

Telemedicine: A Digital Interface for Perioperative Anesthetic Care

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See Article, p 276

GLOSSARY

ICU = intensive care unit; **PICS** = postintensive care syndrome; **VICU** = virtual intensive care unit

The potential applications for telemedicine have reached an inflection point in health care. Mobile smartphone ownership in the United States has reached >90% in the 18- to 49-year-old population,¹ mobile computing and cellular phone technology have combined high-fidelity cameras and telecommunication hardware to make video teleconferencing seamless, and patients are more accustomed to interfacing with their health care systems via digital telecommunications including e-mail, mobile phone, and electronic patient portals. Recent market analyses project the global telemedicine market to grow to \$130.5 billion by 2025,² and yet, anesthesiology is the specialty least engaged with telemedicine-based clinical work.³ Therefore, it is very timely that Bridges et al⁴ published their narrative review of telemedicine for the preoperative, intraoperative, and postoperative phases of anesthetic care. The article not only reviews the current literature on telemedicine case reports, case series, and clinical trials evaluating the value of telemedicine opportunities in our specialty, but it also delineates the hurdles that will need to be overcome to make telemedicine a mainstay technological platform within our specialty, including data security, technological limitations, medico-legal compliance, and reimbursement uncertainty. Such an article is a requisite on which anesthesiologists must develop future strategies to improve the delivery of care to our patients using telemedicine. As maturation

of technology continues to accelerate, telemedicine provides opportunity to expand the connection of the anesthesiologist with patients beyond the operating room and into the perioperative space, and anesthesiologists should be early adopters of telemedicine technology to expand our ability to improve anesthetic patient care using this digital platform.

PREOPERATIVE CONSULTATION AND PREOPERATIVE OPTIMIZATION

As Bridges et al⁴ documents, anesthesiologists have had over a decade-long experience with telemedicine for preoperative consultation. Our specialty's experience with preoperative telemedicine platforms commenced in 2004 through the use of a monitor and digital camera mounted on a stand-alone unit that required a remote operator to assist patients with the remote connection. Today, the capital expense to initiate telemedicine preoperative consultations has decreased significantly, and several institutions report successful use of telemedicine for preoperative consultation with mobile phone-based video conference tools⁵ and mobile app-based telemedicine portals.⁶ Results from these studies show high patient satisfaction rates and low rates of case cancellations.

Two-way digital communication is not the only method that telemedicine can improve the patient experience or expand the patient's access to anesthesiologist specialty consultation. Telemedicine may facilitate preoperative remote patient monitoring activities by perioperative anesthesiologists, allowing remote optimization of anticoagulation, glucose control, fluid status, weight management, and increasing functional capacity before surgery. As mobile health research further advances, anesthesiologists may accomplish optimization activities using data from wearable sensors, including consumer wearables, actigraph data, continuous glucose monitors, Bluetooth

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connected smart home devices, and cardiopulmonary sensors, with data transmitted into electronic medical record portals collecting patient-collected outcome data. While remote monitoring potential certainly exists, large barriers remain including standardizing data collection methods, maintaining data repositories, and optimizing data storage into data lakes to facilitate anesthesiologist review,⁷ which necessitates anesthesiologists to actively engage in this arena with research.

In addition, in the past 5 years, prehabilitation of surgical patients for improved surgical outcomes has gained increasing attention,⁸ and telemedicine opens new portals from which clinicians can guide prehabilitation activities. Theory from industrial engineering and controller systems may be used to design mobile health platforms to measure and achieve health care milestones before surgery whether that be glucose control, achieving target dry weights for heart failure patients, increasing exercise capacity or 6-minute walk test distance.⁹ Prehabilitation endeavors may not need to remain within the confines of a clinical environment but may transition to personalized programs that are delivered directly to the home environment with remote monitoring and periodic patient interactions from a distance. The surgical episode marks a perfect “teachable moment” for lifestyle change in patient populations, and telemedicine will provide a portal for anesthesiologists to play an active role to inculcate lifestyle changes and improve population health before and after surgery.

POSTOPERATIVE TRANSITION OF CARE AND FOLLOW-UP

Telemedicine use in the postoperative setting among anesthesiologists is still nascent. While Bridges et al⁴ references the virtual intensive care unit (VICU) within a hospital setting, little literature exists regarding anesthesiologist engagement beyond the hospital episode. Telemedicine in the postoperative setting has shown success among surgeons by increasing accessibility to surgeons, reducing wait times, and producing cost savings for patients.¹⁰ As patient comorbidity complexity increases, transitions of care from the inpatient to the outpatient setting become more paramount: patients need antihypertensives and anticoagulants restarted; they need management of their early postoperative pain; dialysis schedules need coordination; their heart failure medications need reinitiation; and these are areas that are ripe for anesthesiologist involvement. Medicare and Medicaid established 7- and 14-day transitional care management codes to prevent unnecessary rehospitalizations during this transition, and anesthesiologists can use telemedicine as a platform to participate in this goal. Such engagement with the patient extends the role

of the anesthesiologist beyond the immediate post-anesthesia care unit environment back to their home after their procedure and bookends the preoperative experience that patients have with their anesthesiologist, allowing the anesthesiologist to participate as an active team member in advancing the “Hospital at Home” surgical readmission reduction strategy.¹¹

