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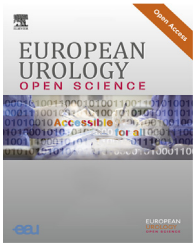

European Association of Urology

Review – Education

Telemedicine in Urology: Where Have We Been and Where Are We Heading?

Evangelos N. Symeonidis [a,†], *Domenico Veneziano* [b,†], *Hendrik Borgmann* [c], *Łukasz Zapała* [d], *Athanasios Zachariou* [e], *Horst Brenneis* [f], *Stefan M. Haensel* [g], *Helmut Haas* [h], *Fotios Dimitriadis* [a,*]

[a] *Department of Urology I, Aristotle University of Thessaloniki, School of Medicine, Thessaloniki, Greece;* [b] *Smith Institute of Urology, Northwell Health, New York, NY, USA;* [c] *Department of Urology, University Hospital Medical School Brandenburg, Brandenburg an der Havel, Germany;* [d] *Department of General, Oncological and Functional Urology, Medical University of Warsaw, Warsaw, Poland;* [e] *Department of Urology, University of Ioannina, Ioannina, Greece;* [f] *Department of Urology, Saarland University Medical Center, Homburg/Saar, Germany;* [g] *Department of Urology, Franciscus Hospital, Rotterdam, The Netherlands;* [h] *ESUO, Heppenheim, Germany*

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Abstract

Context: Humanity is facing significant challenges, and in 2019, a new coronavirus caused an unprecedented global disease outbreak. The coronavirus disease 2019 (COVID-19) pandemic vastly impacted health care delivery, generating devastating economic, social, and public health disruption. Although previously underutilized, it was not until recently that telemedicine emerged and amassed tremendous popularity.
Objective: To examine and assess telemedicine's past, present, and future roles in urology.
Evidence acquisition: We queried relevant literature investigating the role of telemedicine in urology using the electronic PubMed database and mainly focused on English-language studies of any design.
Evidence synthesis: Growing attention has been paid to the widespread adoption of novel telehealth technologies for managing various diseases. Meanwhile, solid evidence supports the meaningful use of telemedicine for most urological diagnoses. Existing literature delineates telemedicine as a viable, safe, and convenient alternative to in-person clinical visits.
Conclusions: The present article overviews the evolution of telemedicine in urology, and discusses its application in outpatient and physician's office settings. In addition, it highlights the technical, legal, ethical, and financial aspects of telemedicine while providing valuable insights and practical considerations for the future of telehealth in urology.

† These authors contributed equally and are joint first authors.
* Corresponding author. Department of Urology, "G. Gennimatas" General Hospital, Aristotle University of Thessaloniki, 546 35 Thessaloniki, Greece. Tel. +30 231 099 2525; Fax: +30 231 099 2525.
E-mail address: helabio@yahoo.gr (F. Dimitriadis).

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Patient summary: Urologists must adopt telemedicine carefully in daily practice, always adhering to predefined regulatory frameworks.

1. Introduction

The current coronavirus disease 2019 (COVID-19) pandemic caused a rapid and grievous global health emergency. That led to enormous pressure on our health care systems, disturbing our professional activities with severe economic consequences and dramatic changes in our daily lives [1,2]. Many countries have strictly controlled movement and socialization to tackle virus dissemination. These measures had an inevitable impact on how we practice clinical medicine and the expectations of our patients. The vaccination program and medical treatment against COVID-19 throughout Europe are expected to significantly relieve this unparalleled public health, social, and economic condition.

Still, our priorities as urologists, even under this unprecedented situation, are to prevent our patients from COVID-19 contamination, protect ourselves as health care professionals, and deliver optimal urology care [3]. A significant part of urological diseases concerns patients at the highest risk of adverse outcomes from COVID-19 due to advanced age and male gender [2,3]. Avoiding unnecessary medical visits in the office and outpatient clinics, and home emergency calls is a reasonable alternative. This would reduce unneeded contacts, protect patients, and decrease the burden of care and consumption of resources [3,4].

