits performed by the neurosurgery department.	Rapid implementation of telemedicine to evaluate neurosurgery patients became an effective tool for preoperative consultation, postoperative and follow-up visits during the COVID-19 pandemic, and decreased risks of exposure to severe acute respiratory syndrome coronavirus 2 to patients and health care staff.	Not listed
Debono et al.	2016 France	European Spine Journal	Surgical	Prospective, cohort study	Neurosurgery	60	Assess the feasibility of Mobile app for postoperative monitoring after outpatient lumbar discectomy.	Overall patient satisfaction was excellent. Mobile app provides an effective useful tool for outpatient spine surgery monitoring and minimizes the need for in person visits for postoperative patients.	Lumbar discectomy; Outpatient monitoring; Mobile app; eHealth; Fast-tracking
Dirnberger et al.	2020 USA	The American Journal of Surgery	Surgical	Observational, prospective	General surgery	167	To examine the safety and efficacy of telehealth for general surgery patients treated at the Minneapolis VA Medical Centre.	The telehealth program appears to be safe, saves time and money for veterans and results in extremely high patient satisfaction.	Telehealth; General surgery; Patient cost-savings; High patient satisfaction
Drake & Ritchie	2016 UK	Annals of Surgery	Surgical	Perspective piece	N/a	N/a	Current and emerging uses of telemedicine in clinical practice –is it safe for use in our patients?	Describes the advancements of telecommunications. Advantages and disadvantages of telehealth. Future possibilities of telemedicine.	Ambulatory care; e-health; internet; outpatients; Skype; telemedicine
Ellimoottil et al.	2018 USA	JAMA Surgery	Surgical	Perspective piece	N/a	N/a	Discussion about the benefit and potential of telemedicine from surgeons to the home of patients.	Key advantages of conducting video-visits directly with patients at home: improved efficiency and patient experience. Also, allow for improved access in rural communities. Regarding barriers to implementing this innovation more broadly: if the patient requires a physical examination or in-office diagnostic testing	Not listed

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Ellison et al.	2004 USA	Journal of the American College of Surgeons.	Surgical	RCT	Urology (male)	85	Assessed the impact of introducing remote video conferencing during the immediate postoperative period (telerounds) on patient-reported satisfaction with their hospitalization.	they are not suitable. Also, regulatory and reimbursement issues that vary state-to-state. Telerounding either as an additional visit or as a substituted bedside visit is associated with increased patient satisfaction in postoperative care. This type of interaction appears to acceptably facilitate physician communication with hospitalized patients.	Not listed
Garden	2002 USA	Journal of Correctional Health Care	Surgical	Observational, retrospective	Orthopaedics	N/a	To investigate and evaluate a start-up telemedicine program. The numbers of off-site visits, surgeries, total visits, grievances and costs associated with on-site telemedicine were compared for years 1997, 1999 and 2000.	Transitioned from active on-site ortho clinic to an almost exclusive telemedicine clinic –increased clinic numbers and maintained number of procedures.	Not listed
Goedeke et al.	2019 Germany	Journal of Paediatric Surgery	Surgical	RCT	Paediatric surgery	224	To assess the quality and perception of a telemedical follow-up exam on paediatric surgical patients after discharge from the hospital in a prospective, randomized controlled trial in an academic university hospital centre.	Telemedical post-hospitalization follow-up in paediatric surgery provides a cost-effective, time-saving alternative for patients and caregivers that is well received and accepted. The quality of clinical data transmission is sufficient to provide safe care and uncompromised clinical judgment.	Telemedicine; Telehealth; Paediatric surgery Outpatient; Follow-up; Clinic
Grandizio et al.	2020 USA	Journal of Hand Surgery American	Surgical	Prospective, cohort study	Hand & upper extremity surgery	57	To compare travel burden, visit time, and patient satisfaction between an initial post-operative telemedicine visit and a second conventional in clinic visit.	A telemedicine program decreases travel burdens associated with conventional in-clinic appointments. Telemedicine significantly decreases visit times without decreasing patient satisfaction for patients who elect to participate in remote video visits. Recognition of early postsurgical complications was not compromised by utilizing this technology, even during our early experience.	Telemedicine; telehealth; virtual visits; hand surgery; technology
