INTRODUCTION

“The secret of change is to focus all of your energy, not on fighting the old, but on building the new.”

-Socrates

When Johannes Gutenberg invented the printing press in 1440, its invention transformed what is today modern Europe, ushering in significant changes in western culture and modern medicine. Today, an electronic revolution—telemedicine—is changing the very essence of how physicians practice medicine. In what is described as the democratization of access to knowledge, information, and process, the information freely available today has a profound effect on how medical care is and will be delivered. Urology as a specialty must respond critically to evaluate and implement sound strategies that fully leverage this revolution in health care. The aim of this white paper is for the reader to fully understand the current and future state of technology and how to best tailor various practices to incorporate this technology.

Telemedicine and telehealth, describe the use of telecommunication tools including Internet exchange, video exchange, and email to exchange information in the context of health care between patients, providers, consultants, and content for the purpose of education, evaluation, decision-making and treatment. Communication modalities that can be used for telemedicine include text, voice, and two-way audio-video. Platforms include desktop and laptop computers, touch pads, smart phones, wireless wearable sensors, and other emerging telecommunication and patient monitoring technologies.
Telemedicine’s historical role has been to increase access to health care for remote or sequestered populations such as inhabitants of rural areas, military personnel, and prisoners. The goal, initially, was to provide an adequate substitute for unavailable “brick and mortar” infrastructure, but innovative implementation has yielded processes that have supplanted the traditional models of care delivery and will likely continue to do so in both predictable and unpredictable ways. The earliest use of telemedicine was for acute stroke in 1999. A remote neurologist could expedite the timely administration of fibrinolytic therapy for a patient in an ER. The obvious advantage of this telemedicine solution has propelled telestroke companies to the forefront of mainstream stroke care delivery in the United States in both rural and urban emergency rooms. Asynchronous telemedicine applications (performed at one point in time, interpreted at another or from another place) such as Nighthawk Radiology Services are equally ubiquitous.

Currently, telemedicine applications have evolved to broadly cover care for chronic and emergent conditions. Psychiatry broadly utilizes telemedicine psychiatric “office” visits in addition to emergency care. Primary care and internal medicine have demonstrated the value and utility of telemedicine across venues and across credentials from intensivists running command and control centers remotely for multiple ICU stations to physician assistants on video phone chats to a patient’s home. From rural satellite clinics, to urban elementary schools, to retail minute clinics, telemedicine care is demonstrating high patient and provider satisfaction coupled with low error rates and high efficiency. Specialists and surgeons have recently been ramping up the adoption of telemedicine. Pediatric surgeons are telemedicine accessible to many hospitals that lack expertise on their staff. Consultations are increasingly provided via telemedicine by dermatologists, orthopedists, general surgeons, and ophthalmologists.
Urology is well suited not only to join the revolution, but also to potentially lead it as a surgical sub-specialty. An impressive array of urologic telemedicine services have been successfully implemented, some as demonstrations in single-institution pilot programs, and others as standard operating procedures of national health care systems. Academic urologists have pioneered adult and pediatric teleconsultations, as well as post-operative inpatient and outpatient telemedicine rounds. Veterans’ Association (VA) urologists have mainstreamed adult teleconsultations, and private practitioners have provided the complete spectrum of non-operative inpatient care telemedicine from the ER to pre-operative holding to post-operative rounding and discharge. Private practitioners have also provided a telemedicine alternative to traditional follow-up office visits for local urology patients and skilled nursing home residents.

Telemedicine in the arena of actual surgery has not been described extensively, but it is abundantly clear that “telesurgery” is evolving in urology in a variety of telemedicine applications, including telementoring, teleproctoring, telesurgery, and teleconsultation. It has been described as the presence of a “revolution of smart connectivity.” Surgery faces immediate challenges to implement measurable, value-driven data. This democratic access to data and information will have major ramifications on how surgery is performed. The physical tools and connectivity in health care that are currently being used provide “intelligence” unheard of a decade ago. Surgery, unlike any other aspect of medicine, relies on all human senses to deliver the very best technical results. This unique and ancient physical reliance has historically been the very reason why new technologies that reliably perform what surgeons have done for centuries have been questioned. The new technology, with sensors, processors, and software, has now been embedded in the current basic surgical tools, and may very well not only be just as good, but perhaps even better at emulating human senses. According to Porter and Hepplemann, this “IT-driven transformation” coupled with data
storage, connectivity, and analysis will accelerate improvements in function, functionality, performance, and ultimately, the value of care delivery.\textsuperscript{20}

Workforce shortages in urology have well been documented. The need stems from a known mal-distribution of urologic care and a growing shortage of urologists, especially in rural areas. The median age of the practicing urologist is 53 years, and urologists are exiting the workforce faster than they are entering given the static nature of GME funding. It is important to note that 62.3\% of counties in the United States have no urologists. Fewer than 10\% of urologists practice in rural areas, and they tend to be older.\textsuperscript{21}

Given the increased complexities of urologic care and the subsequent trend toward sub-specialization in the field, another telemedicine opportunity exists to provide specialized urologic knowledge, treatment recommendations, and surgical expertise in a timely manner for patients and providers, not only in remote settings, but in urban settings as well. As remote sensors become more sophisticated, the spectrum of urological conditions that can be managed by telemedicine will increase and traditional urology practice patterns will be disrupted as patients will prefer to have care more centric to their location and schedules. Traditional sectors of our society have already incorporated and transformed a customer-centric focus, including travel, retail sales, and banking.

Interest in telemedicine is also growing as a result of health care reform and increased emphasis on health care value. As such, telemedicine is now becoming rapidly integrated, not only into health care systems, hospitals, clinics, and private physicians’ offices, but also into home health agencies, consumers’ homes, and workplaces.

