available at www.sciencedirect.com
journal homepage: www.europeanurology.com

European Association of Urology

Platinum Priority – Review

Editorial by Roman Sosnowski, Hubert Kamecki, Steven Joniau, Jochen Walz, Zachary Klaassen, and Joan Palou on pp. 820–821 of this issue

Telehealth in Urology: A Systematic Review of the Literature. How Much Can Telemedicine Be Useful During and After the COVID-19 Pandemic?

Giacomo Novara [a,], Enrico Checcucci [b], Alessandro Crestani [c], Alberto Abrate [d], Francesco Esperto [e], Nicola Pavan [f], Cosimo De Nunzio [g], Antonio Galfano [h], Gianluca Giannarini [i], Andrea Gregori [j], Giovanni Liguori [f], Riccardo Bartoletti [k], Francesco Porpiglia [b], Roberto Mario Scarpa [e], Alchiede Simonato [d,l], Carlo Trombetta [f], Andrea Tubaro [g], Vincenzo Ficarra [m], on behalf of the Research Urology Network (RUN)*

[a] *Department Surgery, Oncology and Gastroenterology, Urologic Unit, University of Padova, Italy;* [b] *Division of Urology, Department of Oncology, School of Medicine, San Luigi Hospital, University of Turin, Orbassano, Italy;* [c] *Urology Unit, Veneto Institute of Oncology IOV—IRCCS, Padua, Italy;* [d] *Urology Section, Department of Surgical, Oncological and Oral Sciences, University of Palermo, Palermo, Italy;* [e] *Department of Urology, Campus Biomedico University of Rome, Rome, Italy;* [f] *Department of Urology, University of Trieste, Cattinara Hospital, Trieste, Italy;* [g] *Department of Urology, Sant'Andrea Hospital, University La Sapienza, Rome, Italy;* [h] *Urology Unit, Niguarda Hospital, Milan, Italy;* [i] *Urology Unit, Academic Medical Centre, "Santa Maria della Misericordia" Hospital, Udine, Italy;* [j] *Urology Unit, Ospedale Sacco, Milan, Italy;* [k] *Department of Translational Research and New Technologies, Urologic Unit, University of Pisa, Italy;* [l] *Urology Unit, Department of Surgery, S. Croce e Carle Hospital, Cuneo, Italy;* [m] *Department of Human and Pediatric Pathology "Gaetano Barresi", Urologic Section, University of Messina, Italy*

Article info

Article history:
Accepted June 10, 2020

Associate Editor:
James Catto

Keywords:
Telehealth
Telemedicine
E-health
Coronavirus
Severe acute respiratory syndrome coronavirus 2
COVID-19

Abstract

Context: Coronavirus disease 2019 (COVID-19) pandemic has caused increased interest in the application of telehealth to provide care without exposing patients and physicians to the risk of contagion. The urological literature on the topic is sparse.
Objective: To perform a systematic review of the literature and evaluate all the available studies on urological applications of telehealth.
Evidence acquisition: After registration on PROSPERO, we searched PubMed and Scopus databases to collect any kind of studies evaluating any telehealth interventions in any urological conditions. The National Toxicology Program/Office of Health Assessment and Translation Risk of Bias Rating Tool for Human and Animal Studies was used to estimate the risk of bias. A narrative synthesis was performed.
Evidence synthesis: We identified 45 studies (11 concerning prostate cancer [PCa], three hematuria management, six urinary stones, 14 urinary incontinence [UI], five urinary tract infections [UTIs], and six other conditions), including 12 randomized controlled trials. The available literature indicates that telemedicine has been implemented successfully in several common clinical scenarios, including the decision-making process following a diagnosis of nonmetastatic PCa, follow-up care of patients with localized PCa after curative treatments, initial diagnosis of hematuria, management diagnosis and follow-up care of uncomplicated urinary stones and uncomplicated UTIs, and initial evaluation, behavioral therapies, and pelvic floor muscle training in UI patients, as well

DOI of original article: https://doi.org/10.1016/j.eururo.2020.06.031.
* Corresponding author. Department of Surgery, Oncology, and Gastroenterology, Urology Clinic, University of Padua, Via Giustiniani 2, 35100 Padua, Italy. Tel.: 0039 049 8211250; Fax: 0039 049 8218757.
E-mail addresses: giacomonovara@gmail.com, giacomo.novara@unipd.it (G. Novara).

https://doi.org/10.1016/j.eururo.2020.06.025

as follow-up care after surgical treatments of stress urinary incontinence or pelvic organ prolapse. The methodological quality of most of the reports was good.
Conclusions: Telehealth has been implemented successfully in selected patients with PCa, UI, pelvic organ prolapse, uncomplicated urinary stones, and UTIs. Many urological conditions are suitable for telehealth, but more studies are needed on other highly prevalent urological malignant and benign conditions. Likely, the COVID-19 pandemic will give a significant boost to the use of telemedicine. More robust data on long-term efficacy, safety, and health economics are necessary.
Patient summary: The diffusion of coronavirus disease 2019 (COVID-19) infections has recently increased the interest in telehealth, which is the adoption of telecommunication to deliver any health care activity. The available literature indicates that telemedicine has been adopted successfully in selected patients with several common clinical urological conditions, including prostate cancer, uncomplicated urinary stones, uncomplicated urinary infections, urinary incontinence, or pelvic organ prolapse. Likely, the COVID-19 pandemic will give a significant boost to the use of telemedicine, but more robust data on long-term efficacy, safety, and costs are necessary.

1. Introduction

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the disease it causes, coronavirus disease 2019 (COVID-19), are causing a rapid and tragic health emergency worldwide. This is reshaping the health systems in several countries worldwide, due to the need to dedicate significant medical resources to the assistance of critically ill COVID-19 patients, with substantial implications also on the medical disciplines not primarily involved in the management of COVID-19 patients [1–3]. In this regard, one of the more appealing issues has been the increasing interest in telehealth. Telehealth refers to any health care activity performed by telecommunication. According to the Telehealth Resource Center, a leading consortium of telehealth networks, telehealth includes "a collection of means or methods for enhancing the health care, public health, and health education delivery and support using telecommunications technologies" [4]. Telehealth practice has currently expanded beyond traditional diagnostic and monitoring activities to include consumer and professional education. It encompasses distinct domains of application, including live videoconferencing, asynchronous transmission of recorded data, remote patient monitoring, and mobile health (ie, any activity supported by mobile devices such as cell phones, tablet computers, or wearable devices) [4]. Before the present pandemic, the primary motivation to enhance telehealth was initially represented by the possibility to increase the access to health care for conditions and populations for which care was otherwise not available (eg, military, prisons, and rural locations). However, the available Internet-based platforms and the enormous diffusion of home and mobile devices also made it clear that more ambitious opportunities were present. Consequently, telehealth may enable more convenient delivery of health care even for those patients who could have regular access to the standard health system and, hopefully, reduction of health care costs [5]. These concepts are even more relevant in the present pandemic due to the need to comply with quarantine strategies to reduce virus diffusion as well as to protect both patients and physicians. Specifically, a recent report, evaluating 400 patients scheduled for office consultation for a large variety of urological diseases in a German referral center, showed that about 95% of the patients were at increased risk for a severe outcome of COVID-19 and that 85% of them would have favored telemedical consultation during the pandemic [6]. That is even more relevant considering that the present situation, hopefully with a lower level of emergency, will likely affect our activities for several months and will modify the organization of our hospitals, making telehealth more appealing for the foreseeable future.

The urological literature on telehealth is sparse. Owing to the potential utility to adopt such telehealth interventions during the present COVID-19 pandemic and the near future, we elected to perform a systematic review of the literature to collect all the available pieces of evidence concerning the urological applications of telehealth.

2. Evidence acquisition

The request for registration of the present systematic review was submitted on April 8, 2020 to PROSPERO (CRD42020178933). The systematic review of the literature was performed on April 8, 2020, on PubMed and Scopus databases. The PubMed search used a complex search strategy, including both medical subject heading (MeSH) and free text protocols. Specifically, the MeSH search was conducted by combining the following terms retrieved from the MeSH browser provided by PubMed: "Telemedicine," "Urology," "Prostatic Neoplasms," "Urinary Bladder Neoplasms," "Kidney Neoplasms," "Testicular Neoplasms," "Prostatic Hyperplasia," "Urinary Calculi," "Sexual Dysfunction, Physiological," "Erectile Dysfunction," "Infertility, Male," "Urinary Tract Infections," "Urinary Incontinence," "Urinary Incontinence, Urge," and "Urinary Incontinence, Stress." Multiple "free text" searches were also performed, searching for the following terms individually in all fields of the records: "telehealth," "telemedicine," "prostate cancer," "bladder cancer," "kidney cancer," "testis cancer," "benign prostatic hyperplasia," "urinary tract infections," "urinary

incontinence," "urinary stone," "sexual dysfunction," "erectile dysfunction," "infertility," and "genitourinary trauma." Subsequently, the search results were pooled, applying no limitations. The search on Scopus used the same free text protocol, with the same keywords. Subsequently, the query results were pooled without applying any limit.

Two of the authors reviewed the title and abstract of all the records to select the papers relevant to the review topic. Subsequently, the selected papers were assessed in full-text format by two other authors to collect all the relevant data. Specifically, we elected to collect all the clinical studies evaluating any telehealth interventions in any urological conditions. Finally, we also included relevant studies identified from the reference list of the papers identified in our systematic search.

An electronic spreadsheet was designed by one of the authors for data extraction, which was performed independently by two other authors and double checked completely by a further one.

One of the authors estimated the risk of bias of the available studies by the National Toxicology Program/Office of Health Assessment and Translation (NTP/OHAT) Risk of Bias Rating Tool for Human and Animal Studies [7]. The NTP/OHAT Risk of Bias Rating Tool for Human and Animal Studies includes 11 questions, each of them applicable to one to six study design types (experimental animal, human controlled trial, cohort, case control, cross-sectional, and case series/case report). Specifically, questions 1, 2, 3, and 6–11 were adopted for randomized and nonrandomized comparative studies, whereas questions 4 and 8–11 were adopted for noncomparative studies (see Supplementary Tables 1 and 2). The study complied with the recently reported Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement [8].

3. Evidence synthesis

A total of 229 records were retrieved from PubMed and 240 from Scopus. After the process, summarized in the Supplementary Figure 1, we identified 45 studies to be included in the systematic review [9–53].

Eleven studies reported data on the application of telehealth in prostate cancer (PCa) [17,20,26,30,34,35,37,39,42,45,48], three studies in the diagnosis of patients with hematuria [31,40,43], six studies in the management of urinary stone disease [9–11,44,46,47], 14 studies in the management of urinary incontinence (UI) [12,22,23,25,27,28,32,33,36,38,49–51] five studies in urinary tract infections (UTIs) [15,16,19,21,53], and six studies in other urological conditions [11,14,18,24,41]; 12 reports were randomized controlled trials (RCTs) [12,17,18,22,25–27,33,34,38,44,48]; and there were a large number of prospective studies.