Grenda et al.	2020 USA	Annals of Surgery	Surgical	Perspective piece	General thoracic	N/a	To describe our institution's experience with transitioning to an almost exclusive telehealth outpatient experience in a general thoracic surgical practice across the domains of new patient evaluation and postoperative care.	Describes the practicalities of implementing telehealth during COVID-19. New patient evaluation and post-operative applications described. Survey to track patient satisfaction. Acknowledge some patients may still require face-to-face.	COVID-19; surgical practice; telehealth
Gunter et al.	2016 USA	Journal of the American College of Surgeons	Surgical	Systematic review	N/a	N/a	To examine how telemedicine is currently used to facilitate postoperative recovery after hospital discharge.	Telemedicine shown to be safe and effective for surgical patients in the post-discharge period. It provides significant savings to patients and the health care system and is acceptable to both patient and provider. As technology becomes more affordable and widely available, the opportunities for future applications are vast.	Not listed
Hakim et al.	2020 USA	The American Journal of Surgery	Surgical	Narrative review	N/a	N/a	A review describing the application of telemedicine in caring for surgical patients, and methods for potential implications of telehealth care for	Local primary care physicians may perform physical examinations under specialist supervision via telemedicine. Telehealth offers timely visits and high	Telemedicine; Surgery; Surgical; COVID-19; PPE; Coronavirus

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Author:	Year: Country:	Name of Journal:	Journal Type:	Study Design:	Surgery sub-specialty:	Sample size (n = ):)	Objective:	Outcome:	Keywords:
							surgical patients during the COVID19 pandemic.	rates of patient and clinician satisfaction. Pre-operative and post-operative applications of telemedicine. Patient enrolment logistics COVID-19 impact on telemedicine implementation.	
Harno et al.	2001 Finland	Journal of Telemedicine and Telecare	Medical Informatics	Prospective, cohort study	Orthopaedics	419	Clinical effectiveness and costs of videoconferencing in orthopaedics between primary and secondary care were examined.	Direct costs of an outpatient visit were 45% greater per patient than for a teleconsultation. Regarding feasibility, videoconferencing (49%) and standard outpatient (93%) rated by surgeons as excellent or good; only the clinical history was retrieved in both teleconsultations and in-person visits equally well. Confidence of the surgeons in replacing an outpatient visit with a videoconference remained low for 89% of the outpatients.	Not listed
Hwa et al.	2013 USA	JAMA Surgery	Surgical	Pilot study	General surgery	141	To examine whether an allied health professional telephone visit could safely substitute for an in-person clinic visit.	Telehealth can be safely used in selected ambulatory patients as a substitute for the standard postoperative clinic visit with a high degree of patient satisfaction. Time and expense for travel (7–866 miles) were reduced and the free clinic time was used to schedule new patients.	Not listed
Jefferis et al.	2016 UK	International Urogynecology Journal	Surgical	Observational, retrospective	Gynaecological surgery	262	One proposed alternative is telemedical follow-up, as introduced by our unit in 2010. We report on 5 years of experience with telephone follow-up.	Telephone follow-up is an appropriate mode of follow-up for uncomplicated primary incontinence surgery.	Mid-urethral sling; Post-operative review; Telephone follow-up
Jiang et al.	2019 USA	Surgical Infections	Surgical	Perspective piece	N/a	N/a	In this article, we propose a roadmap for developing incision image algorithms for automatic SSI detection and evaluation.	Interactive image acquisition as well as customized image analysis and machine learning methods for SSI monitoring will play critical roles in developing sustainable mHealth apps to achieve the expected outcomes of patient-taken incision images for effective out-of-clinic patient-centred healthcare with substantially reduced cost.	Surgical site infection; wound healing; wound management