Private payers are increasingly covering telemedicine either by law or by choice. Large gaps still exist in telemedicine reimbursement, but nonetheless, almost all states provide Medicaid coverage for it. The VA has embraced telemedicine across specialties, including a very robust urology pro-
gram. In 2015, 677,000 veterans were seen with a budget of $1.04 billion, and the budget is increasing yearly. Although fee-for-service Medicare reimbursement for telemedicine is restricted to remote or very specific chronic care, CMS is currently liberalizing its implementation in alternative payment models such as accountable care organizations (ACOs).

The regulatory landscape of telemedicine is quite varied from state to state. Rules differ, for example, in what criteria must be met to establish a valid doctor-patient relationship, requirements of consent, and whether a provider must be in physical proximity to the patient. Currently, state licensure requires that a patient be treated in the state that the patient resides. This is streamlined somewhat by states participating in the Interstate Medical Licensure Compact. This multi-state compact aims to streamline the licensing requirements for telemedicine services across state lines. Federal laws regarding telemedicine and Medicare, Tricare, or the VA may circumvent these restrictions.

The logistics of implementing telemedicine are straightforward and are becoming simplified rapidly. Hardware costs decrease steadily and HIPPA-compliant software is increasingly available and accessible. As technology increases, the primacy of the doctor-patient relationship remains unchanged. Telemedicine should be viewed as the practice of medicine with certain advantages and limitations, but with all the ethical constraints, courtesies, and compassion of traditional medicine.

**TELEMEDICINE SERVICES**

Telemedicine can be described in terms of services provided and the mechanisms used to provide these services. Some of the applications described below may be considered nascent in urology, but their adoption is spreading and evolving rapidly. Telemedicine can support the delivery of care by virtually reproducing traditional models, but it also can provide novel approaches to care not available without this innovative technology. Although telemedicine serves the patient, it may also
be configured to explicitly serve providers with services ranging from medical education and expert opinions to intra-operative consultations.

**Telemedicine: Services for Patients**

**Online Services:** Using these services, urology patients have secure online access that permits them to connect via the Internet or mobile web application with the urologist’s office at anytime from anywhere. Patients are able to view portions of their medical record and thus satisfy the US government’s stage 2 objective of meaningful use of an electronic health record (EHR). Patients may send and receive secure messages with their urology care team, request future appointments, receive alerts for preventative services and chronic conditions (e.g., urologic cancer rechecks), complete pre-visit questionnaires, and view and pay their bill. In this form of telemedicine, it is anticipated that some aspects of care could become entirely automated.

**Video Visits:** This service involves a live two-way interaction between the provider and a patient using the Internet and mobile devices to support the episode of care. Video visits are what defines a reimbursable service for almost all payers. Although information can be exchanged between doctors and patients verbally or in a written format, it is the live, face-to-face video connection that defines reimbursable telemedicine. Video visits have a potential role as an alternative to traditional visits in clinic, office, urgent care, hospital, and skilled nursing settings. Specifically, video visits in urology are being used for new patient visits, follow-up visits, hospital or clinic consultations, ER visits, and hospital rounding.

These video visits encourage convenient and thorough communication channels to engage patients with chronic conditions such as erectile dysfunction, frequent urinary tract infections, and stone disease. Shared medical appointments (SMA) in urology have been described by Dr. Eugene Rhee and colleagues to address chronic care for patients in a group setting that allows providers to scale
access efficiently within the practice. The provider moderates the group in a single “sitting” with active, valuable patient participation in a model already used in group therapy. This innovative patient encounter expands compliant group video visits for urology, in addition to what is being learned in regular face-to-face SMAs.

**eConsults:** This electronic method allows a urologist to answer another provider’s focused questions about diagnosis, therapy, or management of an individual patient. The urologist reviews the supporting material and documents of the patient’s EHR, imaging studies, and laboratory tests and provides a formal response to the question. While the requesting provider and the consulting provider can be in the same geographical area, the requesting provider is often at a remote location. eConsults can be synchronous and involve real-time interactions similar to video visits described above. However, one difference is that the patient is typically not present for the eConsult. eConsults can also be performed in an asynchronous fashion where the information regarding a patient is sent electronically to the consulting provider, who then communicates a plan to the requesting provider. eConsults are performed using electronic software and hardware specifically for electronic consultations. For example, a portal called Websphere (Cisco) has been used for eConsults. The response is documented in the medical record of the provider completing the eConsult. eConsults are convenient for patients because they provide timely access to specialty expertise without requiring the patient to actually travel to visit with another urologist. Thus, eConsults allow patient visits to be completed in a shorter timeframe and streamline the delivery of care. Scheduling is also more flexible with eConsults, especially asynchronous consults that can be completed outside the bounds of regular business hours. By using asynchronous eConsults particularly for more straightforward urologic problems, it is anticipated that more time would be allotted for syn-
chronous eConsults or for traditional face-to-face consults on more complex patients during regular business hours.

eConsults can provide the urologist with treatment support and guidance. Virtual tumor boards can be accomplished, radiology studies may be reviewed with a consultant radiologist, or a second opinion review of digitally transmitted histology images may be requested from an expert located anywhere in the world. These are powerful tools increasingly available in urology.

**Teleintraoperative consultation**: The most important and valuable role of electronic consultation for urologic care may be intraoperative consultation. The urologist remotely contacts surgeons from other fields (e.g., general surgeons) or other urologists to offer electronic consultations regarding intraoperative findings. Similarly, a urologist could be available to take intraoperative electronic consults from other surgeons during a case. Electronic intraoperative consultations may help improve delivery of care since expert opinions that otherwise would not be available could be provided electronically.

Teleconsultation and teleproctoring/telementoring have been piloted in urology since 2015 by Kaiser Permanente, one of the largest health care organizations in the United States, including the evaluation of not only robotic cases, but urologic endoscopic stone and laparoscopic cases as well. This provides any surgeon with the ability to gain urgent, intraoperative consults as well as telementoring/teleproctoring opportunities.