3.1. Risk of bias assessment

Supplementary Tables 1 and 2 summarize the risk of bias for comparative and noncomparative studies, respectively. The overall quality of most of the reports was good.

3.2. Prostate cancer

Table 1 summarizes the studies evaluating the application of telehealth interventions to PCa management.

Among the 11 studies that reported data on application of telehealth in PCa [17,20,26,30,34,35,37,39,42,45,48], there were four RCTs [17,26,34,48], two nonrandomized comparative studies [20,37], and five case series [30,35,39,42,45].

3.2.1. Nonmetastatic PCa

Concerning treatment selection and decision-making process in localized PCa, Schaffert et al [39] tested the effectiveness of an online tutorial on the different treatment options, which was piloted in 56 patients with newly diagnosed PCa. Patient satisfaction and the effectiveness of the tutorial were evaluated through a set of validated questionnaires. The overall patient satisfaction with the tutorial was very high, and the patients reported that they were well prepared for the decision making, had a low decisional conflict, and had almost no decisional regret 3 mo after the choice.

With regard to the follow-up of patients with localized disease, four studies reported on the application of health medicine in the follow-up of patients treated with curative intent [20,26,37,45]. In the most relevant report, Viers et al [26] randomized 55 patients treated with radical prostatectomy (RP) at least 90 d before to remote video visits or traditional office visits. Notably, those patients were prescreened to exclude active urological problems such as fever, weight loss, urinary retention, hematuria, pain, and incision erythema/drainage. The primary outcome was video visit efficiency, defined as differences in timing for the total patient-urologist encounter time minus any overlap with the resident or midlevel provider, as well as waiting time in the examination room, total patient-provider consultation time, and total time devoted to the patient's care. Secondary outcomes, assessed via a specific patient questionnaire, included perceived efficiency, confidentiality, utility, satisfaction, and costs associated with each visit. Video visits were shown to be as effective as traditional office visits in terms of total time devoted to patient care (mean 17.9 vs 17.8 min, $p = 0.97$), total patient face time (14.5 vs 14.3 min, $p = 0.96$), patient-staff face time (12.1 vs 11.8 min, $p = 0.85$), or patient waiting time (18.4 vs 13.0 min, $p = 0.20$). Similarly, no differences were identified in all the secondary endpoints, including the patient's trust of the provider, perception of visit confidentiality, ability to share sensitive/personal information, quality of education provided, and overall satisfaction with the encounter. Most importantly, video visit was associated with lower costs, including distance traveled (median 0 vs 95 miles), travel time (0 vs 95 min), working day missed (0 vs 1 d), and money spent ($0 vs $48, all $p < 0.0001$). Similarly, in a nonrandomized study, Leahy et al [20] assessed patients' satisfaction following a nurse-led telephone consultation versus regular medical follow-up in a group of PCa patients with low- and intermediate-risk cancer treated with radiation therapy, demonstrating similar satisfaction in

Table 1 – Clinical studies evaluating the applications of telehealth in prostate cancer management.

Reference	Study design	Clinical setting	Cases	Studied intervention	Methods	Endpoint	Major findings
				Any stage prostate cancer			
Paterson (2016) [30]	Prospective series	All stages and treatments	12	Real-time data collection using mobile technology	Self-reports were collected for 31 d prompted by an audio alarm 3 times per day	To empirically test the propositions of social support theory in real time within individual men living with and beyond prostate cancer	Response rates were >90%. Men reported a lack of satisfaction with their support over time 16% identified the negative effects of social support . In 50%, the propositions of social support theory did not hold considering their within-person data
Trinh (2018) [42]	Prospective series	Localized or asymptomatic metastatic primary prostate cancer currently receiving androgen deprivation therapy	46	RiseTx website program	Through activity tracker (Jawbone) and access to the RiseTx website program, survivals were monitored to increase walking by 3000 daily steps above baseline levels over 12 wk	Measures of SED, MVPA, and daily steps were compared across the 12-wk intervention	Measurement completion rates were 97% and 65% at immediately after the intervention and 12-wk follow-up for all measures, respectively . Significant improvements in the weekly minutes of SED time (−455.4 min), weekly minutes of MVPA (+44.1 min), and step counts (+1535 steps) were observed after the intervention
Lee (2019) [48]	Randomized controlled trial	Not reported	50	Smartphone application to record physical activities	The smartphone application was used to record physical activities vs standard written report; participants also received weekly remote consultations based on the activity record from the app, without visiting a clinic	To compare the effectiveness of smartphone-based and conventional pedometer-based exercise monitoring systems in promoting home exercise among prostate cancer patients	There were no significant differences in the rates of uptake (80.0% vs 88.0%), adherence (92.5% vs 79.5%), or completion (76.0% vs 86.0%) between groups. Most physical functions were significantly improved in both groups without differences (except for weight)
			50	Written record of physical activities			
				Nonmetastatic prostate cancer			
Parsons (2008) [17]	Randomized controlled trial	Any nonmetastatic	48	Telephone-based dietary counseling	Dietary intake and plasma carotenoid levels were assessed at baseline and 6-mo follow-up	To evaluate the feasibility of implementing a diet-based intervention in men with nonmetastatic prostate cancer	In the intervention arm, mean daily intake of total vegetables, crucifers, tomato products, and beans/legumes increased by 76%, 143%, 292%, and 95%, respectively, whereas fat intake decreased by 12% ($p < 0.02$). In the control arm, there were no significant changes
			26	Standardized, written nutritional information			Similarly, in the intervention arm, mean plasma levels of alpha-carotene, beta-carotene, lutein, lycopene, and total carotenoids increased by 33%, 36%, 19%, 30%, and 26%, respectively ($p < 0.05$). In the control arm, there were no significant changes
Leahy (2013) [20]	Prospective study with retrospective control	Low- to intermediate-risk patients treated with radical radiotherapy	86	Nurse-led telephone consultation	Nurse-led telephone consultation vs standard medical follow-up was conducted in low- and intermediate-risk patients treated with radical radiotherapy	Participants completed the Satisfaction with Consultation Scale, the Brief Distress Thermometer and the EPIC	There was no statistically significant difference in patient satisfaction on any of the study measures . No differences were recorded in terms of distress (11% vs 10%), EPIC scale, and impact of symptoms

Table 1 (*Continued*)

Reference	Study design	Clinical setting	Cases	Studied intervention	Methods	Endpoint	Major findings
			83	Standard medical follow-up			
Viers (2015) [26]	Randomized controlled trial	Localized cancer treated by radical prostatectomy	24	Remote video visit	Video visits, with the patient at home or work, were included in the outpatient clinic calendar of urologists	The primary outcome was video visit efficiency, defined as differences in timing for the total patient-urologist encounter time minus any overlap with the resident or midlevel provider, as well as waiting time in the examination room, total patient-provider consultation time, and total time devoted to the patient's care	Primary endpoint: no difference in: - Total time devoted to patient care (mean 17.9 vs 17.8 min). - Total patient face time (14.5 vs 14.3 min)
			22	Traditional office visit	Traditional follow-up with office visit	Secondary outcomes, assessed via the patient questionnaire, included perceived efficiency, confidentiality, utility, and satisfaction	- Patient-staff face time (12.1 vs 11.8 min). - Patient waiting time (18.4 vs 13.0 min). Secondary outcomes: no differences in: - General health status, degree of patient activation, including taking an active role in their health care (mean Likert scale agreement 1.5 vs 1.4) and discussing concerns with their provider even when not asked (1.3 vs 1.2). - Patient trust of the provider (1.0 vs 1.0), perception of visit confidentiality (1.1 vs 1.0), or ability to share sensitive/personal information (1.3 vs 1.0). - Perceived efficiency (2.1 vs 1.4). - Quality of education provided (1.3 vs 1.4). - Overall satisfaction with the encounter (1.2 vs 1.1) The video visit group incurred significantly lower costs
Lange (2017) [37]	Quasiexperimental	Localized cancer treated by radical prostatectomy	18	Guided chat group for outpatients with prostate cancer	Use chat group to exchange concerns and problems, and support the fellow patients vs standard approach	Effectiveness of the chat groups in psychosocial aftercare for outpatients with prostate cancer after prostatectomy in terms of distress, anxiety, depression, anger, need for help, quality of life, fear of progression, and coping with cancer	In the intervention group, scores for anger, coping with cancer, physical component of quality of life, and depression were poorer in comparison with the control group. Web-based chat groups may not be an effective way to decrease prostate cancer perceived distress even if the intervention participants seem to accept the intervention

Table 1 (*Continued*)

Reference	Study design	Clinical setting	Cases	Studied intervention	Methods	Endpoint	Major findings
			26	Standard treatment			
Galsky (2017) [35]	Prospective series	Clinical trial of metformin in nonmetastatic patients with failure of local treatments	15	Telehealth video visits (televisits) during the clinical trial	Televisits were conducted monthly by using a Health Insurance Portability and Accountability Act–compliant smartphone application	Determine the feasibility of telemedicine-enabled study visits and patient satisfaction	Of the televisits, 100% were completed by the participants. Patient satisfaction was very high
Schaffert (2018) [39]	Prospective series	Localized cancer, any treatment	56	Online tutorial objectives to support the decision-making process	Online tutorial and questionnaires (the first one 4 wk after the first login and the second one 3 mo after treatment decision). The surveys used the PDMS, the DCS, and the DRS	Patient satisfaction and effectiveness	Satisfaction with the online tutorial was very high. Three months after the decision, they felt that they were well prepared for the decision making (mean PDMS 75), had a low decisional conflict (mean DCS 9.6), and had almost no decisional regret (mean DRS 6.4)
Belarmino (2019) [45]	Prospective series	Localized cancer treated by radical prostatectomy	20	Adoption mobile application (app)	Push notification to perform Kegel exercise	Patient satisfaction and usability	Of the responders, 100% revealed that the app is easy to use and the questions are easy to understand. 93% revealed that the app is useful
				Metastatic prostate cancer			
Chambers (2017) [34]	Randomized controlled trial	Metastatic	94	Mindfulness-based cognitive therapy delivered by phone	Participants were assessed at baseline and were followed up at 3, 6, and 9 mo	Psychological distress, cancer-specific distress, and prostate-specific antigen anxiety	Mindfulness-based cognitive therapy delivered via phone was not more effective than minimally enhanced usual care in reducing distress in men with advanced PCa
			95	Usual care			

DCS = Decisional Conflict Scale; DRS = Decisional Regret Scale; EPIC = Expanded Prostate Cancer Index Composite; MVPA = moderate-to-vigorous physical activity; PCa = prostate cancer; PDMS = Preparation for Decision Making Scale; SED = sedentary behavior.

both groups. Galsky et al [35] implemented a similar approach during an RCT testing the role of metformin in nonmetastatic PCa patients after failure of local treatments, demonstrating a high patient satisfaction rate.

