

THE ORTHOPAEDIC FORUM

Telemedicine in Orthopaedic Surgery Challenges and Opportunities

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Abstract: Improvements in technology and a push toward value-based health care have poised the telemedicine industry for growth; however, despite the benefits of virtual care, widespread implementation had not occurred until the coronavirus 2019 (COVID-19) pandemic. Powerful barriers have hindered the widespread adoption of telemedicine, including lack of awareness, implementation costs, inefficiencies introduced, difficulty performing physical examinations, overall lack of perceived benefit of virtual care, negative financial implications, concern for medicolegal liability, and regulatory restrictions. Some of these challenges have been addressed with temporary state and federal mandates in response to the COVID-19 pandemic; however, continued investment in systems and technology as well as refinement of regulations around telemedicine are needed to sustain widespread adoption by patients and providers.

Telemedicine refers to the use of technology to remotely deliver clinical care^{1,2}. The first documented accounts of telemedicine were in the late 19th century, when telephone wires were used to transmit electrocardiograph data^{3,4}. Improvements in audiovisual communication technologies over the past 2 decades have allowed for expansion of telemedicine usage^{5,6}. Specifically, the widespread use of personal computing devices and access to high-speed videoconferencing has made remote clinical care more feasible. The research interest in this sector has risen recently as well; today, a PubMed search of the keyword “telemedicine” returns 32,594 results, and a search of the keywords “telemedicine” and “orthopedic/orthopaedic” returns 313 articles (Figs. 1 and 2).

There are several benefits to telemedicine. Remote visits can provide increased access to care, lower overall costs, and high patient-satisfaction rates^{7,8}. In orthopaedic surgery, Wongworawat et al. speculated that patients will drive telemedicine demand

because of availability and convenience, but adoption will be contingent on physician acceptance and health-system partnerships⁹.

Promising projections led to the initiation of an array of telemedicine platforms and new clinical codes for reimbursement of remote health-care delivery¹⁰. Many hospital systems, health insurance companies, technology startups, and large corporations such as Google, Amazon, and Walmart have promoted telemedicine delivery options to help control costs of care and improve overall patient convenience, efficiency, and value¹¹⁻¹³. Recent concerns over the coronavirus disease 2019 (COVID-19) pandemic have further led health-care systems, governments, and the public to acknowledge and explore the benefits of telehealth^{14,15}. Departments of orthopaedic surgery that had never previously used telemedicine have been forced to utilize virtual consultations to continue patient care, and departments that

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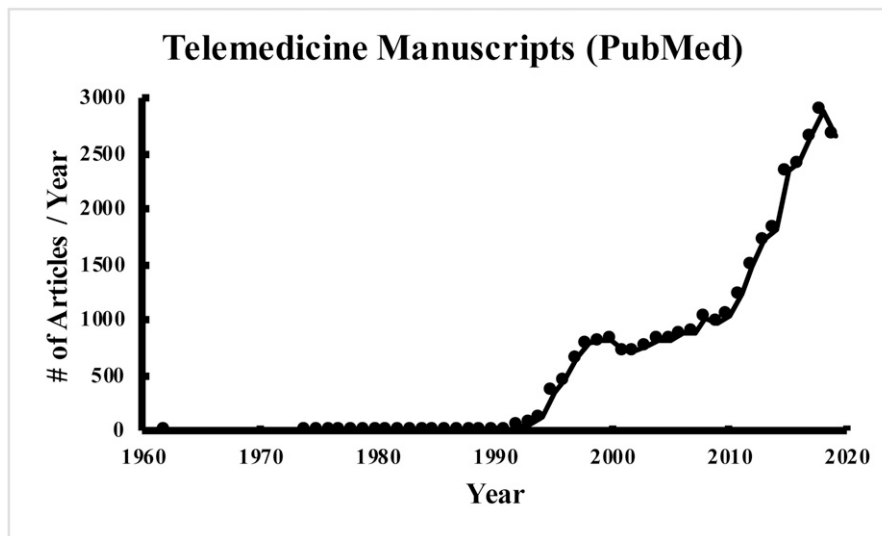


Fig. 1

Graph showing the number of articles related to telemedicine published per year from 1962 to 2019. The interest in telemedicine research has increased exponentially, with a peak of 2,887 articles published in 2018.

already had the technology have seen a dramatic increase in provider engagement^{16,17}.