**Telementoring and Teleproctoring**: Telementoring and teleproctoring services involve having a urologist serve as a mentor and/or proctor during a telesurgical procedure. These services could revolutionize the way that surgeons are licensed and credentialed to practice urology, enhancing the efficiency of evaluation without requiring the physical presence of fellow surgeons in order to sign off on privileges.
Long-distance communication in surgery through telemedicine and robotic technology have allowed transition from difficult and impractical physical mentoring to telementoring and teleproctoring. Hinata and colleagues in one of the first reported series of telementoring and teleproctoring in robotics demonstrated the usefulness of a telementoring system to promote the spread of precise surgical techniques associated with robotic-assisted radical prostatectomies. The group demonstrated proper function and acceptable latency with no differences in surgical outcomes, incline operative ties, complication rates, early continence status, and positive margin rates between the telementoring and direct mentoring group.

**Telesimulation and telesurgical rehearsal:** Ongoing advances are being achieved in simulators used to learn minimally invasive surgical techniques. Using telemedicine concepts, it is conceivable that networks of simulators could be used to assist with teaching of novice surgeons outside the operating room. This approach would permit standardized teaching and the potential for real-time interactive proctoring during simulated procedures. There may also be an opportunity in which patient-specific simulations could be used in a similar fashion to permit rehearsal of a procedure before the actual operation. Indeed, efforts are ongoing to develop urology patient-specific simulations that could be rapidly and easily integrated into telemedicine.

**Medical education:** This cost-effective application may provide continuing medical education credits for health professionals and special medical education seminars for targeted groups in remote locations. These offerings could be interactive in a one-to-one fashion or be carried out in an interactive fashion between the course director and a group of participants. This concept would build on what is currently accomplished with webinars or electronic videoconferences by having an opportunity for participants to benefit from two-way interactive communication during sessions.
Great interest in graduate medical education and telemedicine exists with the possibility of flexible supervision to address quality and efficiency needs both in clinics and operating rooms.

EXAMPLES OF TELEMEDICINE UROLOGY

The telemedicine experience in urology spans the spectrum from new patient consultations to telesurgery to post-operative rounds and even virtual house calls. As the technology and bandwidth have become more accessible, utilization is increasing. This section highlights the experiences of both pilot programs and institution-wide protocols in urological telemedicine care.

Outpatient Telemedicine

The VA is aggressively expanding telemedicine services, having budgeted $1.2 billion for the effort in 2017. Jeremy Shelton, MD and his urology colleagues in the Los Angeles VA have been providing consultations to veterans who live remotely as well as those who live in areas of greater Los Angeles where traffic patterns are prohibitive. All urologic conditions can be initially evaluated and followed by telemedicine, and patients come to the clinic for inpatient exams and procedures as indicated. The most commonly managed conditions include lower urinary tract symptoms, elevated PSA, and prostate cancer. The encounters have very high satisfaction rates, with 95% of patients rating them as very good to excellent and 80% of urologists rating them as excellent. An average of 277 travel miles and $200 in travel costs were saved per visit. Similar savings and satisfaction were reported by a telemedicine program at the VA Medical Center in Omaha, Nebraska. More than 1,000 patients have been cared for telemedicine (personal conversation), and the VA has provided a broad range of telemedicine services.

At the Mayo Clinic in Rochester Minnesota, Matthew Gettman, MD and his colleagues provide televisits for patients following prostatectomy. Many patients come from great distances (average 95 miles), including across state lines, for care. An earlier prospective study of this program demon-
strated similar patient-to-provider face time (14.5 minutes vs. 14.3 minutes), patient wait time (18.4 minutes vs. 13.0 minutes), and total time devoted to care (17.9 minutes vs. 17.8 minutes). However, the patient’s time away from work was greatly reduced and travel expenses were eliminated. There was nearly identical satisfaction for urologists conducting the visits via telemedicine compared to in person.  

Dr. Paolo Andreassi and colleagues at the University of California Davis Department of Urology provide telemedicine urology consults for most adult and pediatric urological conditions. The appointments are conducted in the presence of the primary care physician at satellite clinics equipped with the telemedicine audio-visual platform. Medical records and diagnostic studies are provided well ahead of the scheduled appointment. Pediatric urologists have embraced telemedicine driven by the scarcity of their services. Catherine Devries, MD, a pediatric urologist at the University of Utah, has been providing remote consults for several hundred rural patients annually for the past several years. She utilizes the Tele Home system, which incorporates a web cam, PC, and encrypted software with a unique log-in code provided for the patient. Dr. William Kennedy, a pediatric urologist at Lucille Packard Children’s Hospital at Stanford, cares for numerous patients each month using the Cisco Health Presence software platform. Nurse practitioners travel to rural clinics, as well as inner-city satellite hospitals. National and international consultations are provided through the Cisco Health Presence platform as well. Wait times for consultations are reduced by 50%, and the majority of families prefer this method of consultation. Dr. Stephen Canon and associates at Arkansas Children’s Hospital demonstrated the value of telemedicine pre-operative consultations and post-operative follow-up for patients in remote rural areas. There were no complications compared with in-person pre-operative consultations, and significant travel time was saved. Instead of traveling an average of 335
km to Arkansas Children’s Hospital, these patients could travel to a local clinic 35 km away that was equipped with the telemedicine platform.12

A statewide telemedicine network in Arkansas enables urologists to identify and direct care for patients with prenatal urological anomalies.12 Dr. Robert Nguyen pioneered a post-operative telemedicine program at Boston Children’s Hospital where VGo remote-controlled telemedicine robots were sent home with children who were discharged from the hospital after surgery. This enabled the urologist to closely monitor the children in their own homes during the critical post-operative period. This robotic presence was welcomed by the families, and children often did not want to return their new robotic “friend.”11 Rush Children’s Hospital in Chicago uses the VGo robot to keep inpatients connected with school and family who are not able to come to the hospital. Aaron Spitz, MD in collaboration with OptumHealth has employed the VGo robot to provide new patient consultations as well as follow-up care for residents of a local skilled nursing facility. The distance of the facility to his urology practice in Orange County, California is only two miles, but the telemedicine connection allows for a great reduction in the burden associated with transfer of these convalescing patients to and from the facility.

