Review Article

Telemedicine in Urology: State of the Art

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Whereas telemedicine is recognized as one of the fastest-growing components of the healthcare system, the status of telemedicine use in urology is largely unknown. In this narrative review, we detail studies that investigate the use of televisits and teleconsultations for urologic conditions. Moreover, we discuss current regulatory and reimbursement policies. Finally, we discuss the significant barriers to widespread dissemination and implementation of telemedicine and reasons why the field of urology may be positioned to become a leader in the provision of telemedicine services. UROLOGY 94: 10–16, 2016. Published by Elsevier Inc.

Telehealth, defined as the use of technology to enhance communication among healthcare providers, patients, educators, and administrators, was once viewed as a futuristic concept without obvious implications for the practicing urologist. This notion is unquestionably evolving as the telehealth industry is rapidly growing and telehealth tools have increasingly gained acceptance by physicians and patients. The telehealth market is expected to grow by 20%-50% each year and reach approximately $30 billion dollars by 2019.[1] Telehealth services are now used by hospitals, physician offices, home health agencies, skilled nursing facilities, and many other providers along the healthcare continuum. Millions of Americans and approximately 50% of acute care hospitals are currently using telehealth in some capacity.[2] Federal hospitals are no exception. In fact, the U.S. Department of Veterans Affairs (VA) has been a pioneer in the use of telehealth for over 20 years. In 2014, there were 1.2 million telehealth visits conducted for 690,000 Veterans across 44 specialties. Moreover, the 2016 VA budget includes $1.2 billion earmarked for telehealth.[3]

Although the words "telehealth" and "telemedicine" are often used interchangeably, the former has come to be used to refer to communication technologies applied to improving overall health status, whereas the latter refers more specifically to applications used in the diagnosis and treatment of diseases.[4] This review will focus on telemedicine. Telemedicine can be implemented through a multitude of modalities including videoconferencing software, mobile applications, and wearable devices and monitors. It can be used to provide direct patient care with an established provider or it can be used as a means to facilitate provider-to-provider interaction. For example, one physician may consult another physician electronically (and remotely) to discuss a difficult case (ie, teleconsultation or e-consult). Radiology images can be available for remote diagnosis and review. Some rural hospitals leverage the expertise of nearby academic medical centers by using telemedicine services in the intensive care unit (eg, eICU), and some physician groups use telemedicine services to reduce the costs associated with chronic care management. Moreover, there has also been an enthusiastic growth in "mHealth," which refers to the transmission of medical information specifically through the use of mobile phones or other mobile communication devices.[5] Over 150,000 health-related applications for smartphones are available.

Whereas telemedicine is recognized as one of the fastest-growing components of the healthcare system, its use in urology has garnered relatively little attention. In this narrative review, we examine the current literature on the utilization of telemedicine in urology and its associated outcomes to better understand how it has been deployed to date, as well as the barriers to further adoption. We focus on 2 important uses of telemedicine: (1) to transmit information between healthcare providers and patients during a clinical encounter (ie, televisit); and (2) to transmit questions between healthcare providers (ie, teleconsultation or electronic consultation). Moreover, we discuss key legal and reimbursement issues to help provide broader context around the implementation of telemedicine in clinical practice.

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METHODS

We performed a literature review using PubMed and Google Scholar to identify all recently published studies related to urological telemedicine. Our search strategy combined the only 2 Medical Subject Heading (MeSH) terms directly related to our topic "Telemedicine" and "Remote consultation" with the MeSH term "Urologic Diseases/therapy" and the keyword "urology." We limited our search to articles published in the last 10 years and those that were written in English. We then augmented the formal literature search by performing manual search engine queries to find articles in the press, presentations and unpublished abstracts related to urological telemedicine, and general regulatory and reimbursement issues.