Kelly et al.	2020 Ireland	Irish Journal of Medical Science	Medical science	Observational, retrospective	Vascular surgery	597	(1) analyse current trends of information communication methods in a vascular surgery outpatient population, (2) assess how the older population has adopted information communication methods (3) propose ways to improve the adoption of information communication methods.	Within this patient population, the use of technologies decreases with increasing age of the patients. This demonstrates a large population of service users who are contented with conventional methods of communication. Change within healthcare ICT is inevitable, and therefore, these patients need to be guided and educated to allow a smooth transition from the old to the new.	eHealth; Elderly; Electronic communication; Information communication technology; Vascular
Laferriere et al.	2020 USA	Hawaii Journal of Health and Social Welfare	Health services Research	Observational, retrospective	Paediatric surgery	1081	To characterize potential telehealth candidates to estimate the opportunity for telehealth delivery of outpatient paediatric surgical care.	Use of telehealth services is reasonable in select paediatric surgical patients and offers a significant cost savings to those traveling from other Hawaiian islands. Over 30% of outpatient paediatric surgical encounters met stringent criteria as candidates for telehealth delivery of care. This represents a significant	Telehealth; Paediatric Surgery; Hawai'i; Telemedicine; Telecare

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Author:	Year: Country:	Name of Journal:	Journal Type:	Study Design:	Surgery sub-specialty:	Sample size (n = ):)	Objective:	Outcome:	Keywords:
Lal et al.	2020 India	Journal of Clinical Orthopaedics and Trauma	Surgical	Narrative review	Orthopaedics	N/a	We hereby propose the evolving knowledge in changes in OPD management practices for orthopaedic surgeons in the COVID-19 era	opportunity for direct, travel-based cost savings as well as opportunity cost savings associated with the implementation of telehealth delivery of outpatient paediatric surgical care in Hawai'i. The review highlights the safety of patient and orthopaedic surgeons in OPD by screening and maintaining hygiene at various levels. The article also mentions the duties of the help desk, OPD hall supervisor and the new norms of air conditioning, ventilation, safe use of elevators, sanitization of OPD premises and biomedical waste disposal. The optimum and safe utilization of human & material resources, DO's and DON'Ts for patients & health staff have also been proposed. The reorganization of plaster room, the precaution during plastering, fracture clinic, dressing and injection room services are discussed as per evolving guidelines. This article will also give deep insight into the OPD plan & telemedicine graphically.	COVID 19; Outpatient; Orthopaedics; Coronavirus; OPD
Loeb et al.	2020 USA	Journal of the American Academy of Orthopaedic Surgeons	Surgical	Perspective piece	Orthopaedics	N/a	This article provides practical instruction based on our experience for physicians who wish to implement telemedicine during the COVID-19 pandemic	Our orthopaedic surgery department rapidly introduced a robust telemedicine program during a 5-day period. Implementation requires attention to patient triage, technological resources, credentialing, education of providers and patients, scheduling, and regulatory considerations. Between telemedicine encounters and necessary in-person visits, providers maybe able to achieve 50% of their typical clinic volume within 2 weeks.	Not listed
Lu et al.	2018 USA	Telemedicine and e-Health	Medical Informatics	Systematic review	N/a	N/a	Systematic review of studies involving the use SMS and mobile application-based interventions in surgical patients to evaluate the advantages and disadvantages of each system, as well as of mobile interventions as a whole.	Mobile interventions provide a sophisticated yet simple tool to improve perioperative healthcare. Future considerations to address include usage fatigue and Health Insurance Portability and Accountability Act compliance concerns.	e-health; rehabilitation; telecommunication; telehealth; telesurgery; telemedicine
Ma et al.	2018 Australia	ANZ Journal of Surgery	Surgical	RCT	General surgery	179	Test the hypothesis that postoperative telephone review is as effective and safe as outpatient clinic follow-up for patients who have undergone emergency laparoscopic appendectomy or cholecystectomy.	Telephone follow-up post laparoscopic appendectomy or cholecystectomy is safe, satisfying and effective.	Appendectomy; Australia; cholecystectomy; laparoscopic; prospective studies.