Eric Geisler, MD in Austin, Texas as well Aaron Spitz, MD in Orange County, California provide urological follow-up visits routinely to their locally based, urban private practice patients using the ChironHealth Web-based platform. These patents prefer the convenience of follow-up visits from their iPhone, iPad, or camera-ready computer, and these visits have augmented their practices while keeping their physical office space available for more complex patients requiring in-person evaluations.
Inpatient Telemedicine

Telesurgery

Kavoussi and colleagues were pioneers for telementoring, teleproctoring, and telesurgical applications in urology. The initial work in urology was carried out between the Policlinico Casilino, “Tor Vergata” University of Rome and Johns Hopkins Medical Center in Baltimore, Maryland, starting in 1998. Two separate operating sites were used for all telementored procedures. In the primary operating room, the surgical team included the surgeons, assistant surgeon, surgical scrub nurse, and circulating nurse. Equipment included standard laparoscopic instruments, an external camera system, a multidirectional microphone, and purpose-built robotic arm to manipulate the laparoscope (AESOP Robot, Intuitive Surgical, Sunnyvale, CA). For some experiments, the researchers used a second robot called PAKY (Percutaneous Access to the Kidney; Urorobotics Laboratory, Johns Hopkins Medical Center, Baltimore, MD) to perform radiographically guided needle orientation and insertion for percutaneous procedures. Connectivity between sites required the use of high-capacity telephone lines (ISDN) that each carried 128 kbps and associated software for data transmission. At the remote site, hardware included a video monitor with speaker, a multidirectional microphone, video mixers, a robotic control pad, and a telestrator video sketchpad (Chryon, Melville, NY). To complete the telementoring, teleproctoring, and telesurgical procedures, the remote surgeon had the ability to manipulate the robot using the robotic control pad. The remote surgeon could use verbal communication as well as visual information with the teleillustrator to mentor the surgeon through the procedure. With these experiments, the remote surgeon also had the ability to control the electrocautery for cutting and coagulation functions. Between 1998 and 2000, feasibility of telementoring, teleproctoring, and telesurgery in urology was shown through 17 procedures with uneventful post-operative courses. In 10 cases, telementoring was deemed successful. In five cases, telementoring was not possible secondary to connectivity is-
sues between the primary and remote site. In two cases, intra-operative complications required conversion to open surgery. The time delay for image transmission between sites was <1 second. The first actual reported complete telesurgical case in the medical literature occurred in 2001 whereby a New York City general surgical team performed a laparoscopic cholecystectomy using a ZEUS robotic system on a patient in Strasbourg, France with a 144-ms time delay. The University of Virginia created and tested in a feasibility trial a telecystoscopy system that was validated by experts. Interestingly, the telecystoscopy video quality was further validated by both experts and non-experts, known as “crowd sourcing.” Results from the group had high concordance with these two groups.

This technology has also been implemented by Dr. Eugene Rhee within Kaiser Permanente, San Diego as a “store and forward” technology that is embedded within the EHR system. This allows parallel access for patients that permits cystoscopy to be performed by any staff urologic provider at any location and time convenient for the patient. The results are then “stored” within the EHR system and “forwarded” to the provider who ordered the cystoscopy.

Novel solutions such as these are particularly needed for urologists using telemedicine in the operating room. In this regard, urologists should partner with telecommunication and surgical instrument companies to develop products that would support urologic telemedicine in the future. The Kaiser Permanente Telesurgery pilot program is an example of a major collaboration with TIMS Medical based in Massachusetts to create a true telesurgical operating room with real-time ability to jointly perform any procedure remotely as a “virtual assistant.” This currently is performed by viewing a video monitor in both places with the simultaneous ability to tele-illustrate for purposes of precise surgical supervision. As urologists and other providers react to the anticipated changes of health care reform, it will be vital that this type of innovative thinking and new approach to old problems be evaluated further to assess its true potential to provide enhanced urologic care.
Telerounding

Telerounding, the concept of remotely rounding on patients, was first introduced by Kavoussi and coworkers in 2004. Telerounding was performed using a 60-inch tall, wheel-driven, remotely controlled robot that consisted of the motor base unit, a microcomputer, a flat screen monitor, and a microphone. Data from the patient were transferred to the provider via the robot using wireless connections to high-speed data lines. Proprietary software was used to integrate the data. The robot was designed to travel to the patient. The physician was then able to interact with the patient via a remote base station that included a microcomputer, digital video camera, a flat screen monitor, a microphone, and a joystick controller. Using this device, feasibility of a remote rounding robot was proven. In a prospective randomized study of 270 adult post-operative patients that compared traditional rounding to robotic telerounding, differences in patient satisfaction were not significantly different between groups and robotic telerounding did not result in missed or increased post-operative complications. Furthermore, lengths of stay between groups were not significantly different. Two-thirds of patients agreed that if their attending surgeon was out of town, they would rather experience a telerounding encounter from their own surgeon than be seen in person by another attending surgeon.