Two other studies assessed specific issues in the follow-up of RP patients, such as the role implementation of Kegel exercise to improve continence recovery [45] and psychosocial aftercare for outpatients with PCa treated by RP [35]. Both studies were inconclusive.

Finally, Parsons et al [17] evaluated the feasibility of implementing a diet-based intervention in a small randomized trial, evaluating 84 PCa patients. Specifically, telephone-based dietary counseling was more effective than standardized written nutritional information in daily intake of total vegetables, crucifers, tomato products, and beans/legumes, and fat intake decreased.

3.2.2. Metastatic PCa

A single RCT was focused on metastatic PCa. Specifically, Chambers et al [34] randomized 189 patients to 8-wk, group-based, mindfulness-based cognitive therapy delivered by phone versus standard care to evaluate the impact on psychosocial stress. Participants were assessed at baseline and were followed up at 3, 6, and 9 mo by a set of validated questionnaires (the Brief Symptom Inventory-18, the Impact of Event Scale, and the Prostate-Specific Antigen Anxiety subscale of the Memorial Anxiety Scale for Prostate Cancer). The experimental intervention failed to be demonstrated as more effective than the standard treatment. However, the study findings are limited by a large number of patients dropping out from the interventional arm.

3.2.3. Studies on patients' mixed stages and therapies

Lee et al [48] randomized 100 patients with PCa to smartphone-based and conventional pedometer-based exercise monitoring systems in promoting home exercise. The smartphone app was used to record physical activities versus the standard written report. The major findings of the trial were that a similar improvement in physical functions was observed in both groups. Conversely, in a small prospective study, Trinh et al [42] demonstrated that the use of an activity tracker (Jawbone) and the access to a website program were able to decrease the weekly minutes of sedentary behavior time (−455.4 min), and improve weekly minutes of moderate-to-vigorous physical activity (+44.1 min) and step counts (+1535 steps).

Taken together, these data seem to indicate that telemedicine has been implemented usefully to guide PCa patients in the decision-making process and treatment selection following a diagnosis of nonmetastatic PCa. Similarly, telehealth is suitable for the follow-up of patients who received curative treatments, with the available studies demonstrating high patient satisfaction, similar efficacy to standard consultations, and some advantages in terms of costs, distance traveled, and working day missed. Moreover, in consideration of the increasing interest in physical activities and dietary adjustments in patients treated with androgen deprivation therapies, telemedicine could also be used to implement specific activities and monitor patients' results in this setting. Telemedicine can be implemented appropriately in these clinical settings during the present pandemic.

3.3. Hematuria

Table 2 summarizes the studies evaluating the application of telehealth interventions to the diagnosis of hematuria.

Sener et al [40] evaluated the agreement between two groups of urologists in assessing the severity of hematuria either during office consultations or by evaluating two pictures of voided urine in a sterile container sent via WhatsApp. The authors demonstrated almost a perfect agreement between the two groups in evaluating hematuria severity and needs for further invasive treatments. More interestingly, Safir et al [31] reported on 150 patients with hematuria enrolled in a teleurology clinic. Specifically, patients were scheduled for a dedicated 20–25 min long telephone appointment consisting of a structured interview performed by a physician resident. At the end of the telephone encounter, the provider arranged for the patient to undergo upper tract imaging, flexible cystoscopy, and additional studies, if indicated. Moreover, patients were offered subsequent cystoscopy appointments, where a physical examination was also performed. The study demonstrated median time from consult request to appointment of 12 d and after that to cystoscopy of 16 d. Patients reported high satisfaction with telephone evaluation, with scores exceeding 9 out of 10 for overall satisfaction, efficiency, convenience, friendliness, care quality, understandability, privacy, and professionalism. Virtually, all patients (98%) preferred telephone-based encounters to face-to-face clinic visits due to transportation-related issues (97%) and logistical clinic issues (65%). Of the patients, 97% reported high-quality evaluation. Finally, Zholudev et al [43] reported on cost comparisons, evaluating 300 patients with hematuria referred to a teleurology clinic and 100 patients managed in a regular clinic in the USA. The study found higher average patient time (266 vs 70 min, $p < 0.001$) and higher average cost per encounter ($135.02 vs $10.95, $p < 0.001$) in the standard face-to-face consultation. Cost savings associated with each electronic encounter totaled $124.07, with transportation being the primary driver of overall costs ($83.47 per encounter), followed by patient time ($32.87 per encounter) and clinic staff cost ($18.68 per encounter).

These data indicate that a virtual clinic for initial evaluation of patients with hematuria is feasible, effective, associated with high patient satisfaction, and cost effective, and can be implemented effectively in the present pandemic.

3.4. Urinary stone disease

Table 3 summarizes the studies evaluating the application of telehealth interventions to urinary stone disease management.

Table 2 – Clinical studies evaluating applications of telehealth in the diagnosis of hematuria.

Reference	Study design	Cases	Studied intervention	Methods	Endpoint	Results
Safir (2016) [31]	Prospective series	150	Teleurology clinic for patients referred for hematuria utilizing a telephone call to obtain hematuria- related clinical information.	Patients with hematuria were scheduled for a dedicated telephone appointment consisting of a structured interview performed by a physician resident. Each teleurology appointment consisted of an approximately 20–25-min encounter, during which the provider used a structured interview to obtain routine hematuria-related clinical information and completed a template-based hematuria consult note in the electronic medical record. At the end of the telephone encounter, the provider arranged for the patient to undergo upper tract imaging, flexible cystoscopy, and additional studies, if indicated. Patients were provided cystoscopy appointments within 30 d. A physical examination was performed on the day of cystoscopy	Efficacy and satisfaction with telephone appointments or hematuria consults. Patients were offered a voluntary, anonymous survey to evaluate their telephone clinic experience following cystoscopy. A 29-question survey regarding overall acceptance and satisfaction of the clinic (8 questions) and impact factors (21 questions)	Median time from consultation request to appointment was 12 d and thereafter to cystoscopy was 16 d. Patients reported high acceptance and overall satisfaction with telephone evaluation; mean scores exceeded 9 out of 10 for overall satisfaction, efficiency, convenience, friendliness, care quality, understandability, privacy, and professionalism. When presented with a choice, nearly all patients (98%) preferred telephone-based encounters to face-to-face clinic visits due to transportation-related issues (97%) and logistical clinic issues (65%). Of patients, 97% reported high-quality evaluation
Sener (2018) [40]	Prospective series	212	Patients assessment in the clinic	Group A: 2 urologists seeing the patients in the clinic and taking a medical history and performing a physical examination	To evaluate the inter-rater reliability of WhatsApp use in the evaluation of hematuria. The two groups separately ranked hematuria (0—no hematuria, 1—hematuria that does not require invasive treatment, 2—hematuria requiring bladder drainage or any form of active treatments)	Group A urologists were in accordance with 96.22% of cases. Group B urologists had common opinions in 99.5% ($n = 203$), and there was almost perfect agreement between 2 groups ($\lambda = 0.992$). The number of common opinions among "blind" urologists is more than the number of common opinions among the consultants. When further classification is performed as serious and nonserious hematuria, the rate of misdiagnosing serious cases is approximately 6.5–7%. However, using WhatsApp, the urologists can differentiate between normal urine and any form of hematuria with 100% accuracy
			Assessment of 2 pictures of voided urine in a sterile container via WhatsApp	Group B: 2 "blind" urologists who had no access to patients' medical history, nor could they visit or see patients, but were permitted only to receive pictures via WhatsApp. Each patient was asked to urinate into a sterile container and take two pictures of the sample with their smartphone. The images were sent using WhatsApp via 3G technology		
Zholudev (2018) [43]	Prospective series	300	Teleurology clinics	Cost comparison of teleurology versus face to face clinic regarding hematuria patients. Overall cost consisted of 3 cost categories: transportation, clinic operation (administrative, nursing, and provider related), and patient time	To understand the economic impact of teleurology in the initial evaluation of hematuria based on analysis and comparison of the cost of telephone encounters and conventional outpatient clinic encounters	Average patient time was greater for face-to-face encounters (266 vs 70 min, $p < 0.001$). Transportation was the primary driver of overall costs ($83.47 per encounter), followed by patient time ($32.87 per encounter) and clinic staff cost ($18.68 per encounter). The average cost per encounter was $135.02 for face-to-face clinic visit vs $10.95 for teleurology ($p < 0.001$), exclusive of provider and laboratory times. Cost savings associated with each tele-encounter totaled $124.07
		100	Standard clinics			

Table 3 – Clinical studies evaluating applications of telehealth in urinary the management of urinary stone disease.

Reference	Study design	Cases	Studied intervention	Methods	Endpoint	Results
			Diagnosis and treatment planning			
Hayes (1998) [9]	Prospective series	32	Telemedicine consultations for complex and/or complicated urinary stone disease vs only telephone consultations	Virtual consultations to discuss complicated urinary stone disease, which was already discussed by telephone consultation. During the virtual consultation, specific tools, including zooming, pointing, and drawing, were used by the urologists to view and annotate the image, explaining the surgical approach to the patient and the referring urologist before transfer	To assess the effectiveness of telemedicine on the clinical decision-making process for patients with urolithiasis	The recommendation of the consulting urologist at the tertiary center was altered in 12 patients (37.5%) after the telemedicine consultation, compared with the recommended treatment after the initial telephone consultation
Johnston, (2005) [11]	Prospective series	11	Remote assessment of CT images	Selected images from CT scans were compressed and delivered by e-mail for urological assessment	To assess the concordance among initial radiological diagnosis on CT scans and urologist assessment of selected images sent by e-mails	Hydronephrosis was correctly identified 100% of the time, while perinephric stranding was correctly identified 80% of the time. Stone presence and location were correctly identified in 80% of the cases
						One 3-mm lower-ureteral calculus and one 1-mm pelvic calculus were not identified. Stone size was estimated within 1 ± 1 mm compared with the staff radiologist's report
Connor, (2019) [46]	Prospective series	1008	Specialist- led virtual ureteric colic clinic in patients with uncomplicated acute ureteric colic	Patients with uncomplicated acute ureteric colic referred in real-time by clinicians using an electronic referral method integrated into the electronic health care record platform and a virtual clinic telephone consultation. After the call, the patient could have the following outcomes: discharge investigations and a further virtual clinic, and face-to-face clinic or direct referral for stone intervention. The virtual clinic was supervised by 3 dedicated urologists. In the case of clinical uncertainty, the patient would be referred to a standard clinic	To evaluate the clinical, fiscal, and environmental impact of a specialist-led acute ureteric colic virtual clinic pathway	The median (interquartile range) time from presentation to virtual clinic outcome was 2 (4) d. The outcomes were as follows: 16.3% of patients were discharged, 18.2% were discharged after further virtual clinic, 17.2% underwent an intervention, and 48.4% were referred to a standard clinic. Introduction off a virtual clinic saved £145, 152 for NHS. Overall, 15,085 patient journey kilometers were avoided, equal to 0.70–2.93 metric tons of carbon dioxide equivalent production
			Telementoring			
Rodrigues Netto, (2003) [10]	Case report	2	Telementoring	Telementoring during laparoscopic bilateral varicocelectomy and a percutaneous renal access for a percutaneous nephrolithotomy via AESOP 3000 (Computer Motion Inc., Cremona Drive Goleta, CA, United States) and PAKY robots	None	The two procedures were completed successfully