Systematic interest in the field of telemedicine existed before the COVID-19 crisis, evidenced by considerable research and corporate initiatives^{18,19}. The Kaiser Family Foundation found increasing rates of employee telemedicine coverage: in 2019, 82% of large employers offered health benefits that cover telemedicine, up from 63% in 2017 and 27% in 2015¹⁹. However, usage rates remained disproportionately low compared with interest. A 2019 survey conducted by J.D. Power found that <10% of patients nationwide had tried telehealth²⁰. The IBM MarketScan Database showed

lower rates; only 2.4% of large-company employees with eligible coverage utilized at least 1 telemedicine visit in 2018²¹.

In this overview, we seek to define the scope of telemedicine and present the current literature supporting the use of telemedicine in orthopaedic surgery. We describe the benefits and challenges, outline recent changes that have occurred as a result of the global COVID-19 pandemic, and discuss the further steps necessary to improve adoption within the field.

Defining the Scope of Telemedicine

Telemedicine is a vast field encompassing a variety of services^{1,7}. The National Academy of Medicine defines telemedicine as

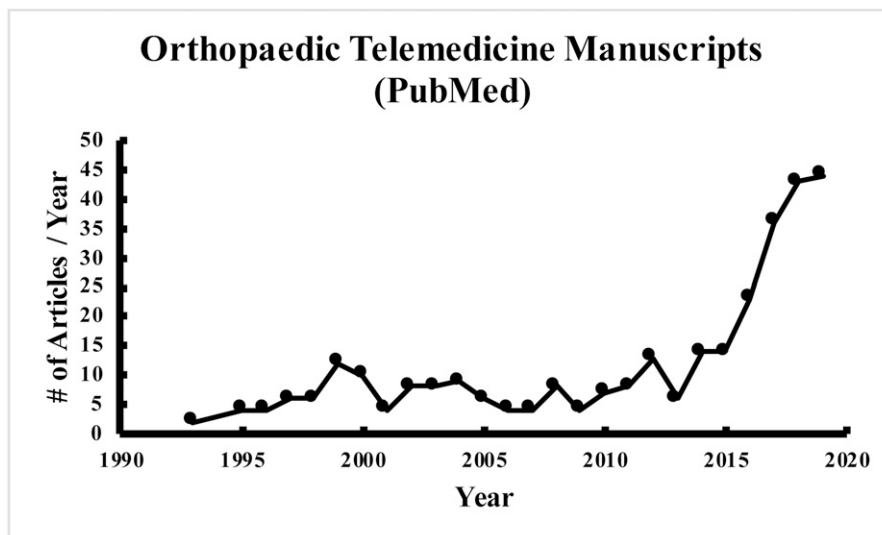


Fig. 2

Graph showing the number of articles related to orthopaedic telemedicine published per year from 1993 to 2019. The interest in orthopaedic telemedicine only began to rise in 2015 and has risen to >40 articles per year since then.

“the use of electronic information and communications technologies to provide and support health care when distance separates the participants;”²¹ however, terminology has not been standardized across different organizations. There are over 100 peer-reviewed definitions of the word used by various parties, highlighting its wide scope and ever-changing nature; much of this is because of the rapid evolution of novel communication and monitoring technologies.^{22,23}

“Telemedicine” was the original term used to describe remote delivery of health care. The term “telehealth” was developed to encompass a broader delivery of services provided, including care delivered by all health-care workers, rather than just physicians, as well as all aspects of clinical and nonclinical care delivery.^{24,25} Today some groups such as the U.S. Department of Health and Human Services use the terms interchangeably, whereas others differentiate between them, referring to telemedicine as a subset of telehealth^{23,26,27}. The American Telemedicine Association, for example, refers to “telehealth” broadly as “technology-enabled health and care management and delivery systems that extend capacity and access;” they define this term as comprising a wide range of fields including “AI [artificial intelligence], virtual reality, and behavioral economics.”²⁸

However it is defined, telemedicine generally refers to health information that is either synchronously or asynchronously transmitted, or remotely collected. This communication can be between patients and medical providers or consultations between 2 providers. Synchronous communication includes videoconferencing and phone calls, whereas asynchronous methods include email, voicemail, fax, and patient portal messaging. Remote patient monitoring refers to data collected from wearable or implantable devices.

For the scope of the present article, when referring to telemedicine, we focused on virtual visit interactions, which are synchronous outpatient video interactions between patients and providers.

Published Telemedicine Results in Orthopaedic Surgery

Although interest in the field is apparent, with >30,000 articles returned through a “telemedicine” keyword search on PubMed, targeted research covering the efficacy of telemedicine in orthopaedic surgery is in the early stages. Approximately 300 articles are returned in a PubMed search using the keywords “telemedicine” and “orthopaedic/orthopedic” (Fig. 2). Much of the literature discusses 1 or more of 3 topics: (1) patient satisfaction, (2) cost-effectiveness, and (3) efficacy and accuracy of care.