In this regard, one of the more appealing solutions has been the constantly increasing interest in telemedicine. According to the World Health Organization (WHO), telemedicine focuses on distance as a critical factor for delivering individual health care services using technologies [5]. It offers a broad range of applications and possibilities, including live videoconferencing, transmission of recorded data, and remote patient monitoring supported by mobile devices such as cell phones, tablet computers, or wearable devices (Fig. 1). Accordingly, telemedicine may transform a part of the standard in-person healthcare to a distance delivery of healthcare services with the same efficiency and, hopefully, with reduced healthcare costs [6]. However, some technical issues of telemedicine continue to demand answers, and at the same time, many ethical, legal, privacy, and financial issues need to be resolved. In the future, the "virtual urologist" needs to claim the trust and acceptance of urological patients, especially the elderly who face adaptation issues with the new technologies.

2. Evidence acquisition

We conducted a relevant literature search of the electronic PubMed database investigating the role of telemedicine in urology, mainly focusing on English-language studies of any design.

3. Evidence synthesis

3.1. *Technical aspects of telemedicine: making the pieces work together*

In the early 1990s, Internet access opened doors to globalization. Connectivity from one side of the world to the other changed our lives unprecedentedly. Health care is being

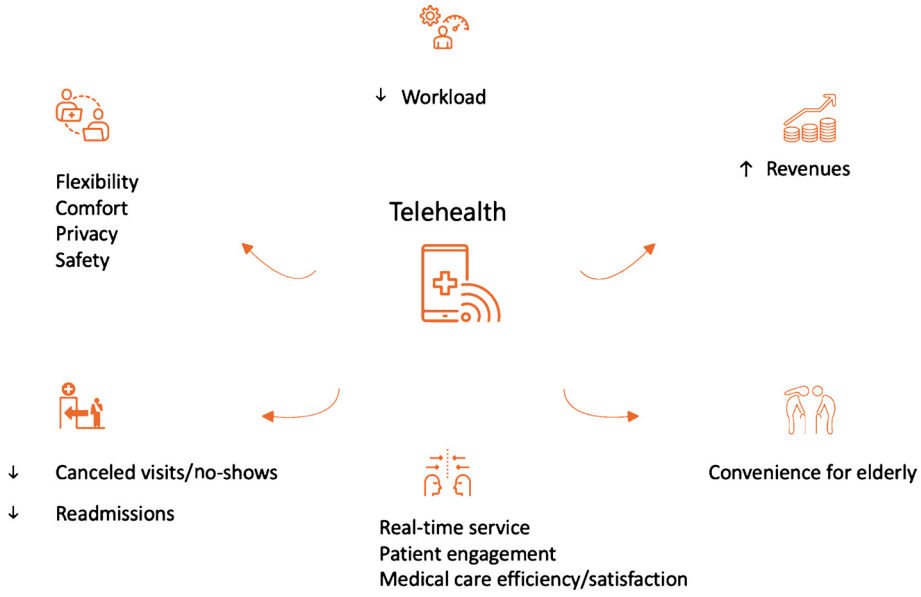

Fig. 1 – Schematic presentation of telemedicine benefits in health care.

slowly affected by this tremendous change, with consequences that we are starting to understand today thanks to the advent of ultrabroadband Internet, also named 5G [7,8]. The speed and data-transfer volume guaranteed by this technology further expand the concept of telemedicine, allowing several levels of interaction between the physician/surgeon and the patient, ranging from simple remote consultancy to telesurgery [9].

Increasing Internet speed has become more crucial than ever due to the need for more interaction [8]. Nowadays, the old phone call is replaced by web conferencing, even more under the push of social distancing forced by COVID-19. If we consider the ideal system, the surgeon should have tactile feedback and a full understanding of the remote area while being visible on the other side, at least with the implementation of an avatar [7,9]. In any case, remote communication requires two systems to be connected and data transferred between them.

The UK National Health System relies on artificial intelligence, thanks to its telemedicine software Babylon Health, to provide early diagnostics and optimize the workflow, even before being connected to an actual physician [10]. A delay between the patient and the doctor in a diagnostic setting may not cause serious issues; nevertheless, it might become dangerous during a remotely driven surgical procedure, where having a wide band becomes critical.

As previously mentioned, the introduction of 5G is bringing fresh air today in this field, owing to its transfer capability of 10 gigabytes per second (Gbps), as opposed to the actual 1 Gbps offered by a full-band optic fiber connection [9]. High connecting speed opens the doors to remote surgery in the upcoming few years [7,8]. At the same time, this novelty might not be the revolution that many were waiting for, as one surgeon will continue to operate on one single patient at a time, just like today, even if the surgeon is on the opposite side of the globe.