Table 3 (*Continued*)

Reference	Study design	Cases	Studied intervention	Methods	Endpoint	Results
			Post-surgical evaluation			
Aydogdu, (2019) [44]	Randomized controlled	40	Standard rounds	Patients undergoing percutaneous nephrolithotomy were randomly divided into two groups. Group 1 included 40 patients who were followed- up with standard rounds and group 2 included 40 patients who were followed-up with telerounding in addition to standard rounds. Telerounding was performed with a high- quality tablet using the Skype application. Additional telerounding visits by the operating surgeon, were performed on the evening before the surgery and each night during the hospital stay of the patients postoperatively	Patient and surgeon satisfaction rates were assessed with a VAS scale. Both surgeon and patients filled in the "satisfaction" and "quality of telerounding conference" surveys on the day of discharge	The mean time of preoperative telerounding visit was 3.65 ± 0.59 (2–4) min. The mean time of telerounding visits on the postoperative 1st and 2nd days were 3.80 ± 0.62 and 2.9 ± 0.91 min, respectively. The VAS score evaluating the surgeon's satisfaction rate for telerounding was 91 ± 11.2, and patients expressed a high level of satisfaction (72.5%)
			Therapies for the prevention of stone recurrence			
Gasparini, (2019) [47]	Prospective series	500	Telemedicine program to enroll patients at high risk of recurrent kidney stones and provide dietary instruction, metabolic evaluation, and medical therapy	The program was staffed by a clinical pharmacist and supervised by urologists following a protocol based on the American Urological Association guidelines. Patients were contacted entirely via telemedicine. A telephone follow-up occurred at a minimum of 6-wk, 3-mo, 6-mo, and 12-mo intervals in the 1st first year; more frequent follow-up occurred if laboratory, medication, or compliance issues arose. After the 1st first year, telephone follow-up occurred annually.	To determine the feasibility of a multicenter, pharmaciststaffed program to enrol patients at high risk of recurrent kidney stones and provide dietary instruction, metabolic evaluation, and medical therapy via telemedicine.	Among patients enrolled for 3 mo, 99% self-reported compliance with at least 3 of 5 aspects of dietary advice. A complete metabolic evaluation including 24-h urine collection was performed in 80% of patients by 12 mo.
						A significant improvement in all urinary parameters occurred in 52 patients with calcium stones who repeated 24-h urine testing. The 12-mo dropout rate was 12.4%.

CT = computed tomography; NHS = National Health Service; PAKY = Percutaneous Access to the Kidney; VAS = visual analog scale.

Among the six studies evaluating the use of telemedicine in the management of urinary stone disease [9–11,44,46,47], there was a single RCT [44]. All the other reports were prospective series with the exclusion of a single case report [10].

In a small and old prospective study, Johnston et al [11] evaluated the feasibility of initial radiological diagnosis of stones on computed tomography scans through the assessment of selected images sent by e-mails, demonstrating good accuracy. These results are surprisingly good considering the limited and now outdated technology available at the moment of the study. It is indeed pretty clear nowadays that a complete remote assessment of any radiological examination is feasible and easy to perform.

Connor et al [46] evaluated the performance of a virtual clinic to assess patients with uncomplicated acute ureteric colic. The median (interquartile range) time from presentation to the virtual clinic outcome was 2 d. Specifically, 16.3% of patients were discharged, 18.2% were discharged after further virtual clinic, 17.2% underwent an intervention, and 48.4% were referred to a regular clinic. The adoption of the virtual clinic was shown to have saved £145 152 for the National Health Service (NHS). Overall, 15 085 patient journey kilometers were avoided, equal to 0.70–2.93 metric tons of carbon dioxide equivalent production. Moreover, Hayes et al [9] reported on the adoption of telemedicine for second opinion consultation in case of complex and/or complicated urinary stone disease. Specifically, telephone consultation followed by virtual meetings with patients and referring urologists was performed in 32 cases, with a single expert consultant urologist providing final suggestions on the specific treatment. Finally, the virtual consultation allowed alteration of the treatment plan made during the telephone consultation in 37.5% of the cases.

Concerning the early postoperative evaluation of surgically treated patients, Aydogdu et al [44] reported a small RCT, where patients treated by percutaneous nephrolithotomy were followed up with standard rounds (40 cases) or with standard rounds and additional telerounding visits via the Skype app. Telerounding was associated with high patient and surgeon satisfaction, but no clinical data on the real impact of telerounding were provided in the paper. Only a single study reported on telementorship during a case of percutaneous renal access for percutaneous nephrolithotomy, just describing a successful surgical outcome [10].

Finally, Gasparini et al [47] evaluated the application of telemedicine in 500 patients at a high risk of stone recurrence after initial treatment. Specifically, dietary instruction, metabolic evaluation, and medical therapy were provided. A telephone follow-up occurred at a minimum of 6-wk, 3-mo, 6-mo, and 12-mo intervals. More frequent follow-up occurred if laboratory, medication, or compliance issues arose. After the 1 st year, telephone follow-up occurred annually. Among patients enrolled for 3 mo, 99% self-reported compliance with at least three of five aspects of dietary advice. A complete metabolic evaluation, including 24-h urine collection, was performed in 80% of patients by 12 mo. A significant improvement in all urinary parameters occurred in 52 patients with calcium stones who repeated 24-h urine testing. The 12-mo dropout rate was 12.4%.

All these data indicate that the implementation of telehealth interventions is feasible and effective in the field of urinary stone disease, especially in the diagnosis and treatment planning of patients with uncomplicated disease. Moreover, all the metabolic evaluation and medical therapies for stone, former patients can be implemented successfully via telemedicine. The application of telemedicine in these clinical settings can be recommended in the present pandemic.

3.5. Urinary incontinence

3.5.1. Any kind of UI

Table 4 summarizes the studies evaluating the application of telehealth interventions to the management of any type of UI.

Among the seven studies evaluating the use of telemedicine in the management of any kind of UI [12,23,32,38,49,51,52], there were two RCTs [12,38]. All the other reports were prospective series.

In one of the RCTs, Jones et al [38] randomized 195 patients referred to urogynecology services of the Sheffield Teaching Hospitals to telephone versus regular office consultation. The primary endpoint was the mean "short-term outcome scale" score on the Patient Experience Questionnaire (PEQ). The secondary outcome measures included the other domains of the PEQ (communications, emotions, and barriers), Client Satisfaction Questionnaire (CSQ), Short-Form 12 (SF-12), personal, societal, and NHS costs. The study finally demonstrated similar results for the primary endpoint, as well as for CSQ and SF-12 scores. However, the intervention group showed significantly higher PEQ domain scores for communications, emotions, and barriers, indicating that patients "favors for virtual clinics." The virtual clinic also reduced consultation time (10.94 vs 25.9 min) and consultation costs (£31.75 vs £72.17) significantly, but was less effective than standard care due to higher clinic reattendances. However, the difference was minimal (£38.04).

In the other RCT, Hui et al [12] assessed the effectiveness of behavioral training administered through either videoconferencing (31 patients) or face-to-face consultation (27 patients). Participants in both treatment groups experienced significant improvement in symptoms and pelvic floor muscle strength, without any difference between the two treatment groups. Likewise, good efficacy for behavioral therapies based on health medicine in female UI was also reported by Yu et al [23], Schimpf et al [32], and Goode et al [52].

Finally, Davis et al [51] evaluated the impact of a 6-wk evidence-based educational/skill-building program, delivered via a tablet personal computer, on the caregiver experience and care recipient outcomes. The study was preliminary, including only three caregiver/care-recipient dyads, but seems to suggest a promising role for such educational tools.

Table 4 – Clinical studies evaluating applications of telehealth in the management of patients with any kind of urinary incontinence.

Reference	Study design	Cases	Studied intervention	Methods	Endpoint	Results
Hui (2006) [12]	Randomized controlled trial	31	Telemedicine continence program to manage incontinence in older women	At baseline, both groups were assessed face-to-face for pelvic floor muscle strength, instrumental biofeedback, and verbal feedback by vaginal palpation. During the intervention period, identical behavioral training was administered via telemedicine or in outpatients service	Participants were asked to rate the severity of their existing bladder problem	Participants in both treatment groups experienced significant improvement in their symptoms (namely, a reduction in the number of daily incontinence episodes and voiding frequency, while the volume of urine at each micturition increased). Pelvic floor muscle strength as measured by the Oxford Score also improved. Clients' perceptions of their symptoms showed significant improvement in both groups following intervention. Overall, no significant difference in treatment outcomes, in terms of both subjective and objective data, was observed in the two treatment groups
		27	Conventional outpatient continence service to manage incontinence in older women		Objective measures included the number of incontinent episodes, voiding frequency, and voided volume, as documented in a 3-d voiding diary, and pelvic floor muscle strength by digital assessment using the Oxford Scale	Self-reported satisfaction with the use of videoconferencing as a mode of care delivery was also high (100% were satisfied or highly satisfied)
Yu (2014) [23]	Prospective series	31	Introducing a telemonitoring system for continence assessment in a nursing home	Care staff were trained in the use of a telemonitoring system for continence assessment. Voiding events for each older person were recorded using the system during a 72-h urinary continence assessment, and the data were used to prepare an individualized care plan. After 2 wk of using the new care plan, a second assessment was carried out for each older person, using the telemonitoring system	To explore the effects of introducing a telemonitoring and care planning system for urinary continence assessment in a nursing home and adherence by care staff to urinary continence care plans	The volume of urine voided into the continence aids was significantly reduced; the number of actual and successful toilet visits was significantly increased
						Increased adherence to urinary continence care plans by staff
Schimpf (2016) [32]	Prospective series	87	Nurse telephone follow-up under physician direction to assess symptom improvement and patient satisfaction	Nurse telephone follow-up for prescribed medication follow-up after physical therapy symptom assessment, and efficacy of recommended bowel regime	To assess symptom improvement and patient satisfaction of nurse telephone follow-up under physician direction	The most common diagnoses were overactive bladder and mixed urinary incontinence. Satisfaction rates and the level of convenience for patients were high. Women indicated ease of speaking over the telephone about their condition and confidence in the treatment plan. Satisfaction with telephone follow-up did not differ significantly based on age or diagnosis

Table 4 (*Continued*)