Patient Satisfaction

Traditionally, conventional visits have been the gold standard for patient satisfaction. However, recent evidence has shown that telemedicine satisfaction rates are comparable with those of in-person visits, and patients who experience virtual outpatient visits are more likely to seek another in the future²⁹⁻³⁵. Buvik et al. instituted a randomized controlled trial in Norway involving patients receiving real-time orthopaedic video con-

sultations and patients receiving traditional in-person visits²⁹. Of the 389 patients included in the study, 99% rated the consultation as very satisfactory or satisfactory; furthermore, 86% of the videoconferencing patients preferred a video-assisted consultation as the next visit. In 2019, a similar trial was performed in rural and suburban Pennsylvania to assess follow-up after pediatric fracture care. In that nonrandomized study, all patients were given the option to receive clinical care through telemedicine or in-person visits³⁰. Patient satisfaction was similar between the 2 groups, telemedicine decreased travel costs and times ($p < 0.001$), and only 8 of 101 telemedicine patients preferred an in-person follow-up as a next visit.

For both of those studies, the videoconferences took place at regional medical centers with trained clinicians onsite, with the orthopaedic surgeons conferencing in from tertiary care centers. Therefore, we expect higher rates of technical difficulties when patients conference in from their own homes rather than from health-care facilities.

Cost-Effectiveness

Orthopaedic surgery telemedicine cost analyses consistently point toward cost-effectiveness³⁶⁻⁴¹. A financial analysis performed in Finland reported that orthopaedic telemedicine virtual consultations resulted in a 45% savings in direct costs (accounting for personnel costs, service charges, material expenses, travel, etc.)³⁶. Utilizing data from a randomized controlled trial comparing telemedicine and conventional outpatient visits in 145 orthopaedic surgery patients, Ohinmaa et al. found that telemedicine was less costly even when factoring in software, maintenance, health-care salaries, and transportation³⁷. Aponte-Tinao et al. analyzed orthopaedic oncology telemedicine services versus in-person appointments in Argentina and found that telemedicine led to a decrease in health-care costs of between 12.2% and 72%³⁹. Finally, a 2012 analysis performed by McGill and North showed that videoconferencing fracture clinics could result in savings by avoiding unnecessary hospital transfers⁴¹.

Efficacy and Accuracy of Care

One of the largest concerns from providers and patients when it comes to telemedicine is the efficacy and accuracy of care compared with traditional in-person visits. Early research on telemedicine shows that virtual orthopaedic care, under certain circumstances, may be as effective as face-to-face consultations⁴²⁻⁴⁵.

In a randomized study of 389 orthopaedic surgery patients, Buvik et al. reported that video-assisted consultations were not inferior to standard consultations. In that study, radiographs were obtained immediately prior to 88% of the 199 remote consultations and 89% of the 190 standard consultations⁴². No significant difference was found between groups in the number of patients who underwent a surgical procedure, and the mean visit duration was not significantly different ($p = 0.60$). The orthopaedic surgeons in that study were pleased with the video consultations, rating 98% of the visits either “good” or “very good.” Seventeen of the 302 telemedicine visits

were delayed by an average of 12 minutes because of technical difficulties, although there were 2 outlier delays of 75 and 60 minutes. For the telemedicine encounters, patients were in a remote health-care facility with trained staff, separate from the facility in which the treating physician was located. If sessions had been performed outside of designated facilities, it is feasible that more technical delays causing lower satisfaction rates might have resulted.

In a prospective evaluation of pediatric orthopaedic teleconsultations in Djibouti between 2009 and 2011, Bertani et al. found that of the 48 telemedicine visits for 39 patients, teleconsultation resolved 90% of diagnostic uncertainties, although clinical outcomes were cited as “good” or “very good” in only 81% of the treated patients⁴⁴. Haukipuro et al. performed an orthopaedic randomized controlled trial and found that patient satisfaction was similar between the telemedicine (n = 76) and conventional groups (n = 69)⁴⁵. Both the general practitioner and the orthopaedic specialist were present during the consultations. The physicians had more problems examining telemedicine patients than clinic patients, but the researchers concluded that virtual evaluation added the benefit of enabling simultaneous communication between the patient, the primary care provider, and the specialist.