The authors suggested that telerounding may improve the quality of health care delivery by increasing access and decreasing medical errors. It was also suggested that robotic telerounding may help ease the time burden associated with traveling to multiple hospitals to perform traditional rounding. In a related study, the same researchers found that the addition of telerounding had a significant positive impact on patient-reported satisfaction with their hospitalization. Specifically, telerounding improved patient perception of surgeon availability, quality of the medical information delivered, thoroughness of the examination, and postoperative care coordination. However, the
investigators also felt that telerounding should not be a replacement for traditional rounding. Situations may arise in which the physical presence of the surgeon post-operatively is required. This group also pointed out that the efficacy of robotic telerounding systems is unproven for patients who require protracted hospitalizations.31

Peter Bretan, MD, a urologist in Novato, California, has successfully utilized this same robotic platform, the RP-Vita from In-touch Heath, for the last seven years to provide comprehensive inpatient care to six rural hospitals and a prison an average 100 miles away from each other and from his office. These facilities have no other access to urology support. Using the robotic telemedicine platform and the assistance of nurse practitioners, Dr. Bretan provides ER and inpatient consultations and care. Through thoughtful coordination with interventional radiology, general surgery, and the ER staff, he is able to coordinate care for any urological emergency as well as coordinate surgical disposition at “hub” hospitals to which he travels weekly. Post-operative rounds and discharges are completed telemedicine.32 Aaron Spitz, MD, in Irvine, California, has also been using this same robotic platform to provide urological consultation for a local ER. Although the hospital is only five miles from his practice, the disruption of his office practice is minimized as is the delay in disposition for the ER staff and patients.

Building upon the success of robotic telerounding, other groups have devised rounding systems based on telemedicine principles. Kau and colleagues successfully used laptop computers equipped with built-in webcams (MacBook Pro, Apple, Cupertino, CA) and videoconferencing software (iChat, Apple, Cupertino, CA) to carry out real-time video and audio connections between the patient and nurse at the bedside and the urologist at a remote location.33 In a group of 10 patients studied with the telerounding system, 90% of patients agreed or strongly agreed that the telerounding system permitted easy communication with the urologist. In addition, all patients agreed that telerounding should be a regular part of patient care and that the system would be ac-
ceptable if their urologist was unable to be in direct contact with them. All physicians and nurses agreed that the laptop telerounding system was easy to use, enhanced patient care, and would be a welcome alternative if direct physician contact was not possible. However, the authors cautioned that telerounding should not be viewed as a replacement for traditional face-to-face rounding by the urologist. The authors also reported that the rounding system with laptops was simple to use and more cost-effective and readily available than purpose-built telerounding robots. The authors noted that videophones were considered for the trial, but that the small screen size was a factor that led them to use laptop computers.33

Building upon the success of the two prior research groups and the advent of newer telecommunication devices, Kaczmarek and colleagues evaluated the feasibility of telerounding with a commercially available computerized tablet device. The researchers enrolled 32 patients to compare tablet telerounding on post-operative day one to traditional rounding with direct patient contact on day two. To perform tablet telerounding, an iPad 2 (Apple, Cupertino, CA) was used and tablets remotely communicated with two-way proprietary videoconferencing applications (FaceTime, Apple, Cupertino, CA) using wireless Internet connections. The results for tablet telerounding were favorable, with 91% saying their care was better with telerounding and 97% saying that telerounding should be part of routine patient care. In addition, 94% of patients stated that they could easily communicate with their urologist using the telerounding system. The authors concluded that tablet telerounding was useful to improve a patient’s satisfaction during the hospital stay and that it was convenient for urologists as well.34

In comparison to video visit teleconsultation that may be performed preoperatively, telerounding after surgery is logistically much easier to implement. In most instances, the patient and provider are in the same state during telerounding and therefore licensure issues are obviated. If the patient is hospitalized in a different state than the provider is located during the telerounding consultation,
then the provider must be licensed in the state where the patient is located. Because telerounding would be performed within the 90-day post-operative global period, issues related to billing are avoided.

**Delivery Modes for Telemedicine**

**Networked programs:** This approach links tertiary care hospitals and clinics with outlying clinics and community health centers in rural or suburban areas. The links may use dedicated high-speed lines or the Internet for telecommunication links between sites. Most telecommunication companies have developed electronic infrastructures that support telemedicine at least in the sense of synchronous or asynchronous consults. Solutions for telesurgery are emerging but less widely available.

**Point-to-point connections:** This approach utilizes private high-speed networks to directly link with and deliver services to independent medical service providers. In this example, the independent medical service providers would use commercial-based electronic infrastructures to deliver care.

**Web-based e-health patient service sites:** This approach provides direct consumer outreach and services over the Internet. In keeping with the definition of telemedicine, sites that provide direct patient care are included in this category. Most commonly, this form of telemedicine would pertain to synchronous and asynchronous consults carried out using commercially available hardware and software that utilize encryption to comply with HIPPA. One such company is ChironHealth, which provides an Internet-based platform that works with iPhones, iPads, and PCs utilizing the Google Chrome browser.
As with traditional health care, the delivery of telemedicine can be enhanced by adhering to standard operating procedures. General and specialty medical societies are currently generating guidelines for telemedicine that include technical instruction as well as ethical considerations. The American Urological Association (AUA) is currently engaged in generating telemedicine guidelines with appropriate partners. Such standards may form the basis of uniform and high quality patient care and enhanced patient safety. Furthermore, established guidelines lend legitimacy to the practice of telemedicine, which encourages legislators and payers to support its practice.

