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Surgery and the Smartphone: Can Technology Improve Equitable Access to Surgical Care?

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Abstract

Unfortunately, many patients in the United States experience healthcare disparities in access to surgical care, including geographic constraints, limited transportation and time, and financial hardships. Living in a “surgical care desert” results in a delay in care, driving up healthcare costs and reducing quality of care. In the age of COVID-19, patient access to healthcare has been further diminished by physical distancing guidelines, naturally increasing the need for innovative telehealth solutions. In this review, we focus on using smartphones for mobile health technology (mHealth) in the delivery of surgical care. This manuscript is aimed at a general surgical audience that may be interested in exploring how mHealth can improve both access and healthcare quality for surgical patients and their families. We review the current uses of mHealth by surgeons for surgical site infection, new models of the perioperative surgical home, acute care surgical triage, remote patient monitoring devices, and evaluation and management surgical consultations in the patient’s home. We also review institutional and governmental barriers to the adoption of mHealth and offer some preliminary solutions that may aid the surgeon who wishes to implement this technology in their day-to-day practice.

Keywords

health equity; telemedicine; telehealth; technology; mobile health; mhealth

The American College of Surgeons Health Policy Research Institute has raised concerns about the access to care for underserved and rapidly aging populations in pockets of both rural and urban areas of the United States. Unfortunately, the COVID-19 pandemic has exacerbated this growing healthcare access problem in the United States. One in five patients (or 60 million people) has limited access to safe, timely, and affordable surgical care,

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primarily affecting low-income, rural, and ethno-racial minority communities. These patients face numerous barriers to care, including geographic constraints, limited transportation, and financial hardships (e.g., parking, lodging, meals, child and elder care, time away from school or work), particularly in rural and medically underserved areas. Living in a "surgical care desert" results in a delay in care, which disproportionally increases utilization of emergency services, which leads to higher costs and inferior clinical outcomes[1].

Mobile Health Solutions May Improve Equity in Surgical Care

While a variety of disruptive technologies have improved the surgeon's life and work in the hospital, a major disruption in our civil lives – the smartphone – has largely been overlooked in delivering surgical care. Adult cellphone ownership approaches 96% in the United States, with broad utilization in all groups irrespective of race/ethnicity, socioeconomic status, or urban-rural classification. Mobile health (mHealth) technology is emerging as a new tool to improve healthcare delivery. While patients historically have had a limited role in their healthcare, electronic healthcare data are becoming increasingly accessible to patients in more digestible formats, empowering patients to participate more actively in the management of their conditions, health behavior change, care coordination, and care team communication[2]. More importantly, technology may bridge the gap in access to healthcare, bringing patients in medically underserved communities in closer contact with their healthcare providers.

Today, the most common example of surgeons leveraging smartphone technology is in surgical site infection (SSI) surveillance. A landscape analysis of mHealth applications devoted to SSI found 10 apps designed for post-discharge SSI detection, but only two in full clinical use[3]. Most of these apps were used in pilot projects or were deployed in a research setting. Using mHealth technology to identify SSI earlier in the post-operative course may decrease hospital readmission and lower healthcare costs. Importantly, because post-operative wound care is generally covered by the "global period", healthcare systems may invest in this technology for cost avoidance, which may speed up implementation of this new service. Improving access to these technologies for medically underserved populations has a strong potential to decrease ED visits and hospitalization with early detection and treatment of post-operative SSI.

In addition to SSI surveillance, new smartphone-based models of the perioperative surgical home (PSH) are being developed to improve the value proposition and increase patient engagement[4]. The central tenet of PSH is to focus on the patient's clinical outcomes and experience throughout the surgical experience, from shared decision-making pre-operatively, to perioperative assessment and optimization, to rehabilitation and recovery. Pre-operatively, PSH may leverage mHealth to engage the patient and family in shared decision-making, expanding the patient's experience beyond the "one-stop shop" of the surgical clinic visit[5]. On the in-hospital side, other studies have used smartphone apps to improve communication within a team-based model of care, comprising of surgeons, anesthesia, hospitalists, advanced practice providers, rehabilitation, primary care providers, pharmacists, and case managers, among others[6]. Post-operative rehab programs have also demonstrated a benefit

in patient engagement when delivered through various mobile health portals, including apps or chatbots[7]. Mhealth connectivity should enhance the PSH by improving communication and engagement across the continuum of surgery.

Acute care surgical triage is another area that may benefit from smartphone implementation in healthcare delivery. The most advanced examples of using smartphone-based applications for surgical triage exist in burn care. Smartphone app-based platforms have been developed to help triage burn-injured patients to geographically-distant burn centers, decreasing unnecessary transfer and enhancing traditional telephone-based triage[8]. These interventions have also been shown to decrease transport and in-patient care utilization by steering patients to the outpatient setting, which highlights the apps' potential to drive down the cost of care. Other smartphone platforms are available that improve the delivery of outpatient burn wound care that decreases clinic utilization and improves compliance to therapy[9]. These mHealth systems may be adapted to other acute or chronic surgical problems, such as complex abdominal wall reconstruction, intestinal fistula management, or post-trauma recovery.