Broadly, orthopaedic telemedicine has the potential to provide effective and accurate care. Various other studies of telemedicine in orthopaedic surgery have had similar results^{46,47}. Studies in other fields such as trauma management, minor injury treatment, and emergency medicine support similar findings⁴⁸⁻⁵⁰.

Benefits

Overall, there are substantial benefits to the use of telemedicine in orthopaedic surgery. The most promising benefits include (1) high patient satisfaction rates, (2) increased patient convenience, (3) increased access to care, (4) decreased overhead for providers, and (5) societal cost savings.

Challenges

The benefits of orthopaedic telemedicine, however, do not exist without substantial challenges. The use of telemedicine has been strikingly low as a percentage of total health-care services: prior to COVID-19, only between 2.4% and 10% of patients utilized virtual visits^{19,20}. The following factors may help explain the lack of adoption.

Lack of Awareness, Access, and Technology Literacy

A survey conducted in 2013 found that 96.1% of clinicians had little knowledge about telemedicine⁵¹. Patients also lacked awareness of telemedicine options; according to a 2019 J.D. Power survey, 29% of patients who had not used telemedicine believed that such services were not available to them and 37% did not know if telemedicine was offered by their health-care provider⁵². Furthermore, some patients do not have access to or familiarity with computers, smartphones, or high-speed internet. Proper bandwidth capabilities are necessary for both patients and physicians. Although patients may only need 4 to 10

Mbps to support high-quality video consultations, larger hospitals and institutions may need up to 1,000 Mbps to support all data-transfer needs⁵³.

Technology Implementation and Maintenance Costs

Implementing and maintaining telemedicine capabilities for health-care systems can require substantial investment. Equipment must first be purchased, and an infrastructure must be set in place that includes hardware, software, and personnel. Increasingly, software that is secure enough to meet the requirements of the Health Insurance Portability and Accountability Act (HIPAA) and integrated with electronic health-record systems are becoming available, but these platforms can be expensive to implement. Training, maintenance, and support must also be provided to assist patients, administrative staff, and providers.

Inefficiencies Introduced

Audiovisual issues may cause delays and frustrations. Additionally, billing challenges related to these visits can introduce inefficiencies. Clinicians may experience increased workloads if they are unable to fully integrate support staff into the virtual-visit workflow. Some of these inefficiencies can be alleviated if patients are guided through test videoconference calls before the visit and instructed on how best to contribute to an efficient visit (e.g., being advised to wear shorts or sleeveless shirts if extremities need to be evaluated).

Decreased Ability to Perform Physical Examinations

It may be easier for some specialties to render care via telemedicine than others. For example, a follow-up visit for a midshaft tibial fracture in a neurologically intact patient can be conducted via a video visit along with radiographs. However, numerous maneuvers utilized in physical examination are difficult to perform remotely. Some examples include manual motor testing to determine the strength of an extremity, passive motion to detect pain with range of motion, 2-point discrimination, sensory examination, reflex testing, and palpation to determine sources of pain. Equipping patients with devices (such as goniometers, accelerometers, etc.) that allow for better physical evaluation remotely and establishing consensus on how best to evaluate patients through telemedicine can help surgeons establish differential diagnoses and monitor patient progress.

Lack of Perceived Benefit

In a 2017 survey of the American Orthopaedic Association, only 20% of orthopaedic surgeons believed telemedicine was useful for routine postoperative follow-up, and 42% believed that colleagues would be disinterested in telemedicine⁹. From the patient perspective, many individuals favor in-person visits because they pay similar co-pays and prefer to have direct consultations. For patients who live near the location at which an in-person follow-up would take place, the efficiencies of decreasing transportation time may be lost; various published studies have shown societal cost-efficiency for patients who

TABLE I Useful Resources*

Coverage	Useful Resources
State laws and reimbursement policies	https://www.cchpca.org/telehealth-policy/current-state-laws-and-reimbursement-policies#
Medicare	https://www.medicare.gov/coverage/telehealth https://www.cms.gov/newsroom/fact-sheets/medicare-telemedicine-health-care-provider-fact-sheet
Medicaid	https://www.medicaid.gov/medicaid/benefits/telemedicine/index.html
AAOS CPT code guide	https://www.aaos.org/globalassets/about/covid-19/aaos-coding-guide_covid19.pdf
AAOS startup checklist for practice management	https://www.aaos.org/quality/practice-management/telemedicine/

*Orthopaedic surgeons should understand coverage and reimbursement guidelines on a national basis, along with variations across different states. We have included resources to these as well as links to resources from the American Academy of Orthopaedic Surgeons (AAOS) that assist with practical aspects of establishing telemedicine practice and the process of billing for telemedicine encounters. CPT = Current Procedural Terminology.

lived a minimum distance away, establishing telemedicine visit volume break-even points to offset costs^{36,37}.