Telemedicine is delivered most commonly in real-time using secure internet-based videoconferencing technologies through remote-controlled mobile platforms, fixed workstations, personal computers, and hand-held mobile devices. The network is typically a secure VPN, and the software is typically licensed to a host institution. With advances in encryption software, urologists can use relatively inexpensive videoconferencing software downloaded from the Internet to connect with patients directly in their own home or other non-institutional setting. Another option is the use of Internet-based websites that can serve as a portal for urologists and patients seeking care online. It is conceivable that urologists could sign up with one or more Internet-based company that provides professional profiles that could be viewed online by prospective patients. In this model, patients would find such sites by searching online or by word-of-mouth. In other scenarios, it is conceivable that requests for telemedicine urologic services could be outsourced to companies that contract with hospitals or other institutions in need of these services.
The Video Visit

When considering the use of video visits, the most important step for the provider is establishing what types of patients and in what settings patients will be offered video visits. When setting up the appointment, it is important to determine that the patient has the required hardware and software capabilities as well as sufficient broadband connectivity for the video visit. In addition to having step-by-step instructions, the patient should be provided with contact information for technical support and the host in case troubleshooting is required. Another option to facilitate video visits for individuals who do not have the required hardware and software is to provide the patient an equipped mobile device to carry out the video visit. The patient would follow detailed instructions to connect for the video visit and after completion of the visit would mail the mobile device back to the home institution. Many telemedicine services rely on satellite locations where the patients present for the encounter. The hardware, software, and connectivity are provided and standardized for maximum reliability.

Prior to the start of the video visit, it is important that informed consent be established with the patient. This consent is ideally conducted in real time and laws within the patient jurisdiction should be followed regarding the use of verbal or written consent. The provider should document the provision of consent in the medical record.\textsuperscript{2,11} The consent should include a discussion regarding the structure and timing of services, record keeping, scheduling, privacy, potential risks, confidentiality, mandatory reporting, and billing. It is important that confidentiality and the limits of confidentiality in electronic communication be discussed. It is also important that the issue of video recordings be discussed. Specifics regarding technical failure of the video visit, protocols for contact between sessions, and conditions upon which the video visits will be terminated in lieu of a traditional visit also need to be discussed.
It is important that the video visit be carried out in an appropriate environment for both the provider and the patient. Specifically, it is important that privacy be maintained for both patient and provider during video visits. It is important that the video camera and lighting be arranged such that both the patient and provider can be clearly seen. If the patient is in a public place (i.e., public library or local coffee shop) for the consultation, then the provider should recommend that the consultation be delayed until a suitable private space is identified for the encounter.

It is important that the consultation begins with identity verification of both the provider and patient. In many instances the host clinic may perform the verification prior to starting the video visit. The location of the provider and the patient should also be established during the video visit. Contact information, including email and telephone information, for both the provider and the patient should be verified at some point during the video visit. Lastly, the expectations regarding the video visit and any subsequent visits should be discussed at some point during the video visit.

After the video visit, the urologist must make an entry in the medical record in a similar fashion as for traditional visits. The medical record entry should include an assessment and plan, patient information, contact information, history, informed consent, and information regarding fees and billing. As part of the documentation, it is also important to note that the patient was seen using telemedicine technologies.

Successful videoconferencing requires that a number of technical issues are understood and controlled, such as the videoconferencing application; characteristics of the telemedicine devices, including mobility, network, or connectivity features; and how privacy and security are maintained. When possible, all efforts should be taken to use videoconferencing applications that have been tested with appropriate verification, confidentiality, and security parameters. Video software platforms should not be used when they include social media functions that notify users when an individual on a contact list logs on. Many free video chat platforms include such functionality as a de-
fault setting, and this setting should be changed before providing video-based clinical services. These platforms may also include the capability to create a video chat room that allows others to enter at will. The type of functionality should also be disabled.

In regards to connectivity, telemedicine services can be provided through personal computers or mobile devices that use Internet-based videoconferencing software programs. A bandwidth of 384 kbps or higher in both the downlink and uplink directions is recommended. Because different technologies provide different video quality results at the same bandwidth, each end point should use bandwidth sufficient to achieve at least a minimum of 640 x 360 resolution at 30 frames per second. Each party should use the most reliable connection to the Internet during the video visit. All efforts must be taken to make audio and video transmission secure by using point-to-point encryption that meets recognized standards. Currently, FIPS 140-2, known as the Federal Information Processing Standard, is the US Government security standard used to accredit software encryption and lists encryption types such as AES (advanced encryption standard) as providing acceptable levels of security. Providers should also familiarize themselves with the technologies available regarding computer and mobile device security and should help to educate the patient. When patients or providers use a mobile device, special attention should be placed on the relative privacy of information being communicated over such technology. Mobile devices should require a passcode and should be configured to have an inactivity timeout function not exceeding 15 minutes.

**Telementoring, Teleproctoring, and Telesurgery**

Procedural and operating rooms are increasingly equipped with videoconferencing software that provides opportunity for real-time two-way interactions. Most commonly, videoconferencing has
been used for live surgery demonstrations during educational conferences. Using the same commercially available hardware, software, and telecommunications connections, mentoring or proctoring surgeons from a distance is feasible. This approach was initially used for endoscopic and laparoscopic procedures in urology, but has been recently expanded to include robotic telesurgery formats as well.

The area that has the greatest potential, but also requires the most work, is the area of telesurgery. Before robotic surgery was available to perform complex urologic procedures, efforts focused on telesurgical solutions for transurethral resection of the prostate, percutaneous renal access, and robotic control of the laparoscope. The ultimate goal of telesurgery is to permit a patient to undergo a surgical procedure with the provider performing the procedure an unlimited number of miles away from the patient; however, the notion of separating the patient from the surgeon, and therefore separating the five human senses that have been fundamental to surgery since its inception, challenges any adoption of technology. This directly highlights the legislative, legal, and technical concerns of telesurgery.

While examples of successful telesurgery are available, this approach would not at the present time be considered commonplace. As with the other urological telemedicine applications, a need exists for standard operating procedures with appropriate patient safety and care delivery standards.