In a world facing a never-before-seen shortage of doctors, teletraining is allowing the exponential growth of high-quality education, giving the option for high-risk patients to be treated remotely by an expert [9,11,12]. This "dynamic learning environment" would increase young surgeons' overall competence, further providing patients with more safety [9,13].

3.2. Utilization of telemedicine in the pre- and postoperative course for in-hospital patients

Telemedicine offers a variety of opportunities for patient-doctor interaction in the pre-, peri-, and postoperative settings for patients undergoing urological surgery (Table 1). During the COVID-19 pandemic, telemedicine aided in preoperative prioritization and triage of patients undergoing urological surgery [4,14]. Bidirectional information flow was necessary both for doctors following up on their patient's condition and for patients to understand their risk and the need for prioritized scheduling of surgeries. Before the pandemic, telemedicine was explored for preoperative patient counseling. In a series of 32 patients who had undergone emergency treatment for urolithiasis, telemedicine consultation altered the initial treatment plan in 12 patients (37.5%) [15].

Table 1 – Minimum equipment (hardware and software) and Internet specifications an office/outpatient urologist should have in his/her hands to effectively offer online urologic services

Live surgery	Remote demonstration of surgical procedure with live comments	Video: send Audio: send/receive
Teletraining	Remote hands-on demonstration, with the trainee replicating on the same devices in a different place	Video: send/receive Audio: send/receive
Telementoring	Expert watches the procedure and provides remote guidance through a telestration device	Video: send Audio: send/receive Graphics: send
Teleassistance	Expert watched the procedure, provides remote guidance, and has direct interaction with the operative field	Video: send Audio: send/receive Manipulation: send
Telesurgery	Expert interacts with the patient and remotely performs a complete procedure, thanks to a telemanipulator (master) and a robot placed at bedside (slave)	Video: send Audio: send/receive Manipulation: send Haptic feedback: receive

Table 2 – The effect of telemedicine application on the effectiveness of several urological procedures

Procedure	Effect of telemedicine
Emergency treatment for urolithiasis	Alteration of the initial treatment plan [15]
Aquablation surgery	No differences for the main outcomes of the procedure between telementor guided and onsite guided surgeries [16]
Transurethral enucleation of the prostate	High evaluation scores for safety, efficacy, learning, and connection quality of telementoring [17]
PCNL	Telerounds had high satisfaction rates for surgeons and patients [18]
Prostatectomy	Postoperative telemedicine remote visits had equivalent efficacy and lower costs [19]
Pelvic floor muscle training	Improvement of compliance; capturing patient-reported outcomes [20]
Kidney transplantation	Remote blood pressure and glucose monitoring during follow-up [21]

PCNL = percutaneous nephrolithotomy.

In the perioperative course, telemedicine has been explored for telementoring and telesurgery in minimally invasive procedures (Table 2). Most recently, a series on Aquablation surgery found no differences in the main outcomes of operative time, time to Foley catheter removal, hemoglobin drops, urinary retention, and adverse events between 21 telementor-guided and 38 onsite-guided surgeries [16]. In another recent feasibility study on telementoring for patients undergoing transurethral enucleation of the prostate, high evaluation scores were found for safety, efficacy, learning, and connection quality of telementoring by both the mentor and the trainee [17]. In the early perioperative period, surgeons used telerounds performing percutaneous nephrolithotomy. Satisfaction rates were reported as high by both surgeons (91%) and patients (73%) [18].

In the postoperative course, telemedicine remote video visits for postprostatectomy patients have been compared with traditional onsite visits for efficiency, satisfaction,

and costs. Equivalent efficacy was noted, as measured by the patient-provider face time. No significant differences were reported in patient perception of visit confidentiality, efficiency, education quality, or overall satisfaction. In addition, video visits incurred lower costs in relation to distance traveled, travel time, missed work, and money spent on travel [19].

Furthermore, telemedical health applications have been harnessed to monitor recovery and patient-reported outcomes after robot-assisted radical prostatectomy. Twenty men who underwent prostatectomy received daily push notifications to perform Kegel exercises and a weekly outcome questionnaire via a dedicated mobile health app. The authors concluded that mobile apps could improve compliance with perioperative instructions and allow more frequent capture of patient-reported outcomes with minimal resource utilization [20]. Even for the complex patient population of kidney transplant recipients, remote patient monitoring is feasible for blood pressure and blood glucose monitoring, and thus might be an adjunct in the post-transplant period that can expand care opportunities in the remote care model [21].