Reference	Study design	Cases	Studied intervention	Methods	Endpoint	Results
Jones (2018) [38]	Randomized controlled trial	98	Telephone consultation (virtual clinic) in the care of women with urinary incontinence	Both groups completed a validated, web-based interactive, patient-reported outcome measure (ePAQ-Pelvic Floor), in advance of their appointment followed by either a telephone consultation or a face-to-face consultation	The primary outcome was the mean "short-term outcome scale" score on the PEQ. Secondary outcome measures included the other domains of the PEQ (communications, emotions and barriers), CSQ, SF-12, personal, societal, and NHS costs	The primary outcome showed a nonsignificant difference between the two study arms. No significant differences were also observed on the CSQ and SF-12. However, the intervention group showed significantly higher PEQ domain scores for communications, emotions, and barriers (including following adjustment for age and parity). The virtual clinic also reduced consultation time (10.94 vs 25.9 min) and consultation costs (£31.75 vs £72.17) significantly compared with usual care. Standard care was more cost effective due to greater clinic reattendances in this group, but the difference was minimal (£38.04)
		97	Standard consultation in the care of women with urinary incontinence			
Lee (2019) [49]	Cross sectional	200	A survey regarding women's willingness to use technology to communicate with providers	Women completed a survey regarding what technology they owned, how they utilized it, and their willingness to use technology to communicate with providers	To assess the willingness of women with pelvic floor disorders to adopt nontraditional mobile communication methods with health care providers	After controlling for education and travel distance to clinic, older women remained significantly less likely to express willingness to use various technologies: • Videoconference technology (OR 0.97, 95% CI 0.95, 0.99) • Text messaging (OR 0.94, 95% CI 0.91, 0.97) • Internet-based patient portal (OR 0.96, 95% CI 0.94, 0.98) or e-mail (OR 0.94, 95% CI 0.91, 0.98) Almost 50% of older women and >65% of middle-aged women expressed willingness to adopt technologies for health care communication
Davis (2020) [51]	Prospective series	Three caregiver/care-recipient dyads were enrolled, who completed the study	Development and feasibility of a 6-wk evidence-based, educational/skill-building program delivered via a tablet personal computer, aimed at developing informal caregiver UI knowledge	Data were collected at baseline (T0; face to face), 3 wk (T1; mailing), and 6 wk (T2; face to face) after baseline. As part of the feasibility analysis, weekly logs of prompted voiding, module viewing, and telephone visits were also maintained	To explore the feasibility of an innovative, technology-delivered, prompted-voiding, and skill-building intervention to support the informal caregivers of functionally limited older adults with UI. Second, to assess the acceptability and usefulness of the intervention, and its impact on informal caregiver and care-recipient outcomes	The tablet-facilitated intervention was feasible and acceptable to informal caregivers, and showed promise for improving both caregiver and care recipient outcomes

Table 4 (*Continued*)

Reference	Study design	Cases	Studied intervention	Methods	Endpoint	Results
Goode (2020) [52]	Prospective series	29	An evidence-based 8-wk behavioral mHealth program, MyHealtheBladder, with input from women veterans, behavioral medicine and health education experts, and clinical providers treating UI	The program was story based and included pelvic floor muscle exercises, bladder control strategies, fluid management, risk factor reduction, and self-monitoring	Change in UI frequency and volume, and impact on the quality of life as measured by the validated ICIQ-SF	Reductions in ICIQ-SF scores from a mean of 12.6 ± 3.9 at baseline to 10.4 ± 4.11 at 5 wk, to 8.7 ± 4.0 at the end of the 8-wk intervention. Changes exceeded the minimal clinically important difference for the ICIQ-SF

CI = confidence interval; CSQ = Client Satisfaction Questionnaire; ICIQ-SF = International Consultation on Incontinence Questionnaire-Short Form; NHS = National Health Service; OR = odds ratio; PEQ = Patient Experience Questionnaire; SF-12 = Short-Form 12; UI = urinary incontinence.

3.5.2. *Stress urinary incontinence*

Table 5 summarizes the studies evaluating the application of telehealth interventions to the management of stress urinary incontinence (SUI).

Among the seven studies that evaluated the use of telemedicine in the management of female SUI [22,25,27,28,33,36,50], there were four reports from three RCTs [22,25,27,33], with two studies reporting on the same RCT at different follow-up durations [22,27]; another study [36] was a secondary analysis of one of the RCTs mentioned above [33]. All the three RCTs and their secondary analyses evaluated the electronic implementation of pelvic floor muscle training (PFMT) programs. Of the two remaining studies, one was a prospective, nonrandomized comparative study [50] and the other a retrospective study [28], both evaluating the follow-up after surgical treatments for SUI.

Sjostrom et al [22] randomized 250 community-dwelling women with SUI to a 3-mo PFMT program, including Internet support via e-mail from a urotherapist (124 cases) versus the standard program sent by post where the patients trained on their own (126 cases). At 4-mo follow-up, the mean changes in symptom severity and quality of life scores were similar in both arms, as well as the proportions of participants perceiving that they were much or very much improved (about 70% in both arms). After the treatment, more participants in the Internet group had either stopped using or reduced their usage of UI aids (59.5% vs 41.4%, $p = 0.02$). In the Internet group, more participants experienced the treatment program as "good" or "very good" (84.8% vs 62.9% in the postal group, $p < 0.001$). A subsequent report of the same RCT with 2-yr follow-up data reconfirmed similar improvements in symptoms and quality of life scores at 1 and 2 yr. However, the proportion of participants perceiving that they were much or very much improved after 2 yr was significantly higher in the Internet group (39.2% vs 23.8%, $p = 0.03$) [27].

In another RCT, Carrion Perez et al [25] tested the role of a device consisting of a vaginal probe that transmits wirelessly variations of pressure to a computer application, which allowed the patient to visualize the correct execution of PFMT exercise. The study failed to show any significant improvement in the PFMT by the adoption of the device, as compared with standard care. In the last RCT, Asklund et al [33] tested the efficacy of a mobile app named Tat. The app was focused on PFMT exercises and also contained information that described SUI, pelvic floor, and lifestyle factors related to incontinence. Sixty-two patients were randomized to the use of the app, whereas 61 patients received a standard PFMT program. At 3-mo follow-up, the app group reported larger reductions in the ICIQ-UI SF (3.9 vs 0.9, $p < 0.001$) and mean ICIQ-LUTSqol (4.8 vs 0.7, $p = 0.005$) scores, and larger improvements in the PGI-I scores (participants reporting much improved vs those reporting very much improved UI were 55.7% vs 5%, $p < 0.001$). Moreover, no leakage or $\geq$50% fewer leakage episodes than at baseline was reported by 56.5% of the app group and 29.5% of the control group ($p = 0.005$). The app group reduced the use of incontinence aids significantly, and patient satisfaction with the app was "good" or "very

Table 5 – Clinical studies evaluating applications of telehealth in the management of patients with stress urinary incontinence.

Reference	Study design	Cases	Studied intervention	Methods	Endpoint	Results
			Pelvic floor muscle training			
Sjostrom (2013) [22] [a]	Randomized controlled trial	124	Internet-based treatment program	Both interventions focused mainly on PFMT. The Internet group received 3-mo continuous e-mail support from a urotherapist, whereas the postal group trained on their own. Follow-up was performed after 4 mo via self-assessed postal questionnaires	The primary outcomes were symptom severity (ICIQ-UI SF) and condition-specific quality of life (ICIQ-LUTSqol). Secondary outcomes were the Patient Global Impression of Improvement, health-specific quality of life (EQ-VAS), use of incontinence aids, and satisfaction with treatment	The mean changes in ICIQ-UI SF were 3.4 ± 3.4 for the Internet group and 2.9 ± 3.1 for the postal group ($p = 0.27$) after 4 mo. The mean changes in ICIQ-LUTSqol were 4.8 ± 6.1 for the Internet group and 4.6 ± 6.7 the for postal group ($p = 0.52$). The proportions of participants perceiving that they were much or very much improved were similar in both intervention groups (69.8% in both arms)
		126	Program sent by post			After treatment, more participants in the Internet group had either stopped using or reduced their usage of UI aids (59.5% vs 41.4%, $p = 0.02$)
						In the Internet group, 84.8% of participants experienced the treatment program as "good" or "very good", compared with 62.9% in the postal group ($p < 0.001$)
Carrion Perez (2015) [25]	Randomized controlled trial	10	New telerehabilitation device for stress urinary incontinence	1. Pelvic floor muscle training: 5 sessions of 30 min for 2 wk. 2. Training in the use of the telerehabilitation device (3 sessions of 30 min). The device consists of a vaginal probe that transmits wirelessly (Bluetooth) variations of pressure. The computer application allows the patient to visualize the correct execution of the exercise. 3. Home treatment with the telerehabilitation device using a personalized program. Monthly monitoring by professionals	Outcome measures (baseline and 3 mo) overall and specific quality of life: ICIQ-UI SF and King's Health Questionnaire, bladder diary, perineometry, satisfaction with the program and degree of compliance	There was no statistically significant difference for any outcome measures between groups at the end of the follow-up. The change in perineometry values at baseline and after the intervention was significant in the experimental group (23.06–32.00, $p = 0.011$). No group in this study had any serious adverse effects
		9	Conventional rehabilitation treatment	1. PFMT as in the intervention arm 2. Biofeedback: 10 sessions 3. Home treatment: personalized written program in which exercise with a daily frequency is specified		

Table 5 (*Continued*)