**REGULATION**

Regulations in the practice of telemedicine vary by state. For example, the requirements to establish a patient-physician relationship vary. Some states require an in-person encounter prior to subsequent telemedicine encounters. States vary on the communication modality required to be rec-
recognized as a telemedicine encounter (video versus audio alone). Some states require the physical presence of a health care worker with the patient, known as a “telepresenter.” Consent requirements vary as well. In most cases, the provider must comply with the relevant licensing laws in the jurisdiction where the provider is physically located when providing the care and where the patient is located when receiving care. The jurisdictional licensure requirement is usually tied to where the patient is physically located when he or she is receiving the care, not where the patient lives. In the event that a mandatory reporting issue would arise during the video visit, the duty to notify is tied to the jurisdiction in which the patient is receiving services.\textsuperscript{31} Twelve states currently participate in the Interstate Medical Licensure Compact. This multi-state compact aims to streamline the licensing requirements for telemedicine services across state lines.\textsuperscript{23} Specific licensure details can be obtained by contacting the licensure board for the geographical location of where the provider and patient will be located during the video visit.\textsuperscript{23}

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\textsuperscript{HIPAA, Health Insurance Portability and Accountability Act.}

States participating in the Interstate Medical Licensure Compact include:

- Alabama
- Idaho
- Illinois
- Iowa
A flood of legislative activity surrounds telemedicine, with 42 states having introduced 200 bills in 2015. Even so, federal bills may supersede state laws with regards to the Medicare and VA patient populations. The National Defense Authorization Act for fiscal year 2017 contains a provision that allows patients in the Tricare system to receive telemedicine services from physicians who are licensed in the state in which the physician resides and not the patient, thereby allowing the physician to practice telemedicine across state lines. The Federation of State Medical Boards, the American Medical Association, and the American Osteopathic Association are engaged in efforts to oppose this pending policy. Proposed legislation would similarly override state barriers. The Veterans E-Health and Telemedicine Support Act of 2015 would create an interstate medical license similar to a driver’s license, which would allow telemedicine practice on these patients. The TELE-MED Act of 2015 enables Medicare providers to provide telemedicine services to Medicare recipients in any state. Medicare currently limits authorization for telemedicine to remotely located patients. The CONNECT for Health Act, a bipartisan bill, calls for expanding authorization to all Medicare Advantage patients as well as Medicare patients within alternative payment models such as ACOs. Store and forward technologies would be liberalized from their current use, restricted only to Hawaii and Alaska. Also the list of eligible providers would be expanded as well. It is possible that CMS will expand the utilization of telemedicine for Medicare patients since it is mandated in the Patient Protection and Affordable Care Act, which calls for “...timely communication of
test results, timely exchange of clinical information to patients and other providers, and use of remote monitoring or telehealth.”

**REIMBURSEMENT**

The issue of billing and coding is directly related to the legislative issues of telemedicine. While non-governmental payers and patients have paid directly for telemedicine services, it is anticipated that legislative efforts could help streamline billing and payment. Reimbursement remains the largest obstacle to the widespread adoption of telemedicine. Currently, 29 states and Washington DC have parity laws requiring private payers to reimburse telemedicine services on par with in-person services. Three additional states provide partial coverage. Blue Cross Blue Shield, Aetna, United Health, and Cigna are currently the top payers, but the majority of state employee plans cover some degree of telemedicine services. Retail providers of telemedicine services may contract patients directly or their insurance on a fee-for-service basis. The largest retailer, Teledoc, contracts directly with private insurance payers as well as large employers, so it becomes a value-added service of the plan for a modest out-of-pocket expense to the patient.

In highly integrated health care systems in which fee for service medicine does not apply, telemedicine is provided to save money and/or increase efficiency and access. This logic and incentive applies to the incorporation of telemedicine into integrated models such the VA, the Department of Defense, prisons, and other commercial-capitated patient populations. Hospitals themselves will provide reimbursement for telemedicine coverage in instances where a specialty is not otherwise available but is necessary for the hospital’s overall provision of services. All states but Rhode Island provide Medicaid reimbursement for some level of telemedicine services, but the degree of coverage varies greatly. Requirements vary for qualifying distances to providers, eligible providers, and
technologies. In some states the patient must be in a physician’s office or a federally qualified health center. In half of the states there is no qualification regarding location of the patient.\textsuperscript{38} Store and forward is covered in nine states (seven more than Medicare), including Alaska, Arizona, California, Illinois, Minnesota, Mississippi, New Mexico, Oklahoma, and Virginia. Medicare is the most restrictive regarding telemedicine services. Fee-for-service Medicare reimbursement is typically available only for patients in remote locations that lack providers or in certain restrictive long-term care scenarios.\textsuperscript{38} The total spent by Medicare on telemedicine in 2012 was $5 million,\textsuperscript{38} compared to $1.05 billion by the VA in 2015. The VA has set its budget at $1.2 billion in 2017 and hopes to serve more than 760,000 veterans telemedicine. Political and economic pressures are moving CMS towards more liberal coverage of telemedicine, but concerns about potential overutilization continue to push back. Medicare alternative payment models will provide the earliest opportunities for more widespread access to telemedicine for Medicare patients, as CMS has recently announced liberal coverage of telemedicine services for patients in ACOs. Coverage for Medicare Advantage patients varies.

**DISCUSSION**

Telemedicine promises greater access to care for patients at the same or reduced costs with similar quality and similar patient and provider satisfaction scores. Several studies across specialties, including urology, have demonstrated that telemedicine indeed can fulfill some or even all of this promise, but the overall body of research is limited. The plethora of published studies in urology have clearly stemmed from local unmet needs that needed to be addressed. The potential benefits of telemedicine to the practice of urology include expanded access for patients, efficiency of time and expense, improved patient satisfaction, improved physician satisfaction, and even improved
quality of care. These benefits are what drive clinical innovators to recognize the technologic revolution in front of them and ask the fundamental question: “What if?”