Martinez-Ramos et al.	2009 Spain	Telemedicine and e-Health	Medical Informatics	Pilot study	General surgery	96	To analyse the efficacy of the GPRS mobile phone-based telemedicine system used to assess local surgical wound complications during the	The telemedicine system proposed increases the efficiency of home follow-up to ambulatory surgery, avoids unnecessary hospital visits, and clearly improves patient satisfaction.	Robotic surgery; telesurgery; telehealth

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Mouchtouris et al.	2020 USA	World Neurosurgery	Surgical	Observational, retrospective	Neurosurgery	10,746	postoperative course of patients undergoing ambulatory surgery. Our goal is to determine the extent of adoption of telemedicine across tumour, vascular, spine, and function neurosurgery and utilization for new patient visits.	Use of telemedicine drastically increased across all 4 divisions within neurosurgery with a significant increase in online-first encounters in order to meet the needs of our patients once the shelter-in-place measures were implemented. We provide a detailed account of the lessons learned and discuss the anticipated role of telemedicine in surgical practices once the shelter in-place measures are lifted.	COVID-19; Neurosurgery; Telemedicine
Novara et al.	2020 Italy	European Association of Urology	Surgical	Systematic review	Urology	N/a	To perform a systematic review of the literature and evaluate all the available studies on urological applications of telehealth.	Telehealth has been implemented successfully in selected patients with PCa, UI, pelvic organ prolapses, uncomplicated urinary stones, and UTIs. Many urological conditions are suitable for telehealth, but more studies are needed on other highly prevalent urological malignant and benign conditions. Likely, the COVID-19 pandemic will give a significant boost to the use of telemedicine. More robust data on long-term efficacy, safety, and health economics are necessary.	Telehealth; Telemedicine; E-health; Coronavirus; Severe acute respiratory syndrome; Coronavirus 2; COVID-19
Novoa et al.	2016 Spain	Arch Bronconeumol	Respiratory medicine	Observational, retrospective	Cardiothoracic surgery	1027	Analysing the impact of the systematic Vs occasional videoconferencing discussions of patients with two respiratory referral units along 6-years of time over the efficiency of the in-person outpatient clinics of a thoracic surgery service.	Regular econsultations between clinicians regarding their patients improves efficiency and surgical volume of the thoracic outpatient clinic.	Telemedicine; Videoconferencing; e-Consultation; Interdisciplinary health team; Outpatient clinics; Thoracic surgery
Ohinmaa et al.	2002 Finland	Journal of Telemedicine and Telecare	Medical Informatics	Observational, retrospective	Orthopaedics	145	Compared the costs of conventional outpatient visits to the surgical department of the University Hospital of Oulu with those of videoconferencing between the primary care centre in Pyhäjärvi and the University Hospital (separated by 160 km).	Telemedicine less costly for society than conventional care if > 80 patients/year when traveling on average 160 km to specialist care. Thus, the cost saving from the use of teleconsultation was €4302. Cost-effective for simple follow-up cases, site is ~80 km and the equipment is used for other telemedicine services.	Not listed
Paquette et al.	2018 USA	Annals of Vascular Surgery	Surgical	Observational, retrospective	Vascular surgery	146	Analyse the impact of outpatient telemedicine services on the travel burden of vascular surgery patients with regard to distance, time, and cost, as well as the emission of environmental pollutants.	Utilization of telemedicine services reduces the travel distance, time, and costs for vascular surgery patients. Outpatient telemedicine programs may also provide environmental benefit through the reduction of greenhouse gas and pollutant emissions.	Not listed
Parkes et al.	2019 UK	BMJ Open Quality	Health services Research	Prospective, cohort study	Orthopaedics	115	To evaluate the acceptability to key stake holders of a newly introduced virtual clinic follow-up pathway for hip and knee joint replacement	The virtual clinic process appears to be well accepted by both patients and clinicians. However, appropriate patient selection and clear pathways of communication to address patient concerns are pivotal to success.	Not listed

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Author:	Year: Country:	Name of Journal:	Journal Type:	Study Design:	Surgery sub-specialty:	Sample size (n = ):)	Objective:	Outcome:	Keywords:
Qualliotine & Oroasco	2020 USA	Head & Neck	Surgical	Case report	Otolaryngology	1	The use of a surgical drain often prevents this minimal-exposure approach in that patients return to the outpatient clinic for drain removal.	Patient removed the dressing and drain at home during a telehealth visit on post-operative day 4; healed favourably without complication.	COVID-19; drainage; head and neck neoplasms; neck dissection; telemedicine
Rimmer et al.	2018 USA	Laryngoscope	Otolaryngology medicine	Observational, retrospective	Otolaryngology	250	We present our experience with telemedicine visits in an otolaryngology outpatient setting within our institution's Centre for Head and Neck Surgery.	With appropriate patient selection, telemedicine is an effective way to safely conduct outpatient clinic visits while maintaining high patient satisfaction. It can be particularly useful for institutions with large catchment areas to minimize travel times and increase ease of communication.	Telemedicine; telehealth; otolaryngology; outpatient; clinic.