Reference	Study design	Cases	Studied intervention	Methods	Endpoint	Results
Sjostrom (2015) [27] [a]	Randomized controlled trial	124	Internet-based treatment program	Both Interventions focused mainly on PFMT. The Internet group received 3-mo continuous e-mail support from a urotherapist, whereas the postal group trained on their own. Follow-up was performed after 1 and 2 yr via self-assessed postal questionnaires	The primary outcomes were symptom severity (ICIQ-UI SF) and condition-specific quality of life (ICIQ-LUTSqol). Secondary outcomes were the Patient Global Impression of Improvement, health-specific quality of life (EQ-VAS), use of incontinence aids, and satisfaction with treatment	The mean changes in ICIQ-UI SF were 3.7 ± 3.3 for the Internet group and 3.2 ± 3.4 for the postal group ($p = 0.47$) after 1 yr, and 3.6 ± 3.5 for the internet group and 3.4 ± 3.3 for the postal group ($p = 0.79$) after 2 yr. The mean changes in ICIQ-LUTSqol were 5.5 ± 6.5 for the Internet group and 4.7 ± 6.5 for the postal group ($p = 0.55$) after 1 yr, and 6.4 ± 6.0 for the Internet group and 4.8 ± 7.6 for the postal group ($p = 0.28$) after 2 yr. The proportions of participants perceiving that they were much or very much improved were similar in both intervention groups after 1 yr (31.9% vs 33.8%, $p = 0.82$), but after 2 yr significantly more participants in the Internet group reported this degree of improvement (39.2% vs 23.8%, $p = 0.03$). Health-specific QoL improved significantly in the Internet group after 2 yr (mean change in EQ-VAS, 3.8 ± 11.4, $p = 0.005$)
		126	Program sent by post			
Asklund (2017) [33] [b]	Randomized controlled trial	62	Tat mobile app with a treatment program for SUI, focused on PFMT	Adoption of an app focused on PFMT exercises and also containing information that described SUI, pelvic floor, and lifestyle factors related to incontinence	Three-month changes from baseline in ICIQ-UI SF and ICIQ-LUTSqol	At follow-up, the app group reported larger reductions in ICIQ-UI SF score (3.9 vs 0.9, $p < 0.001$) and in the mean ICIQ-LUTSqol score (4.8 vs 0.7, $p = 0.005$).
		61	Standard	Standard PFMT		The follow-up PGI-I results showed that app group participants reported much improved or very much improved urinary incontinence more often than control group participants (55.7% vs 5%, $p < 0.001$). Concerning weekly leakage episodes, 56.5% of the app group and 29.5% of the control group reported either no leakage or $\geq$50% fewer leakage episodes than at baseline (between-group $p = 0.005$). The app group reduced the use of incontinence aids significantly ($p < 0.001$). At follow-up, the groups were significantly different in the use of incontinence aids ($p = 0.023$). Patient satisfaction with the app was “good” or “very good” in 96.7% of the app group. Two-thirds of the app group (66.7%) reported satisfaction with the treatment outcome, and 21.7% planned to seek additional treatment for incontinence

Table 5 (*Continued*)

Reference	Study design	Cases	Studied intervention	Methods	Endpoint	Results
Hoffman (2017) [36] [b]	Secondary analysis of a randomized controlled trial	62	Treating SUI with pelvic floor muscle training supported by the mobile app	Follow up the women in the app group 2 yr after the initial trial with the same primary outcomes for symptom severity (ICIQ-UI SF) and condition-specific quality of life (ICIQ-LUTSqol) and compared the scores with those at baseline	Two-year changes from baseline in ICIQ-UI SF and ICIQ-LUTSqol	The mean decreases in ICIQ-UI SF and ICIQ-LUTSqol after 2 yr were 3.1 and 4.0, respectively. Of the 46 women, four (8.7%) rated themselves as very much better, nine (19.6%) as much better, and 16 (34.8%) as a little better. The use of incontinence protection products decreased significantly ($p = 0.04$), and the proportion of women who felt that they could contract their pelvic muscles correctly increased from 14/46 (30.4%) at baseline to 31/46 (67.4%) at follow-up ($p < 0.001$)
			Follow-up after surgical procedures			
Jefferis (2016) [28]	Clinical audit	356	Telephone consultations after TVT sling surgery	Cases identified from the BSUG database then had their case notes reviewed. Patients having additional surgery were excluded from the analysis	To report 5-yr experience of telephone consultations after TVT sling surgery	A total of 262 patients were initially followed up via telephone; the remaining 94 were seen in a conventional outpatient clinic setting. Of the 262 patients followed up by telephone, 28 (10%) subsequently required review in an outpatient clinic for a variety of reasons
Balzarro (2020) [50]	Prospective comparative	A total of 215 women following MUS placement for SUI	One-year follow-up telephonic interview using a checklist and validated questionnaires, followed by a standard outpatient clinic visit 7–12 d later including an interview, validated questionnaires, objective examination, and score satisfaction with the telephone follow-up	PGI-I and PPBC questionnaires were administered during the telephone call; at the office follow-up evaluations PGI-I, PPBC, vaginal examination, and a bladder stress test with fluid volumes of 300 ml	To determinate the feasibility, reliability, and patient satisfaction of telephonic follow-up in women treated for SUI or POP	SUI recurrence was 19.1% and 11.6% at the telephone and office follow-up, respectively. De novo urgency urinary incontinence rate was 7.5%. Telephone follow-up was able to detect POP recurrence and related symptoms. Tape and mesh extrusions were detected only at the objective evaluation: 1.9% and 4.4%, respectively. No difference was found at the questionnaires. Satisfaction with the telephone follow-up was high

AVW = anterior vaginal wall; EQ-VAS = EQ-visual analog scale; ICIQ-LUTSqol = International Consultation on Incontinence Questionnaire Lower Urinary Tract Symptoms Quality of Life; ICIQ-UI SF = International Consultation on Incontinence Questionnaire Short Form; MUS = middle urethral sling; PFMT = pelvic floor muscle training; PGI-I = Patient Global Impression of Improvement; POP = pelvic organ prolapse; PPBC = Patient Perception of Bladder Condition; RCT = randomized controlled trial; SUI = stress urinary incontinence; TVT = tension-free vaginal tape; UI = urinary incontinence.

[a] Two reports of the same RCTs at different follow-up durations.

[b] Two reports of the same RCTs (main report and evaluation of the intervention arm at longer follow-up duration).

good" in 96.7% of the app group. Patients in the interventional arm were followed-up to 2 yr, demonstrating sustained benefits [36].

Two other studies assessed the follow-up of patients with SUI treated with implantation of middle urethral tapes. Jefferis et al [28] reported on 262 patients who received telephone consultations after tension-free vaginal tape sling surgery. Among these patients, only 28 (10%) required an outpatient clinic consultation for a variety of reasons (mainly persistent SUI, storage and voiding lower urinary tract symptoms, recurrent UTIs, and symptoms of tape erosions). On the whole, this indicated that the telephone consultation was effective in the vast majority of uncomplicated cases. In a more methodologically robust study, Balzarro et al [50] evaluated 215 women following sling placement for SUI and 205 women with symptomatic anterior vaginal wall defect who underwent anterior repair. Patients underwent a 1-yr follow-up telephonic interview using a checklist and validated questionnaires, followed by a regular outpatient clinic visit 7–12 d later, including interviews, validated questionnaires, objective examination, and score satisfaction with the telephone follow-up. In patients with SUI, SUI recurrence was reported in 19.1% and 11.6% at the telephone and office follow-up, respectively. The de novo urgency UI rate was 7.5%. Telephone follow-up was able to detect the recurrence of pelvic organ prolapse and related symptoms, whereas tape extrusions were detected only at the objective evaluation in 1.9% of cases. No difference was found in the questionnaire scores, and patients' satisfaction with the telephone follow-up was high.

Taken together, the role of virtual clinics in the evaluation of UI patients is appealing but, as far as suggested by the available data, is limited to a single center and not truly cost effective. Conversely, such applications seem to be safe and effective in the follow-up of surgically treated patients. The available data indicate that behavioral training and PFMT can be implemented safely and effectively via telehealth programs. The application of telemedicine in these clinical scenarios can be recommended in the present pandemic.

3.6. Urinary tract infections

Table 6 summarizes the studies evaluating the application of telehealth interventions to the management of UTIs.

All the five studies evaluating the use of telemedicine in UTIs [15,16,19,21,53] were retrospective series, with a single one comparing electronic visits with regular office visits [21]. Virtually, all the studies were focused on uncomplicated female UTIs.

Effectiveness and safety of telemedical management in uncomplicated UTIs were addressed in a Swiss study by Blozik et al [19]. Specifically, the authors reported that 79% of patients had complete symptom relief and 92% had a reduction of UTI symptoms 3 d after teleconsultation. In contrast, only 5% of patients reported deterioration (eg, due to an increase in pain, flank pain, or fever). In the 3 d following teleconsultation, only 4% of women consulted another health care provider, without contacting the telemedicine center further. Moreover, only 8% of patients were referred to face-to-face consultation because they developed additional symptoms or bacterial resistance of the prescribed antibiotic was suspected [19]. Similarly, a high patient satisfaction rate was reported in a cross-sectional analysis of a large direct-to-consumer US telemedicine system [53]. More in detail, Mehrotra et al [21] compared the outcomes of 99 electronic and 2855 office visits at the University of Pittsburgh Medical Center. Physicians were less likely to order a UTI-relevant test (including urinalysis, urine culture, or referral to urology) during an electronic consultation (8% in e-visits vs 51% in-office visits, $p < 0.01$) but more likely to prescribe an antibiotic (99% vs 49%, $p < 0.001$). The number of follow-up visits was indeed similar following electronic or office consultations (7% in both groups, $p = 0.98$). Notably, during e-visits, physicians were less likely to order preventive care (0% vs 7%, $p = 0.02$) [21].

On the whole, these data seem to indicate that the management of uncomplicated UTIs can be performed effectively and safely via telemedicine.

3.7. Other urological conditions

Table 7 summarizes the studies evaluating the application of telehealth interventions in other urological conditions.

Two papers evaluated general urology [24,41], two lower urinary tract symptoms [14,29], and two male sexual dysfunctions [11,18].

3.7.1. General urology

Chu et al [24] reported on the adoption of a urology telemedicine clinic to serve remote locations within the Veterans Affairs Greater Los Angeles Healthcare System. In a 6-mo period, 97 patients, mainly affected by lower urinary tract symptoms (35%), elevated prostate-specific antigen level (15%), and PCa (14%), were evaluated. Only a single patient needed an emergency department consultation within 30 d with an unpreventable urological complaint. Patient satisfaction was "very good" to "excellent" in 95% of cases, and 97% would refer another patient to the urology telemedicine clinic. Patients were estimated to have saved an average of 277 travel miles, 290 min of travel time, $67 in travel expenses, and $126 in lost opportunity cost. Similarly, Sherwood et al [41] reported on the use of telemedicine consultation to evaluate male prisoners in Iowa, USA, demonstrating 90% concordance among in-person and after teleconference diagnoses. Moreover, it was estimated that about 90–94% of the in-person visits could have been replaced by teleconferencing.

3.7.2. Lower urinary tract symptoms

Park et al [14] reported on the development of an algorithm named Personal BPH Control Program to monitor symptoms and adjust follow-up schedule in male patients with benign prostatic hyperplasia (BPH). Based on the International Prostate Symptom Score and average flow rate at uroflowmetry, the authors identified three groups of patients

Table 6 – Clinical studies evaluating applications of telehealth in urinary tract infections management.