Patient access to urologic consultation could be improved with technology in remote urban locations or blighted urban areas with little medical infrastructure. With well-trained advanced practice providers on location, many urologic conditions can be triaged or managed. In cases where hands-on care by a urologist is required, patients can be transported, but with a more clear plan of action than would otherwise be available. Alternatively, telesurgical strategies may allow a less experienced urologist or general surgeon to manage a urological intervention on site. Even if infrastructure is not available to individual patients in their homes, satellite locations still greatly alleviate the travel and time burden of access to the urologist. Although telemedicine can reduce the time requirement and expand reach, ultimately the urologist must evaluate each patient individually, so there are limits to the multiplier effect of telemedicine.

According to survey results, two thirds of urology patients are already willing to engage in telemedicine. Patient satisfaction surveys indicate a high satisfaction rate for patients in remote locations whose travel time is prohibitive, but they also indicate a high satisfaction rate in the post-operative setting in patients located near their urologist’s practice. The patients reported that the urologist appeared to be less rushed and the impression was that the urologist spent more time with the patient, even though the actual time spent was slightly less.¹⁶ Telemedicine allows the physician to go from patient to patient without having to travel in between or disrupt office hours in progress, and so the urologist is more “available” and less rushed, and according to survey results also more satisfied. This improved physician-patient dynamic may translate to improved quality of care since more attention can be placed on the encounter. Outcomes so far have been equivalent or trending better than in-person encounters in the urology studies that have tracked them. In some specialties,
particularly in mental health and intensive care settings, telemedicine delivers a superior product, with greater outcomes and better patient satisfaction compared to traditional consultations.2

Several limitations and challenges affect telemedicine, some that are inherent in the modalities of telemedicine and others that are procedural, cultural, or political and can be overcome. The most obvious technical limitation is the physical examination.

With only two senses—vision and hearing—incompletely available, the provider lacks the complete physical information otherwise available to a keen observer in an in-person exam. This deficit can be improved with the use of a medical assistant on the patient side, providing a physical exam under observation or reporting feedback. An important caveat to telemedicine is the selection of encounters in which the physical exam is not critical to evaluation and treatment, such as a review of test results, or where the limited information available is sufficient, such as a high-definition image of a skin lesion. Carefully selected follow-up visits can be easily managed by providers new to telemedicine. Increased experience allows the urologist to piece together information in ways that compensate for the incomplete physical examination but still lead to a proper evaluation, as has been the case at the Los Angeles VA where almost any new patient can be evaluated remotely.

The incorporation of telemedicine into graduate medical education will push this envelope further and more robustly. Technology advances rapidly and one can imagine a scenario in which increasingly available diagnostic imaging coupled with audio-visual streaming that employs three-dimensional virtual and haptic feedback could augment the incomplete physical exam.

Other technical challenges include the availability and reliability of high-speed internet connectivity as well as the availability of mobile platforms to the patients. Insufficient technical resources disproportionately affect the lower income rural and inner city population, which is the very population that may benefit the most from telemedicine. HIPPA compliance limits the options for connectivity as well. Another limitation is the technical literacy of the patients. Senior patients are in-
creasingly online, but at least 42% of patients over 65 years are not, and this age group represents a large proportion of most urology practices. Many patients in this age group may find the nature of the telemedicine encounter less satisfactory than younger patients who are accustomed to electronic communication with colleagues, customers, friends, and family.

Reimbursement and regulatory hurdles are perhaps the greatest challenge to telemedicine. This disincentive is magnified in states with less regulatory support of parity reimbursement or more cumbersome requirements to practice. Until reimbursement is obvious, fee-for-service urologists are less likely to focus the energy required to change their traditional practice patterns. In the era of health care reform and cost containment, the cost of starting telemedicine programs will also represent a potential barrier. At both the primary and remote sites, an investment in hardware and software will be required to carry out telemedicine consultation as well as the recurring costs associated with data transmission. While it is anticipated that the efficiency of telemedicine will offset the cost of getting started, the value of implementing telemedicine will need to be decided in the context of a specific health care delivery system’s needs and priorities.

Ultimately, physician acceptance is key. While physician satisfaction in surveys in urology has been high, telemedicine can be logistically disruptive to a traditional schedule and can be technically frustrating and therefore a disincentive to the mainstream urologist who is not necessarily an “early adopter” in practice. The incorporation of telemedicine is organic and should be based on the obvious merits it brings, which are still being determined and refined by many pioneer urologists.

The AUA has recognized telemedicine in urology as one of the highest priorities and has formulated the AUA Telemedicine Workgroup with its dedicated volunteer urologists to oversee telemedicine initiatives that touch all AUA committees. Ultimately, a “one size fits all” approach to telemedicine would not be appropriate and could doom telemedicine to suffer the same pushback that EHRs faced as a result of their premature mandate. Ultimately telemedicine is medicine, just
with a different set of tools. The fulfillment of its promise starts with coordinated efforts from organized urology.

**CONCLUSIONS**

Urology telemedicine has developed in many different formats and serves as real illustrative examples of how an electronic revolution like Gutenberg’s printing press has the potential to transform health care. Telemedicine may help address the anticipated shortage of urologists in the near future. Urologists have been pioneers in the use of telemedicine, particularly in the areas of telerobotic surgery, teleproctoring, telementoring, and telerounding. Urologists should continue to embrace new ideas in telemedicine. Many barriers to telemedicine currently exist in urology, but urologists should continue to be collaborative partners to overcome these limitations. As limitations dissipate, and as new technological solutions are developed, it is possible that telemedicine will become completely integrated into urologic training and health care delivery to fulfill the proposition of access and quality urologic care.

**REFERENCES**


36. American Urological Association Staff. Letter to the Senate and House Committees on Armed Services from the American Medical Association, the American Osteopathic Association, and the Federation of State Medical Boards.