Robaldo et al.	2010 Italy	Journal of Telemedicine and Telecare	Medical Informatics	Prospective, cohort study	Vascular surgery	588	We report our experience in the application of telemedicine for fast-track discharge and home-monitoring after carotid endarterectomy.	Telemedicine appears feasible and useful in carotid endarterectomy and may have other applications in vascular surgery care.	Not listed
Rodriguez et al.	2020 USA	European Association of Urology	Surgical	Narrative review	Urology	N/a	To provide practical recommendations for effective use of technological tools in telemedicine.	Telemedicine facilitates specialized urological clinical support at a distance, solves problems of limitations in mobility, reduces unnecessary visits to clinics, and is useful for reducing the risk of viral transmission in the current COVID-19 outbreak. Furthermore, both personal and societal considerations may favour continued use of telemedicine, even beyond the COVID-19 pandemic.	COVID-19; Telehealth; Telemedicine; Telework; Video visit; Social media; Smart work; Outbreak
Siow et al.	2020 USA	Clinical Orthopaedics & Related Research	Health services Research	Observational, retrospective	Orthopaedics	233	To what extent did telehealth usage increase for an outpatient orthopaedic trauma clinic before the COVID-19 stay-at-home order compared to month immediately after the order? What is the proportion of no-show visits before and after this change?	Clinicians should consider implementing telehealth strategies to provide high-quality care for patients and protect the workforce during a pandemic. In a previously telehealth naïve clinic, we show successful implementation of telehealth for a diverse orthopaedic trauma population that historically has issues with mobility and follow-up.	Not listed
Smith AC & Dowthwaite et al.	2008 Australia	Medical Journal of Australia	Health services Research	Observational, retrospective	Paediatric otolaryngology	97	To determine agreement between diagnoses and management plans made during an initial videoconference appointment and subsequent face-to-face consultations in paediatric ear, nose and throat (ENT) surgery.	Decisions about ENT surgical interventions for children assessed during videoconference clinics are in close agreement with decisions made by the same surgeon at face-to-face consultation. The way is open to employ telemedicine more widely for pre-admission ENT assessment. However, as in any telemedicine work, widespread application requires care.	Not listed
Smith AC & Scuffham et al.	2007 Australia	BMC Health Services Research	Health services Research	Observational, retrospective	Paediatric otolaryngology	1499	We have compared the actual costs of providing a telepaediatric service to the potential costs if patients had travelled to see the specialist in person.	During a 5-year period, 1499 consultations conducted through a telepaediatric service was AUD \$955,996 compared to standard referral services to Brisbane RCH costing AUD \$1,553,264; saving of ~AUD \$600,000.	Not listed
Sudan et al.	2011 USA	The American Journal of Surgery	Surgical	Prospective, cohort study	General surgery	28	Primary aim was to show that regionalizing care is feasible by using telemedicine and a network concept.	A cooperative network using teleconference and computerized records facilitated bariatric surgery in high-risk,	Bariatric surgery; Veterans; Telemedicine; Obesity

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Author:	Year:	Country:	Name of Journal:	Journal Type:	Study Design:	Surgery sub-specialty:	Sample size (n = ):	Objective:	Outcome:	Keywords:
Tanaka et al.	2020	USA	The Journal of Bone and Joint Surgery	Surgical	Perspective piece	Orthopaedics	N/a	Secondary aim was to show that high-quality care is achievable in low volume centres with suitable training and resources We report our experience with protocols and methods to standardize these visits to maximize the benefit and efficiency of the virtual orthopaedic examination.	remotely located VA patients with high patient satisfaction and without compromising surgical outcomes. With the rapid incorporation of telehealth visits, as well as the unknown future with regard to the pandemic, the utilization and capabilities of telemedicine will continue to expand.	Not listed
Thompson et al.	2019	USA	International Urogynecology Journal	Gynaecological medicine	RCT	Gynaecological surgery	100	To determine whether postoperative telephone follow-up was noninferior to in-person clinic visits based on patient satisfaction. Secondary outcomes were safety and clinical outcomes.	Telephone follow-up after pelvic floor surgery results in noninferior patient satisfaction, without differences in clinical outcomes or adverse events. Telephone follow-up may improve healthcare quality and decrease patient and provider burden for postoperative care.	Postoperative care; Patient satisfaction; Telephone visits
