The future of anesthesiology requires a very targeted market growth strategy. In the last decade, we have seen major health care legislation expand the number of potential patients who will access our system, and yet revenues are at risk with a challenged payer mix and lower future reimbursements. Technology has often been a market enabler for disruptive business models to deliver services for less overhead cost,\(^1\) which is a major tenet of strategy to bend the cost curve of health care.\(^2\) With new economic pressures, a changing health care customer emerging in the future marketplace, and great strides and adoption in mobile technology, telemedicine offers the anesthesiologist a newer platform on which to develop innovative models of care delivery such as the Perioperative Surgical Home (PSH) and enhanced recovery after surgery (ERAS).

Economic Reasons for Disruptive Innovation

The costs of health care continue to escalate, particularly after the Affordable Care Act, which increased the total population that will access the system. A recent comparison between the United States and other industrial societies continues to cite administrative and overhead costs as a major reason for elevated health care costs in the U.S.\(^3\) Brick and mortar locations to interact with patients for the PSH/ERAS are expensive with respect to space, overhead and staffing costs, and thus could be cost-prohibitive to a business model that has shrinking revenues. Health systems, both academic and private alike, have increased their size and built network over considerable distances to increase volumes in the setting of lower reimbursements; hence, patients must access health care from further distances than before.\(^4\) In health care networks with large geographical scope, transportation costs are high for patients and the corresponding time-based opportunity costs for patients with numerous co-morbidities.
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is high within our fragmented system. As such, telemedicine offers a platform to interact with surgical patients in this environment to keep overhead clinic costs low and lean and to improve access for patients separated by great distances.

Technology Has Evolved for Reliable Use

New health care customers entering the market are showing increasing interest in using mobile technology for their health care needs, and this is not unique to perioperative care. Smartphone use in the U.S. has increased to over 75 percent; in the 30-49 year-old demographic, smartphone adoption has increased upward of 89 percent. New smartphone technology is now equipped with high-fidelity cameras and microphone equipment (Table 1). Smartphone users are able to attach and connect wired and unwired peripheral devices to use interactively with smartphones: retail business illustrates this with mobile phone credit card readers. In health care, these features are illustrated by stethoscopes, ECGs and even ultrasound technology. The U.S. has made great strides in fiberoptic bandwidth capabilities that allow stable internet access in both metropolitan and rural areas alike. With large investments from both the private and public sectors, we will only see mobile technology advance in this space.

A New Health Care Customer

The 30-49 age demographic that has ubiquitously embraced mobile technology for activities of daily life – including recreation, finance, telecommunications and now health care – will be the next wave that accesses the health care system in the next two decades. This customer is also accustomed to just-in-time delivery of services and products: Amazon.com will deliver goods via a smartphone order the same day; Uber and Lyft will send transportation within minutes; haircuts and massages are ordered and completed on the same day via smartphone. The same expectations will hold for the modern health care provider. A reflection of this transition includes the proliferation of clinics with high-fidelity technology integration, including One Medical and Forward.

Telemedicine in Anesthesiology

While telemedicine technology has been most widely used in the radiological and emergency medicine spaces, anesthesiology’s interaction with this technology is not new. Though some exciting applications have trended on social media recently in emergency medicine for acute care management in rural settings, anesthesiology has had over a decade of experience with the technology. The first case series of telemedicine use by anesthesiologists was in 2004 for preoperative anesthesia consultation among 10 patients using a mobile viewing monitor and mounted camera operated by a nurse at the remote consulting site. More recently, several

Continued on page 18

Table 1: Technical Specs Comparing Latest Generation of Smartphone: Samsung S9 and iPhoneX

<table>
<thead>
<tr>
<th>Features</th>
<th>Galaxy S9</th>
<th>iPhoneX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>163g</td>
<td>174g</td>
</tr>
<tr>
<td>Screen</td>
<td>5.8” Super AMOLED</td>
<td>5.8” Super Retina AMOLED</td>
</tr>
<tr>
<td>Camera</td>
<td>12 MP (rear); 8 MP (front)</td>
<td>12MP (Rear); 7MP FaceTime HD (Front)</td>
</tr>
<tr>
<td>Resolution</td>
<td>529 ppi</td>
<td>458 ppi</td>
</tr>
<tr>
<td>Storage</td>
<td>64GB</td>
<td>64/256GB</td>
</tr>
<tr>
<td>Connectivity</td>
<td>4G LTE + WiFi</td>
<td>4G LTE + WiFi</td>
</tr>
<tr>
<td>Video</td>
<td>40K at 60fps</td>
<td>40K at 60fps</td>
</tr>
<tr>
<td>Other Sensors</td>
<td>Accelerometer, Barometer, Gyro, Geomagnetic, Proximity, Iris</td>
<td>Accelerometer, Gyro, Proximity, Compass, Barometer</td>
</tr>
</tbody>
</table>

Data: Samsung.com; Apple.com
institutions have used telemedicine for preoperative evaluation and have shown impressive success with patient satisfaction, low cancellation rates and generalizable success. With advancement of technology, integrated mobile devices have replaced much of the older, clunkier viewing units with accessory camera equipment. Patients are now interacting with their physicians using mobile hand-held, tablet and laptop technology. A recent case report from Dilisio and colleagues demonstrate the use of image capture via a real-time video feed to assess the preoperative airway in patients scheduled for dental procedures who had risk factors for a difficult airway. Overall, anesthesiologists have also been early adopters of tele-ICU capabilities among critically ill patients in remote locations and hospitals.