Overall, telemedicine has successfully been implemented in selected scenarios in in-hospital patients [8]. However, considering the latest or potential future corresponding pandemics, more robust data on telemedicine's long-term efficacy, safety, and health economics are warranted.

3.3. *Ethical and legal aspects of telemedicine*

The WHO definition of telemedicine focuses on distance as a critical factor for delivering individual health care services using technologies [5]. The advanced deployment of novel services formed ethical and legal queries related to telemedicine [14,22]. The regulations vary among European countries, and an additional challenge for health care providers is the necessity to remain compliant with existing laws and medical ethics codes [23]. While telemedicine itself is a rapidly growing health care industry sector in the era of the COVID-19 pandemic, practitioners should follow applicable practice regulations at the facility, regional, and country levels [14,24]. Yet, there is a lack of European Association of Urology (EAU) guidelines on telemedicine covering the legal aspects of the field of urology. More importantly, the EAU published practical recommendations on using technological tools to formalize the role of telemedicine in the common urological practice [14]. Along the same lines, Gómez Rivas et al [25], a few months later, took it one step further, attempting to form the Spanish adaptation of the above recommendations.

A flood of legislative activity has recently surrounded the telemedicine [12]. The same ethical and legal obligations exist for telemedicine as for in-person medicine. At the same time, any doubts arising during an e-visit should claim a traditional patient's appointment [1]. Significant legal and regulatory considerations cover the following topics: (1) obtaining informed consent in real time before any encounter (with information sharing, confidentiality, privacy and data protection, and information security management), (2) national or regional licensing (practicing across countries or districts), (3) privacy and security of transmission and software (eg, software vendors, storage providers, and adequate patient identification), (4) proper electronic medical documentation and solutions in case of technological failures, (5) conflicts of interest, (6) malpractice insurance and reimbursement, and (7) protected health information (confidentiality and other aspects of the patient-professional relationship) [1,12,24,26,27].

When using telemedicine, physicians should judge correctly and document the consultation clinical details in the same way as during stationary visits [28]. Health care providers should manage the results of the informed consent conversation with the patient in the medical record and authenticate the patient's identity. Consequently, there is a general tendency to initiate first an in-person visit with a patient to establish care (eg, physical examination and physician-patient trust relationship establishment) before a telemedicine encounter can take place. A position of a telepresenter, a health care provider (eg, registered nurse or physician) physically available at the patient's location during a nonstationary visit, was also proposed [12]. Finally, in the European Union (EU), patients' data should be stored in compliance with the General Data Protection Regulation to unify the regulation within the EU and give control to individuals over their data [29,30]. There is also a need for integrated telehealth platforms in European countries within a legal framework [14].

However, it is essential to note that some telemedicine papers have demonstrated no benefit and even harm, for example, telemedicine providers prescribed more broad-spectrum antibiotics, as reported by Uscher-Pines et al [12,31]. The use of telemedicine in predefined "uncomplicated" cases would only be a considerable simplification of the matter, though. The major ethical issue is the usage of alternatives to deliver a poor prognosis than telemedicine alone, for example, incorporating an onsite colleague who can provide emotional support [32]. On the contrary, patients suffering from a chronic disease with severe physical disabilities can benefit from telemedicine services while cared for at home, positively affecting their dignity and autonomy. Lastly, it is ethically debatable how and whether to motivate patients who refrain from telemedicine services. The rule of equal health accessibility for all may become a crucial issue in the upcoming process of digitalization of health care systems [32]. In addition, the use of telemedicine in developing countries has also been questioned ethically [33]. Using telemedicine in underserved countries to increase access to care is of much avail, but whether it is the most reliable use of scarce resources is questionable [26].

To sum up, telemedicine will be a suitable model of care only for some patients, albeit with a justifiable place in the post-COVID-19 era. Furthermore, telemedicine will not substitute face-to-face contact with health care professionals, but rather act as a supplementary tool. Thus, in the future, telemedicine progress can be better measured when legal frameworks are introduced, national regulations are developed, more practitioners are trained, regular funding is committed, and long-term plans are developed [11]. In

addition, the use of telemedicine in developing countries has also been questioned ethically [33]. Implementing telemedicine in underserved countries to increase access to care brings excellent benefits, though remaining controversial regarding whether it is the most effective use of scarce resources [26].