POSTINTENSIVE CARE UNIT RECOVERY CLINIC

While hospitalizations are increasing, mortality has declined and more intensive care unit (ICU) survivors are being discharged into the community, and the long-term effects of critical illness and aggressive health care interventions are starting to come into focus. There is increasing recognition in the critical care community of postintensive care syndrome (PICS), a condition where ICU survivors suffer from physical, cognitive, and psychological impairments that may substantially limit the quality of their lives and their economic well-being.¹² Longer-term follow-up of ICU survivors may help us understand the impacts of aggressive health care interventions on patients who survive serious illness but develop “chronic critical illness” that continues well beyond ICU discharge and often culminates in long-term morbidity and mortality. Thus, ICU follow-up clinics that offer focused multidisciplinary care in the window immediately after discharge are increasingly becoming a vital advance in survivorship care. There has been growing evidence in the literature that such clinics deliver more interventions for post-ICU recovery than usual care, with demonstrated reductions in early (within 7 days) and longer time to readmission.^{13,14} One challenge that Post-ICU clinics face is that the ICU survivor population is often too weak and debilitated to physically transport themselves to a clinic visit, which reflects the current model of health care that requires a patient to physically go to a health facility to get medical care. Telemedicine removes financial, geographic, and social barriers to follow-up and will extend the footprint of health care organizations into the homes of ICU survivors, allowing Post-ICU clinics to act as short-term remote surveillance hubs for this high-risk group. As health care increasingly transitions to value-based care, telemedicine may allow anesthesia intensivists with ICU Recovery Clinics to facilitate comprehensive care for the ICU Survivor population, allowing for opportunity of accelerated resolution of recovery from critical illness.

CHRONIC PAIN MANAGEMENT

The majority of telemedicine experience occurs in the outpatient setting, and chronic pain management is one of the largest outpatient venues where anesthesiologists practice. Often, patients suffering from chronic pain have mobility restrictions, and traveling long distances for clinic visits would be more conveniently

and efficiently conducted over telemedicine platforms. Outpatient multimodal pain management regimens can be adjusted and titrated remotely from symptom history and follow-up alone, providing large opportunities for innovation and patient safety development for remote patient monitoring of the chronic pain patient. As an example, innovations in technology have allowed for several companies to patent technologies for a “smart pill box,” which electronically controls demand, delivery, and inventory of medications, similarly to the in-hospital patient-controlled analgesia devices.¹⁵ Anesthesiologists have the opportunity to bundle these innovations into a digital package not only to remotely monitor, prescribe, titrate, and deliver responsible opioid prescriptions, but also to simultaneously use these technologies to study and target opioid reduction and pain management transition strategies.

DEMONSTRATING VALUE

At a time when future payer reimbursement for anesthesia services has uncertainty, many clinicians wonder how to justify adoption of new technological platforms that are unfamiliar within the specialty. Widespread adoption and improved hardware in mobile phone technology have greatly decreased the upfront costs to pilot telemedicine programs compared to a decade before. Patients from the younger demographic are comfortable with remote interactions for their services, and thus developing mechanisms for anesthesiologists to participate in remote care and monitoring only helps to recruit and retain these patients within a health system's risk pool. In addition, consolidation of health care practices across the nation makes telemedicine a needed and cost-effective patient interaction technology. Local practices are consolidating into larger health care system entities for financial purposes and to reap the benefits of economies of scale. That effect has a clear consequence in that patient populations will expand to larger geographic scopes. As more regional specialization emerges, patients will need to consult with physicians for specialty care over greater distances than before. Telemedicine, both for consultation and follow-up, and remote patient monitoring provide possible avenues for overhead reduction and a cost-effective and convenient tool for anesthesiologists to digitally interface with patients across these distances as well as fresh spaces for perioperative innovation within the field. Furthermore, as anesthesiologists explore the use cases of this technology, we restate our ability to be proactive team players for surgical outcomes beyond the operative period alone, particularly when value-based care delivery is paramount.

CONCLUSIONS

Anesthesiologists have established themselves as stewards for patient safety and leaders in quality improvement within health care systems. We have

a responsibility to apply advances in technology to achieve our patient-centered purpose of improving health and the patient experience throughout the perioperative period. Telemedicine not only allows anesthesiologists to extend their expertise inside the hospital with high-fidelity monitoring but also invites us to engage in the spectrum of care outside the hospital. This goal extends our reach not only to affect in-hospital outcomes, but population health outcomes as well. We applaud Bridges et al⁴ for setting the current stage of our work with telemedicine, and we look forward to the experimentation, innovation, and implementation with telemedicine platforms in the future. ■■

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