Negative Financial Implications for Providers

Reimbursement models for physicians may disincentivize the adoption of telemedicine. In several states, lack of parity has resulted in providers being paid more for in-person visits than for telemedicine appointments⁵⁴. Physician billing may be further reduced because of the decreased level of care billed without a detailed physical examination. Also, although health-care facilities may be able to decrease overhead, these facilities will lose additional income from ancillary testing and fees if appointments are not performed onsite.

Possible Increased Medicolegal Exposure

The possibility of increased liability from making diagnoses, recommending surgical treatment, and following up without the ability to perform a physical examination may deter adoption⁵⁵⁻⁵⁷. Additionally, studies have shown that the strength of the doctor-patient relationship may be inversely correlated with the likelihood of malpractice suits, and a strong relationship may be more difficult to develop across a screen⁵⁸⁻⁶⁰. Providers should always rely on the guiding principles of doing what is best for patients and refer patients to the office setting or emergency room when timely, in-person evaluation is required.

Regulatory Barriers

States in the U.S. have begun to reform reimbursement policies, but telemedicine is not treated the same as in-person services^{54,61}. Although most states have passed laws for private payers to reimburse telehealth services, only a small minority of them have mandated parity in reimbursement compared with coverage for in-person services; many of the laws requiring this were passed very recently. Many states require written consent from patients prior to undergoing telemedicine appointments, which adds logistical complexity to the physician practice to obtain the consent⁵⁴. Medicare beneficiaries have

faced restrictions on the originating site of visits, meaning that most patients could not be seen from their own homes and instead had to be at health-care facilities in order for providers to be reimbursed for telemedicine visits⁵⁴. Further, visits are restricted across state lines regardless of payor.

Recent Changes and Next Steps

Because of the recent COVID-19 pandemic, policies have shifted dramatically⁶²⁻⁶⁶. Temporary governmental mandates have allowed clinicians to provide virtual care for patients in states in which they do not hold licenses. These mandates have expanded telemedicine coverage for Medicare patients, improved reimbursement parity between in-person and telemedicine appointments, and in some cases provided reimbursement for care by telephone⁶⁶. Further, telemedicine appointments no longer must occur across HIPAA-secure options. Instead, they can take place through more accessible applications such as FaceTime (Apple) and Skype (Microsoft)⁶². Several insurance companies have issued temporary amendments that largely mirror the federal mandates, but changes in coverage and reimbursement have differed between insurance carriers in various states^{62,67-73} (Table I). The above changes are in the form of temporary mandates during the COVID-19 pandemic and are set to expire once the pandemic resolves. The U.S. Department of Health and Human Services has also asked states to improve legal protections for clinicians⁷⁴. These mostly refer to the care of COVID-19 patients, but protections have also been implemented that can reduce the liability of providers performing telemedicine to care for patients away from health-care settings.

Although recent changes have improved the ability of providers to care for patients remotely and have led to a dramatic rise in the number of telemedicine visits being offered, more sustainable and comprehensive changes are still required to support the integration of telemedicine into daily practice. Given the benefits and challenges of integrating telemedicine into orthopaedic surgery practices, providers must determine if

shifting services virtually will remain beneficial to them and their patients once the pandemic resolves and the temporary mandates expire. Because many surgeons are now providing telehealth visits, those who do not may be at a competitive disadvantage as they may lose future surgical patients. The federal government committed hundreds of millions of dollars to help build the infrastructure necessary for virtual care through the Coronavirus Aid, Relief, and Economic Security (CARES) Act and has already awarded millions of dollars to health systems to help them expand telemedicine options^{75,76}. If systems choose to integrate virtual care, they must harness the opportunities and confront the challenges described above. It is important to note that telemedicine may not be ideal for every type of visit; therefore, identifying specific use-cases and appropriately selecting providers are integral, as is providing sufficient financial, information-technology, and administrative support.

Ultimately, the widespread use of telemedicine in orthopaedic surgery is feasible. In addition to improving the cost and quality of care, developing virtual care pathways would prepare health systems for future public-health crises. However, successful adoption of telemedicine is contingent on coordinated initiatives between doctors, patients, insurance companies, private enterprises, and health-care systems. By tackling the chal-

lenges of implementation and training, raising awareness and improving education, streamlining technology, and collaborating with patients, providers, and payors to align incentives, the field of orthopaedic surgery may benefit from telemedicine in the years to come. ■

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