3.4. Financial aspects of telemedicine: practical considerations

Telemedicine encompasses the full spectrum of diagnostic and therapeutic urological care remotely [11,12]. With the emergence of COVID-19 in early 2020, the implementation of telemedicine in urology leaped several years forward [7]. Ongoing health care reforms consider the prospect of telemedicine vital. Application barriers are reimbursement features, technological literacies, and modifications in the workflow [11,12].

The aspects of billing and coding are directly related to the legislative issues of telemedicine. Before the COVID-19 pandemic, urologists' reimbursement was the most significant obstacle to the widespread adoption of telemedicine [34]. During the past year, patients or insurance companies, almost universally, have provided payment for telemedicine services, usually comparable with an office consultation. However, the extent to which this practice will be continued after pandemic is uncertain. A telemedicine-care-first model can make urological care more patient centered and efficient. On the contrary, an acceptable reimbursement is critical for accounting revenue losses that could arise. Urologists usually charge patients directly or have special contracts with insurance companies on a fee-for-service basis. The physician must know that private insurance companies have individual coverage policies, and a limited number of patients can enjoy all telehealth benefits. Telemedicine billing regulations differ between countries, which has been complicated further by the rapidly changing COVID-19 situation. Urologists, based on no or fewer reimbursements, may be unwilling to apply telemedicine to their practice given the expense and time associated with obtaining the hardware and software required for connectivity [11,12].

The existing standard of care in urological surgical practice includes a regular preoperative consultation, a postoperative evaluation, and scheduled assessments for possible recurrences. Telemedicine eliminates financial costs placed on both the patient and the office urologist. The patients' profits derive from travel time, lost work hours, subsequently missing wages, and transportation costs. The office urologist benefits from staffing costs and the occasional cost of theoretically new patients' consultation [35]. To avoid time-consuming issues that increase financial costs, office staff should contact the patient at the scheduled appointment to deliver instructions for downloading any needed software.

Most outpatient and office urologists routinely perform an in-office ultrasound for urinary system surveillance as part of conventional patient care. However, patients undergoing telemedicine visits have their surveillance studies done outside of the urologist's office, leading to a loss of revenue from ancillary services, such as laboratory and radiology.

During the COVID-19 pandemic, telemedicine reduced the direct contact between patients and urologists. However, office urologists had already included telemedical approaches in their daily routine and used them more frequently than urologists from the hospital sector [4]. Outpatient urologists may consider expanding their services to urological patients treated in the hospital under normal conditions [3]. In addition, urologists can reduce the financial strain on office practices during the pandemic by performing video visits. Furthermore, telemedicine permits increasing market share and accumulating patients who may have preferred to undergo urological surgical services closer to their homes. In highly integrated health care systems where fee-for-service medicine does not apply, telemedicine is provided to save money and increase efficiency or access. Most reports estimating expenses demonstrated advantages for telehealth, whereas a single trial reported a minimal difference favoring standard care [19,36–38].

Future research will assess the financial telehealth potentials of remote patient monitoring through wearable devices that transmit patient data or detect early surgical complications. Telemedicine is also a practical way to engage medical students in patient care and address the gaps in learning caused by the pandemic [13,15]. However, financial topics such as the cost of telemedicine platforms and the students' availability of digital devices or required infrastructure exist. Elaborate research will focus on validating the financial impact on the medical education system and standardizing the methods used to assess cost effectiveness.

3.5. The "virtual urologist": applications and acceptance of telemedicine in the outpatient and office urology settings as an example in a single institution

While a telephone consultation was the ne plus ultra of many office urologists until the COVID-19 pandemic, the pandemic has altered many things. It has significantly increased patients' need for noncontact, virtual, and Internet-based communication [3,39]. Additionally, the overload of telephones in many offices requires an Internet-based relief. The prerequisite is not only ease of use, but also compliance with national and European data protection regulations. The primary purpose of the example described below is to report on practical experiences in a German urological office.