Remote patient monitoring (RPM) devices are another mHealth modality being recently adopted by some surgical subspecialties. These devices, including patches, wearables, and biosensors, allow patient-generated health data to be collected in a variety of scenarios in the perioperative setting. Surgeons have begun using these wearables, particularly Apple Watch™ and Fitbit™, to monitor heart rate and activity level after recovery from surgery[10]. Cardiac surgeons have used real-time monitoring of left ventricular assist device (LVAD) function in LVAD recipients, leading to early detection of flow reductions due to hypovolemia and LVAD thrombosis[11]. The ability to intervene early when a problem occurs may improve outcomes and lower hospitalization utilization, particularly in medically vulnerable populations. Payment structures have been developed by CMS for these services, but they still require the patient to be established with the provider.

Finally, direct-to-consumer evaluation and management (E&M) surgical consultations in the patient's home can increase patient access to surgical care. Prior to the COVID pandemic, virtual E&M consults using a smartphone video link was an emerging field, primarily constrained by a lack of third-party reimbursement and low provider engagement. Virtual E&M consultations did exist prior to the pandemic but have been limited to patient locations in other institutional settings, such as primary care offices, schools, or prisons. These "originating site" constraints have been relaxed during the current COVID-19 pandemic and many direct-to-consumer platforms quickly emerged. Delivery of perioperative care using synchronous video consultation in the home is a significant paradigm shift in the delivery of surgical care, which has the promise of reducing geographic and financial barriers to at-risk patients.

Barriers to Adopting mHealth Solutions

Barriers to implementation of mHealth solutions occur at every level of engagement – from patient, to provider, to health system, and finally to third-party payor. The biggest obstacle remains third-party reimbursement. Pre-COVID-19, the Centers for Medicare and Medicaid

did not support video teleconsultations that were performed outside of specific “originating sites.” Private insurers had fractured coverage models for at-home healthcare delivery, governed by rules that varied by state, technology, and billing code. Furthermore, not every telemedicine encounter is created equal. For example, a clinic nurse receiving data through RPM does not equate to a physician E&M visit. ICD-10 codes are being developed for these services, but few are in use. Further, not all states have parity laws, which are statutes mandating telemedicine services be reimbursed at the same rate as in-person encounters. Finally, it remains to be seen whether smartphone-based teleconsultations in the home will retain financial support from insurance payors beyond the current pandemic.

Lack of access to a smartphone or broadband Internet is another barrier that is slowly becoming less of an issue. Almost all Americans own a cellphone – 96%, although only 81% of patients own smartphones with a higher percentage having access to a smartphone in the home[12]. However, disparities still remain in smartphone ownership: 83% of urban adults vs. 71% of rural adults, and 96% of 18-29 year-olds vs. 53% of adults over the age of 65. In terms of Internet usage, although 90% of adults use Internet, home broadband Internet penetrance varies across most demographic variables, including age, race, income, education, and rural vs. urban settings[13]. Nearly 80% of suburban and urban adults have home broadband connections, while only 63% of those in rural settings do. Federal grant support is emerging to address some of these geographic disparities in access to broadband Internet.

Another major barrier is poor integration of mHealth devices into clinical workflows and the electronic health record, including issues of data management, privacy, standardization, and device interoperability. Implementation science is an emerging discipline aimed at improving the adoption of new ideas into large healthcare systems. An emerging theme from implementation experts is that a clinician champion is needed to introduce, test, and troubleshoot the technology in a real-world environment in order to optimize chances for success. Another important element is buy-in from the supporting hospital system. Telehealth modalities require time and money to implement. For example, in the case of mHealth SSI surveillance, the cost of implementation must be weighed against the potential benefit of reduced hospital readmission after surgery. The value of this intervention must be accepted by all stakeholders in order to promote implementation in the perioperative setting. Finally, patient and provider experience with mHealth is also important when implementing new mHealth interventions. Although patients express high levels of satisfaction with telehealth in most cases, physician satisfaction data are lacking, potentially posing another barrier to mHealth adoption. As both patients and surgeons move to deploy more technology-based services, convenience and experience for both parties must remain a high priority.

Conclusions

The COVID-19 pandemic has proven to be a serious strain on the healthcare system in a variety of ways. Patient access to healthcare has been diminished by physical distancing guidelines, naturally creating more need for healthcare delivery through telemedicine. To combat health disparities and achieve equity in access regardless of background, the surgical

community must remain focused on bridging this gap by integrating communication technology into day-today operations. While mHealth offers promising tools to improve access to healthcare, there are multiple institutional and governmental barriers to the delivery of these new services. To overcome these barriers, the surgical community must advocate for mHealth policy optimization, legislation to disseminate high-speed broadband connectivity, and reimbursement structures that incentivize telemedicine. Future studies by surgeons should focus on establishing workflows for mHealth and technology-supported surgical services, measuring healthcare outcomes, and ensuring surgeon and patient satisfaction with smartphone technologies with these new delivery platforms.

Healthcare is rapidly changing: patients expect convenient and efficient service, payors are seeking to drive down cost, and surgeons are forced to navigate this ever-changing landscape. mHealth has the potential to overcome both distance and time barriers for patients and provide real-time data for practitioners to improve healthcare outcomes and optimize experience. Many institutions and practitioners have pivoted to using telemedicine to mitigate transmission of the COVID-19 in the healthcare setting while continuing to provide necessary care. As states reopen their economies, will surgeons champion these technologies to improve patient access through this novel, modernized delivery of healthcare or will they lose momentum and return to business as usual?

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