Viers et al.	2015	USA	European Urology	Gynaecological medicine	RCT	Urology (male)	55	To investigate patient encounters in the outpatient setting using video visit (VV) technology compared to traditional office visits (OVs).	VV in the ambulatory postprostatectomy setting may have a future role in health care delivery models. We found equivalent efficiency, similar satisfaction, but significantly reduced patient costs for VV compared to OV. Further prospective analyses are warranted.	Telemedicine; Teleconsultation; Video visits; Patient perception; Patient acceptance; Urology; Telehealth; Randomized controlled trial
Vuolio et al.	2003	Finland	Journal of Telemedicine and Telecare	Medical Informatics	RCT	Orthopaedics	145	To see if consultations via videoconferencing and traditional outpatient clinic visits differ in terms of the implementation of the patient management plan during a one-year follow-up.	There were no differences in the implementation of the management plan between the two groups. The study showed that videoconferencing is a valid alternative to outpatient clinic visits for orthopaedic specialist consultations.	Not listed
Walter et al.	2020	Germany	The International Journal of Artificial Organs	Artificial organs medicine	Observational, prospective	Cardiothoracic surgery	22	To provide insights into the left ventricular assist device-specific requirements for telemonitoring and infrastructural translation from caregivers' and patients' points of view.	Although positive expectations are associated with the use of telemonitoring in left ventricular assist device therapy, further action is needed. For example, software and infrastructure developers will need to address issues such as variations among patients and may need to find a balance between designing individualised solutions for compliant patients and a safe and easy-to-handle set-up.	Ventricular assist device; telemonitoring; infrastructural needs; expected benefits
Williams et al.	2018	USA	mHealth	Medical Informatics	Narrative review	N/a	N/a	We describe the history of telemedicine, its adoption in the field of surgery and its various modalities, its use in the postoperative setting, and the potential benefits to both patients and healthcare systems. Also discuss severe barriers.	Telemedicine has afforded improved access to care, greater resource efficiency, and decreased costs associated with traditional office visits and has been well established in a wide array of fields. Telemedicine has been adopted in several domains of surgical care. role of telemedicine in postoperative care has caught attention as it has demonstrated excellent clinical outcomes, enhanced patient satisfaction, increased accessibility along with reduced wait times, and cost savings for patients and health care systems.	Telemedicine; postoperative care; surgery; clinical outcomes; patient cost and time savings; mobile health; telehealth

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Author	Year	Country	Name of Journal	Journal Type	Study Design	Surgery sub-specialty	Sample size (n = )	Objective	Outcome	Keywords
Wood et al.	2016	USA	Journal of Oral and Maxillofacial Surgery	Surgical	Observational, retrospective	Maxillofacial	335	To follow up on the previous study in evaluating the efficiency and reliability of telemedicine consultations for preoperative assessment of patients.	Practitioners successful 92.2% in making diagnosis and management plan off data collected during videoconference without need for in-person consult. Triageed correctly 99.6% to clinic or hospital. 98% patients given sufficient medical and physical assessment to be able to undergo surgery under anaesthesia straight after telemedicine consultation. 95.9% of patients given accurate diagnosis and treatment plan. Estimated savings \$134,640.	Not listed
Yen et al.	2010	USA	Current Opinion in Anaesthesiology	Anaesthesiology medicine	Narrative review	Anaesthesiology	N/a	To discuss the evolution, benefits, and the future of preoperative clinics including a telephone-based system.	It is difficult to compare the efficacy of different preoperative evaluation systems with regard to properly educating the patient, minimizing complications, and maximizing surgical suite functioning. Several authors have pointed out that quality improvement of the preoperative clinic should be guided by obtaining patient feedback.	Case cancellation; patient survey; preoperative evaluation; telephone assessment

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