After several frustrating attempts with Net-based appointment scheduling (too expensive and too complicated), we introduced a system for video consultation and data-protected chat in the wake of the pandemic. The access is granted by the urologist's invitation, which allows the patient to create a password-protected account, or by a widget on the office home page. The urologist must confirm this request. Then, within the framework of a chat function, for example, findings and laboratory value transmissions are possible in a data-protected manner. The patient can also request a video appointment, which the office assigns. Doctors and office staff can use the system via separate

accesses with different authorizations so that the office staff can process that appointment requests. This also leads to a relief of the eternally busy telephone. Patients' acceptance of this system, not only the younger ones, is high. Above all, the independence from office hours and the phone is greatly appreciated. Up to now, over 600 patients have been enrolled in the system. For documentation purposes, the chat history can be transferred to a document file (eg, .doc or .pdf) with just a few clicks, which is then saved in the electronic patient file or printed.

The system can also communicate with other offices: sending patient reports, laboratory results, or ultrasound and x-ray images. Here, too, the system has been proved to be fast and unproblematic. However, networking with hospitals is much more difficult because the firewalls often need to allow communication, and the electronic data processing department is skeptical about such systems. Unfortunately, clinics in Germany prefer to use fax and phone. Another possible application has been found in communication with pharmaceutical industry representatives. Such systems are also conceivable for conducting online conferences or a virtual tumor board.

Other options would be the electronic prescriptions and certificates indicating electronic incapacity to work scheduled for introduction this year. For instance, sending the patient an electronic prescription with a QR code on request is possible. The patient can then use this code at the pharmacy to obtain medication. So far, the introduction of Internet-based and virtual communication in urological practice has proved its worth, demonstrating high acceptance among patients, all the while providing relief for physicians and staff. Rather interestingly, this was confirmed in a recent German series conducted in a tertiary academic unit amid the pandemic; a staggering percentage of patients (85%) were in favor of telemedical consultation either for benign or for oncological diagnoses [39].

3.6. *A technology not devoid of limitations*

Despite the incredible appeal related to the novelty of this technology, telehealth has its limits and dark spots [9]. The first concern is the need for more contact between the physician and the patient, possibly impacting the quality of the cure. Indeed, during a visit, the possibility of touching the patient's body to collect clinical information about the disease is crucial. Moreover, this may lead to a decline in human empathy, with a big loss in the relationship between a doctor and a patient.

Another aspect to consider is telesurgery, advertised as one of the main goals to be achieved since the advent of the ultra-high-speed Internet [40]. While the possibility of operating remotely from one side of the world seems fascinating, it is not clear why a surgeon should do it, as the patient-to-surgeon ratio would still be 1:1. The surgeon, to operate a patient in a different location, should anyway subtract time from his/her local patients, which would not solve any demand issue. At the same time, the distance of the main surgeon would put the life of the patient at a high risk in case of complications requiring immediate and in-presence countermeasures. Despite the availability of sensors to collect biometric data growing at an exponential scale, these still need to be able to provide the same volume of information to the health care professional, simply from home [40]. Other issues to be addressed are the reluctance to accept new technology by the elderly, disproportionate access to technology for the households of lower socioeconomic status, lack of economic incentives, standardization of reimbursement issues, compatibility problems, and lack of specific up-to-date infrastructure [8,11,12]. Eventually, we should always contemplate that telemedicine should follow doctors' needs without forcing an opposite trend to satisfy a growing new market.

4. Conclusions

Undoubtedly, it is difficult to forecast the long-term consequences of the pandemic on our social and occupational life. Social distancing may become a general rule for a long time, and this situation, hopefully with a lower level of emergency, will likely affect and modify health care organizations. In this context, telemedicine constitutes a quite appealing alternative for the foreseeable future. In urology, telemedicine confers many potential advantages, such as fewer patient contacts, lower infection rates among the health care staff, patient convenience, and a reduction in transportation-related emissions. The acceptance by the patients and the potential relief for physicians and staff are high. Accordingly, the economic benefits are successfully reflected in the health care system. Telemedicine, in the end, has its own limitations, requiring prudent implementation through the protection of personal health records and guarantee of professional guidelines. Therefore, our role as urologists is to carefully define its position in everyday urological practice, familiarize it with all the emerging technologies, and provide tools for its optimal effectuation.

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Study concept and design: Zachariou, Haensel, Haas, Dimitriadis.
Acquisition of data: Symeonidis, Borgmann, Brenneis, Zapała.
Analysis and interpretation of data: Veneziano, Borgmann, Zachariou, Dimitriadis.
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