Reference	Study design	Cases	Studied intervention	Methods	Endpoint	Results
Schauberger (2007) [15]	Retrospective series	273	Telephone-based nurse protocol and treatment algorithm to evaluate women with symptoms of acute cystitis	Retrospective analysis of medical records of patients evaluated and treated according to a guideline-based algorithm for symptoms of acute cystitis	To evaluate the short-term (60-d) outcomes for women with symptoms of acute cystitis evaluated and treated with a telephone-based protocol	Of the patients, 75.4% being treated without urinalysis or cultures. Over the next 60 d, 46 (16.8%) were seen or made phone contact for recurrent or persistent urinary tract symptoms, with 6 (2.2%) diagnosed with pyelonephritis. No other adverse events were identified in the 60 d after the use of the protocol
Vinson (2007) [16]	Retrospective series	4177	Telephone management of UTI	Consecutive patients treated by a regional call center of a large group-model health maintenance organization were managed over the telephone for presumed cystitis with 3–7 d of oral antimicrobial therapy	To determine the factors associated with short-term risk for UTI recurrence after telephone management of cystitis	During the 6-wk follow-up period, 644 women (15.4) were diagnosed with UTI. Two factors were independently associated with recurrence in a Cox proportional hazards model: age $\geq$70 yr ($p = 0.003$) and antimicrobial selection ($p = 0.031$). Adjusted hazard ratios in reference to trimethoprim-sulfamethoxazole showed a significant risk reduction only with cephalexin: cephalexin, 0.75; ciprofloxacin, 0.85; and nitrofurantoin, 0.95
Blozik (2011) [19]	Retrospective series	526	Use of telemedicine in females with uncomplicated UTI, with no contraindication for antibiotic therapy, if symptoms were present for <7 d and if the patient had no relevant comorbidity according to a predefined list	Consecutive UTI patients who had a teleconsultation including the prescription of an antibiotic were followed up 3 d later about symptom relief, adverse events, or the need to visit a doctor	The effectiveness and safety of telemedical management	Three days after teleconsultation: • 79% of patients reported complete symptom relief • 92% reported a reduction of UTI symptoms • 5% percent reported deterioration (eg, due to an increase in pain, flank pain, or fever) • 4% reported side effects of the prescribed antibiotics In the 3 d following teleconsultation: • 4% of women consulted another health care provider without further contacting the telemedicine center • 8% of patients were referred to face-to-face consultation due to additional symptoms or bacterial resistance
Mehrotra (2013) [21]	Retrospective comparative	99	E-visits	We studied all e-visits and office visits at 4 primary care practices	To compare the care at e-visits and office visits for two conditions: sinusitis and UTI	Physicians were less likely to order a UTI-relevant test at an e-visit (8% e-visits vs 51% office visits; $p < 0.01$)
		2855	Office visits			Physicians were more likely to prescribe an antibiotic at an e-visit (99% vs 49%, $p < 0.001$)
						There was no difference in the number of patients having a follow-up visit (7% in both groups, $p = 0.98$)
						During e-visits, physicians were less likely to order preventive care (0% vs 7%, $p = 0.02$)
Rastogi (2020) [53]	Cross-sectional observational study	20 600	Utilization of telemedicine in patients seeking care for UTI	Recording general data and prescriptions in patients seeking care for or diagnosed with UTI via telemedicine	To describe the management of UTI in a large nationwide telemedicine platform	Of UTI patients, 94% received an antibiotic, 56% got nitrofurantoin, 29% got trimethoprim-sulfamethoxazole, and 10% got a quinolone. Receipt of an antibiotic was associated with higher satisfaction with care ($p < 0.001$). Antibiotic type varied by physician region. Of the 6% of the study population defined as high risk, 69% received an antibiotic: 72% men, 91% of women over 65 yr, and 21% of patients diagnosed with pyelonephritis

UTI = urinary tract infection.

Table 7 – Clinical studies evaluating applications of telehealth in the other urological conditions.

Reference	Study design	Disease	Cases	Studied intervention	Methods	Endpoint	Results
General urology							
Chu (2015) [24]	Retrospective	General urology	97	Urology telemedicine clinic	Retrospective chart review examining care delivered through urology telemedicine clinics over 6 mo. We examined the urological conditions, patient satisfaction, and emergency department visits within 30 d of the visit. We estimated patient benefit by calculating travel distance and time, and the saved travel-associated costs using Google Maps and US Census income data	To report the use of telemedicine to deliver general urological care to remote locations within the Veterans Affairs Greater Los Angeles Healthcare System	The most common conditions were lower urinary tract symptoms (35%), elevated PSA level (15%), and prostate cancer (14%). One patient was seen in the emergency department within 30 d with an unpreventable urological complaint. Patient satisfaction was "very good" to "excellent" in 95% of cases, and 97% would refer another patient to the urology telemedicine clinic. Patients saved an average of 277 travel miles, 290 min of travel time, $67 in travel expenses, and $126 in lost opportunity cost
Sherwood (2018) [41]	Retrospective	General urology	376	Telemedicine visits of male prisoners	Telemedicine visit care conducted by a urological advanced practice provider, performed using both teleconferencing (ie, phone only) and videoconferencing	To assess whether telemedicine urological care can improve access in underserved population without compromising safety or effectiveness	The most common diagnosis was voiding dysfunction (24%), followed by genitourinary pain (23%). Diagnoses were concordant in 90% of patients; compliance was high (radiology 91%, medications 89%); in-person visits were estimated to be saved in 80–94% of cases. No men required peri-telemedicine ED visits, and no cases of malignancy were missed in the population that returned for an in-person visit. We estimated that >50% of urological complaints in this cohort could have been managed with telemedicine alone
					In most cases, a primary care provider at the prison has been available to perform a basic physical examination before or during the TM visit as requested by the urology app. A staff urologist is also immediately available on call		
					Effectiveness of telemedicine visits was assessed by (1) concordance of telemedicine visits and in-person diagnoses, (2) compliance with radiological and medication orders, and (3) in-person visits saved with telemedicine. Safety was assessed by analyzing the number of patients in which an ED visit was required after a telemedicine visit and missed or delayed cases of malignancy. Estimates were then made of the number of patients who could be managed safely with telemedicine alone		

Table 7 (*Continued*)

Reference	Study design	Disease	Cases	Studied intervention	Methods	Endpoint	Results
Lower urinary tract symptoms							
Park (2006) [14]	Prospective	Benign prostatic hyperplasia	Not reported	Development of an algorithm named Personal BPH Control Program to monitor symptoms and adjust follow-up schedule	IPSS and average flow rate as the variable elements		Patients' condition good (IPSS decrease, compared with the baseline and average flow rate increase >2 ml/s): visit the hospital every 3 mo
							Patients' condition was a warning (IPSS increase >3 points and average flow rate decrease >2 ml/s): visit the hospital every 2 mo
							Patients' condition urgent (IPSS increase >4 points and average flow rate decrease >3 ml/s)
Krhut (2016) [29]	Prospective	Overactive bladder syndrome	29	Overactive bladder symptoms were recorded over 3 d using both an electronic micturition chart and the standard paper micturition chart	Compilation of both electronic and traditional paper micturition chart. The schedule determining which recording method should be used first was assigned based on randomization	To compare a novel wireless phone and web-based technology to record and store overactive bladder symptoms to traditional micturition chart in terms of efficacy, adherence, and patient preference	Of the total number of 29 patients enrolled in the study, 24 completed the full 3-d trial using paper and 27 electronic micturition charts
					The correlation between the frequency and severity of overactive bladder syndrome symptoms, recorded using both recording methods, and patients' quality of life was evaluated using the QoL Due to Urinary Symptoms and Patient Perception of Bladder Condition scales		
					The efficacy of recording OAB symptoms with each method was analyzed and compared		Paper and electronic micturition charts were preferred by 50% of the patients in each case. Using paper micturition charts, 21% of patients forgot to record at least one episode of urgency (vs 17% using the electronic one) and 17% forgot to record at least one micturition (vs 8% using the electronic one)
					After the study, each patient had a one-on-one interview with a specialized research nurse to assess the content validity of electronic charts and their preference for one of the two methods of recording, and to disclose the number of events they forgot to or could not record		A statistically significant correlation was found between lower severity of overactive bladder syndrome symptoms and higher quality of life using both recording methods

Table 7 (*Continued*)

Reference	Study design	Disease	Cases	Studied intervention	Methods	Endpoint	Results
Sexual dysfunction							
Leusink (2006) [13]	Prospective series	Erectile dysfunction	219	Men suffering from erectile dysfunction who visited the website www.erectie.info and received consultation through the Internet	E-consultation through a website. After the consultation, drug therapy, sex therapy, or psychotherapy can be administered, providing specialist contact information. The patient receives information through e-mail on how to use his chosen medication and is requested to present a letter to his family doctor. The group of patients was sent an e-mail inviting them to complete an electronic questionnaire	To estimate whether e-consultation improves erectile function effectively and what are the characteristics and motives of the men who suffer from erectile dysfunction and who use e-consultation	The e-consultation group showed significant improvement in the IIEF-5 score compared with their baseline score. Eighty-one percent replied in the affirmative to the global assessment question. E-consultation is likely to be effective when treating erectile dysfunction, especially among men who find the medium convenient and for those who experience much embarrassment
						IIEF-5 and a global assessment question ("Have your erections become better as a result of the treatment on www.erectie.info?") were used to assess efficacy	
Van Lankveld (2009) [18]	Randomized controlled trial	Erectile dysfunction or premature ejaculation	52	Internet-based therapy	Internet-based psychosexual therapy administered to heterosexual men with erectile dysfunction or premature ejaculation, without face-to-face contact. Nonpharmacological therapies were delivered. As a control, the performance of the patients in the waiting list receiving no treatments was recorded	To test whether Internet-based sex therapy is superior to the waiting list	Sexual function was much or somewhat improved in 40 participants (48%). In participants with erectile dysfunction, a near significant effect of treatment was found ($p = 0.065$), with higher levels of sexual desire ($p < 0.05$) and sexual self-confidence ($p = 0.05$) in treated men, in addition to improved erectile functioning ($p = 0.01$) and overall sexual satisfaction ($p < 0.001$)
			46	Waiting list		The IIEF, IIEF-SD, IIEF-OS, GRISS, GRISS-PE, GEQ, and SEAR-CONF questionnaires were used to assess the efficacy	After treatment termination, in participants with erectile dysfunction, erectile functioning ($p < 0.05$) and overall sexual satisfaction ($p = 0.002$) improved significantly. In participants with premature ejaculation, latency to ejaculation ($p < 0.001$), sexual desire ($p < 0.05$), and overall sexual satisfaction ($p < 0.05$) improved significantly from baseline to after treatment. Sexual self-confidence in men with premature ejaculation remained unchanged during treatment until follow-up at 3 mo after treatment and then was found to be improved at 6-mo follow-up ($p < 0.05$)

BPH = benign prostatic hyperplasia; ED = emergency department; IIEF = International Index of Erectile Function; IIEF-SD = International Index of Erectile Function sexual desire; IIEF-OS = International Index of Erectile Function overall sexual satisfaction; IPSS = International Prostate Symptom Score; GEQ = Global End-point Question; GRISS = Golombok Rust Inventory of Sexual Satisfaction; GRISS-PE = Golombok Rust Inventory of Sexual Satisfaction—Premature Ejaculation; OAB = overactive bladder; PSA = prostate-specific antigen; QoL = quality of life; SEAR-CONF = confidence subscale of the Self-Esteem and Relationship; TM = telemedicine.

needing different follow-up schedules. In another study, Krhut et al [29] compared the efficacy of 3-d electronic and standard paper micturition charts in 29 patients with symptoms of overactive bladder syndrome. The preference of the patients was equally divided between the two tools, and also the number of either micturition or episode of urgency that patients forgot to record was similar.