At UCLA’s Department of Anesthesiology and Perioperative Medicine, telemedicine has been implemented as a default preoperative consultation option between anesthesiologist and patient (Figure 1). Initially, teleconference tools from Zoom.com were employed so that patients could interact with physicians from a home computer, laptop or mobile phone. More recently, video visits have been incorporated directly into our electronic medical record (EMR) from where providers can access the clinic schedule, chart and camera and where patients access the technology from their respective EMR portal. Surgeons refer patients to our preoperative evaluation clinic and choose if patients should receive an in-person consult or a telemedicine consult based upon the patient’s residence location and or co-morbidities. At their scheduled appointment, patients activate their web portal of the EPIC-based EMR, which will contain a link to enable Video Visits with the anesthesia provider. The anesthesia provider will conduct a 30-minute consult that includes taking history, assessing co-morbidities and choosing required additional testing. The anesthesiologist can make recommendations to the patient for additional consults or request additional information and explain details of the anticipated anesthetic plan. The physical exam is brief but includes an assessment of height and weight to calculate BMI and an airway assessment.

Airway photos are captured directly from the online interface, and the image deposits instantly into the patient's chart and is uploaded to the pre-anesthesia note at the conclusion of the consultation.

For a subset of patients in which physiological parameters need to be followed over time, a remote monitoring capability called “Patient Entered Flow Sheets” is activated. Here, patients can manually enter physiological data such as daily weights, blood glucose readings, blood pressure, heart rate, oxygen saturation and exercise regimens until the day of surgery. Some of the physiological data automatically uploads to the EMR from consumer-based actigraphs such as the Apple Watch, Fitbit, glucometers and other Bluetooth-enabled devices. Thus, the anesthesiologists at the preoperative evaluation clinic can follow these patient-entered data points directly from the EMR. These tools allow anesthesiologists to track optimization goals, including blood pressures, glucose and weight prior to surgery when patients are in remote locations away from our physical clinic.

Direct Applications to the PSH/ERAS

A major goal for the PSH/ERAS is to have touch points to the surgical patient from the preoperative epoch well into the post-discharge environment. Telemedicine offers a platform to accomplish both goals. Preoperative assessment
with telemedicine has already been shown to be effective and adequate for preoperative interaction, history-taking and airway examination. Further investments into remote patient monitoring devices, the “internet of things” and wearable technology give new avenues to remotely monitor patient physiology prior to surgery and customize co-morbidity optimization in real time. While the new health care consumer may be more comfortable using and sharing consumer-grade physiology data, it is, however, yet to be determined if consumer monitoring tools will be accurate enough to inform robust health care decision-making. Finally, the platform and accessories make post-discharge follow-up of surgical patients more convenient to the health system and uses fewer administrative resources than previously utilized.

**Reimbursement Policy**

In a fee-for-service setting, many wonder about the reimbursement opportunities for telemedicine use. Policies governing telehealth support and reimbursement vary on a state-by-state basis. Medicare, largely, does not support or reimburse “store and forward” activities by telemedicine programs except for programs located in Alaska and Hawaii. Medicare does reimburse live, virtual interactions with patients as well as 30-minute or more remote monitoring of patients at select, mostly rural, care locations. Medicaid program support and reimbursement often vary by a state-by-state basis.

More recently, the Centers for Medicare & Medicaid Services (CMS) announced physician payments for using communication technology: Virtual Check-in (code GVC11), and remote evaluation of recorded video/images submitted by the patient (code GRAS1). CMS is also proposing separate payments for chronic care remote physiologic monitoring and internet consultations. Such reimbursement codes reflect CMS’ growing support for the use of telemedicine technology for both patient interaction and remote patient monitoring. As such, this opens new opportunities for this technology in the perioperative space.

**Residency Training Opportunities**

As the modern health care consumer environment begins to change, our trainees will need to learn how to adapt to the new expectations of service delivery. They will need to be deft at adapting to patients who will access disruptive technologies as they emerge into the marketplace. Residents will need experience in high-technology platforms that facilitate the “just-in-time” care delivery expectations of this new customer. Since this demographic will experience near ubiquity of smartphone technology adoption by the time they emerge from training, our specialty has an obligation to equip them with the skills to interact with patients beyond the typical clinic or acute care environments.

**Conclusion**

As fee-for-service reimbursements begin to eclipse given the rising costs of health care, a goal to decrease overhead costs while improving access in perioperative care will be tantamount. The convenience, low overhead, potential savings for patients and time efficiencies from telemedicine open new opportunities for anesthesiologists to show high value in the health care transformation as we utilize low-cost and EHR embedded technological tools to continue our vocation of applied physiology, patient comfort and acute care.

**References:**