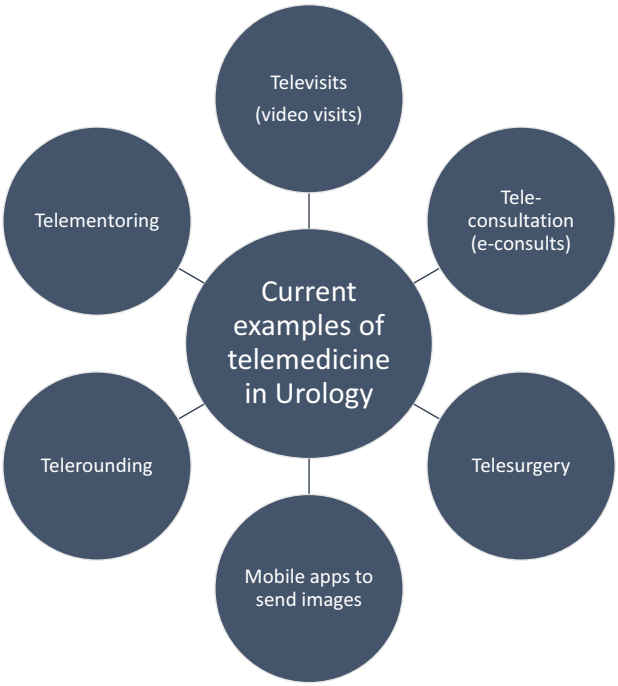

Figure 1. Telemedicine in urology. The figure illustrates the many ways that telemedicine is currently implemented in urology.

RESULTS

Our search strategy yielded 27 peer-reviewed articles related to telemedicine in urology; the review of this literature indicated that telemedicine is delivered in a variety of settings in the urological community (Fig. 1). In addition, we found information on regulatory and reimbursement policies for all states on the American Telemedicine Association (ATA) website.[4] Urologists are currently using and/or testing telemedicine for purposes of monitoring patients,[5,6] performing surgery,[7-14] rounding,[15-17] performing video visits and provider consultations. For the scope of this review, we will focus on televisits and teleconsultations. A selection of the remaining studies are summarized in Table 1.

Televisit

A televisit is defined as a digital office visit that occurs between a physician and patient, and over 1 million medical televisits took place in 2015 through institutions like the Veterans Administration and venders like American Well and Teladoc.[3,4] Whereas televisits are currently more common in other specialties, such as dermatology, there is a great deal of interest in televisits among both urology patients and providers. For example, a recent survey of 1378 urology patients found that nearly two thirds were willing to participate in urological televisits.[21] As expected, willing patients were typically younger, more likely to be college educated, and had to travel longer distances for urological care.

Although urological televisits are not necessarily mainstream at the present time, there are a number of published examples reporting on its early use. At the Mayo Clinic, for example, televisits were offered to patients after prostatectomy.[22] After randomly assigning patients to video visits or traditional office visits, investigators at this institution found that video visits resulted in a similar patient-

Table 1. Summary of select telemedicine studies in urology (excluding televisit and teleconsultation studies)

Category	Reference	Description of Telemedicine Use
Telementoring	Agarwal et al[8]	A robot with digital camera controlled by a senior surgeon was used to provide remote mentoring during an operation.
	Rodrigues Netto et al[10]	Mentored surgery was performed between surgeons in the United States and Brazil.
Telesurgery	Sterbis et al[18]	Resident surgeons performed robotic surgery on a porcine model using a console adjacent to the animal. Attending surgeons simultaneously operated a second console at distances of up to 2400 miles away.
	Challacombe et al[12]	Telerobot was used to perform access for percutaneous nephrolithotomy.
Telerounding	Kaczmarek et al[15]	Rounding on postoperative patients was performed using an iPad.
	Kau et al[19]	Laptop computers with webcams are used to remotely connect urologists with patients.
	Ellison et al[16]	Patients were randomized to bedside rounds vs robotic telerounds.
Teleimaging	Sidana et al[5]	Smartphone photos are transmitted to diagnosis patients in the emergency room or monitor patients at home.
	Johnston et al[20]	Computed tomography images of patients with renal colic were transmitted to mobile devices