3.7.3. Sexual dysfunction

In their study, van Lankveld et al [18] reported an RCT evaluating the efficacy of Internet-based psychosexual therapy administered to heterosexual men with erectile dysfunction or premature ejaculation, without face-to-face contact. Nonpharmacological therapies were delivered. As a control, the performance of the patients in the waiting list receiving no treatments was recorded. Sexual function was much or somewhat improved in 40 participants (48%), with the highest benefit being present in patients with erectile dysfunction. Specifically, higher levels of sexual desire ($p < 0.05$) and sexual self-confidence ($p = 0.05$), and improved erectile functioning ($p = 0.01$) and overall sexual satisfaction ($p < 0.001$) were shown in the treated men. In patients with premature ejaculation, the treatment was ineffective. After treatment termination, erectile functioning ($p < 0.05$) and overall sexual satisfaction ($p = 0.002$) improved significantly in participants with erectile dysfunction [18].

These data seem to indicate that a general urology clinic for male with lower urinary tract symptoms and/or sexual dysfunction could be implemented safely and effectively.

3.8. Discussion

COVID-19 pandemic is significantly modifying the health systems worldwide, with substantial implications also on the medical disciplines not primarily involved in the management of COVID-19 patients. Specifically, the need to comply with quarantine strategies to reduce virus diffusion and protect both patients and physicians has raised novel interest in telehealth interventions, which could allow performing many clinical activities safely and effectively. Our systematic review identified a discrete number of specific papers mainly analyzing various aspects of the management of PCa and UI, which are two of the most prevalent conditions. Moreover, the methodological quality of the reports was also good, including 12 reports from 11 RCTs [12,17,18,22,25–27,33,34,38,44,48] and a large number of prospective studies.

The data of the available literature seem to indicate that telehealth has been implemented successfully in several common clinical scenarios, including the decision-making process following the diagnosis of nonmetastatic PCa, follow-up care of patients with localized PCa who received curative treatments, initial diagnosis of hematuria, diagnosis and follow-up care of uncomplicated urinary stones and uncomplicated UTIs, initial evaluation of patients with UI, administration of both behavioral therapies and PFMT, and follow-up care after surgical treatments of SUI or pelvic organ prolapse. In parallel, considering all the other urological conditions and settings that have not been studied extensively at the moment, it could also be hypothesized, for example, that the majority of follow-up care consultations in which radiological examinations had high relevance could be performed similarly via telemedicine. For example, this could apply to patients who received either radical or partial nephrectomy or ablative therapies for renal cancers, or patients who received retroperitoneal lymph node dissection for testicular cancer. The same could also apply to patients treated for urinary stone and, more limitedly, lower urinary tract symptoms due to BPH or sexual dysfunction. However, if we consider the available recommendations for urological practice during the pandemic, the vast majority of the patients whom we should prioritize fall outside of the clinical settings that have been assessed more frequently in the available studies on telehealth [1–3,54]. However, considering that the present COVID-19 emergency will likely last for months, telehealth could be the safest way to deliver urological care for a large percentage of the patients, such as those who are more at risk of unfavorable outcomes of COVID-19. Although urology embraces all ages of life virtually, the vast majority of our patients are older adults, often with significant comorbidity. Male gender, age, and comorbidities are conditions that have been associated with increased risk for a severe outcome of COVID-19 [6], and consequently, these are the patients who could benefit most from telehealth. Moreover, the resources needed to implement such interventions could likely be of benefit also after the end of the emergency to provide more convenient delivery of health care and, potentially, reduction of health care costs. In this regard, the urological literature is not unanimous. However, the vast majority of the reports evaluating costs demonstrated advantages for telehealth [24,26,43], whereas a single RCT reported a minimal difference (£38.04) in favor of standard care [38]. Moreover, it should also be considered that telehealth can limit patients' traveling, also causing a significant reduction in the emission of carbon dioxide and other atmospheric pollutants. That has been hypothesized in a single study included in the present systematic review [46]. However, significant reductions in the emissions of greenhouse gas, nitric oxide, and sulfur dioxide have been demonstrated in other nonurological studies [55,56].

The present study is important because it highlights the potential utility of telehealth interventions. It identifies which clinical scenarios could be managed safely and effectively by telehealth interventions according to the available literature in the present pandemic and, also, hereafter, due to the possible advantages of such approach in terms of cost and time saving, and pollution prevention. Moreover, it highlights which conditions and clinical settings should be better evaluated and studied (eg, diagnosis and follow-up care of patients with bladder, kidney, or testicular cancers) as well as the kind of long-term and health-economic analyses that are needed.

The present study is not devoid of limitations. First, although the present systematic review followed a strict methodology, and the available papers were of good

methodological quality, the vast majority of the publications were in the field of PCa and UI management. More extensive evaluation of other urological malignancies and other highly prevalent benign conditions, such as male lower urinary symptoms due to BPH, overactive bladder syndromes, and sexual dysfunction, are needed. Second, although most of the studies demonstrated high satisfaction in very selected patients, the selection criteria (outside availability of electronic devices, which are now extremely popular) are not so well defined in the real practice. For example, all the patients who require a physical examination are not ideal candidates for telehealth. However, technology already provides examination kit and apps that allow patients or caregivers to perform guided medical examinations with a health care provider (eg, Tyto from TytoCare, Netanya, Israel). Although, at present, those tools do not respond very well to the urological needs, future improvements could warrant great usability for such apps also in the urological field. Third, long-term data on the efficacy and safety of the urological applications of telehealth are needed because the vast majority of the available papers evaluated the analyzed telehealth interventions at short-term follow-up. Four, more robust health-economic assessments are needed to understand the economic implications of telehealth applications. The implementation of telehealth may require significant investments of resources for health care providers. However, the costs for the institutions and national health systems could be counterbalanced by the increasing number of potential customers as well as by the lower costs sustained by patients. Five, minimal data are available on telesurgery and telementoring for urological procedures [10]. The surgical literature is indeed larger, and some applications of telementoring and telesurgery have been reported [57], including, very recently, even 5G telerobotic spinal surgery [58]. Likely, we will witness a similar development also for the urological surgical procedures. Six, telehealth is strongly dependent on the technological proficiency of patients. As urologists often treat elderly patients, this could be a significant barrier to the adoption of telemedicine for some patients. Finally, the clinical and regulatory framework for the implementation of telehealth has not been reported, and several legal, privacy, and billing issues are evident. These are likely to be different among institutions, health systems, and countries. This can affect the abilities of some institutions to embrace such a revolution.

4. Conclusions

According to the available urological literature, telehealth can be implemented successfully in the management of some patients with PCa, UI, pelvic organ prolapse, uncomplicated urinary stones, and uncomplicated UTIs. Many more urological conditions are suitable for telehealth, but more studies are needed on other highly prevalent urological malignant and benign conditions. Likely, the COVID-19 pandemic will give a significant boost to the use of telemedicine in the immediate future. However, more robust data on long-term efficacy and safety, and above all, health economics are necessary.

Author contributions: Giacomo Novara had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Novara, Ficarra, Simonato, Liguori, Porpiglia, Bartoletti, Trombetta.
Acquisition of data: Abrate, Checcucci, Crestani, Esperto, Novara, Pavan.
Analysis and interpretation of data: All authors.
Drafting of the manuscript: Novara.
Critical revision of the manuscript for important intellectual content: Checcucci, Crestani, Abrate, Esperto, Pavan, De Nunzio, Galfano, Giannarini, Gregori, Liguori, Bartoletti, Porpiglia, Scarpa, Simonato, Trombetta, Tubaro, Ficarra.
Statistical analysis: None.
Obtaining funding: None.
Administrative, technical, or material support: None.
Supervision: None.
Other: None.

Financial disclosures: Giacomo Novara certifies that all conflicts of interest, including specific financial interests and relationships and affiliations relevant to the subject matter or materials discussed in the manuscript (eg, employment/affiliation, grants or funding, consultancies, honoraria, stock ownership or options, expert testimony, royalties, or patents filed, received, or pending), are the following: None.

Funding/Support and role of the sponsor: None.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.eururo.2020.06.025.

References

[1] Ficarra V, Novara G, Abrate A, et al. Urology practice during COVID-19 pandemic. Minerva Urol Nefrol. In press. https://doi.org/10.23736/S0393-2249.20.03846-1.
[2] Simonato A, Giannarini G, Abrate A, et al. Pathways for urology patients during the COVID-19 pandemic. Minerva Urol Nefrol. In press. https://doi.org/10.23736/S0393-2249.20.03861-8.
[3] Ribal MJ, Cornford P, Briganti A, et al. EAU Guidelines Office Rapid Reaction Group: an organisation-wide collaborative effort to adapt the EAU guidelines recommendations to the COVID-19 era. Eur Urol 2020;78(1):21–7.
[4] Center for Connected Health Policy. What is telehealth? https://www.cchpca.org/about/about-telehealth.
[5] Dorsey ER, Topol EJ. State of telehealth. N Engl J Med 2016;375:154–61.
[6] Boehm K ZS, Brandt MP, Sparwasser P, et al. Telemedicine online visits in urology during COVID-19 pandemic—potential, risk factors & patients' perspective. Eur Urol. In press. https://doi.org/10.1016/j.eururo.2020.04.055.
[7] National Toxicology Program/Office of Health Assessment and Translation (NTP/OHAT). Risk of bias rating tool for human and animal studies.

[8] Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Ann Intern Med 2009;151, 264–9, W64.
[9] Hayes WS, Tohme WG, Komo D, et al. A telemedicine consultative service for the evaluation of patients with urolithiasis. Urology 1998;51:39–43.
[10] Rodrigues Netto Jr N, Mitre AI, Lima SV, et al. Telementoring between Brazil and the United States: initial experience. J Endourol 2003;17:217–20.
[11] Johnston 3rd WK, Patel BN, Low RK, Das S. Wireless teleradiology for renal colic and renal trauma. J Endourol 2005;19:32–6.
[12] Hui E, Lee PS, Woo J. Management of urinary incontinence in older women using video conferencing versus conventional management: a randomized controlled trial. J Telemed Telecare 2006;12:343–7.
[13] Leusink PM, Aarts E. Treating erectile dysfunction through electronic consultation: a pilot study. J Sex Marital Ther 2006;32:401–7.
[14] Park MS, Ha YS, Lee KM, Kim WJ, Lee HL. The distant management system of BPH patients using the tele-communications. Korean J Urol 2006;47:489–92.
[15] Schauberger CW, Merkitch KW, Prell AM. Acute cystitis in women: experience with a telephone-based algorithm. WMJ 2007;106: 326–9.
[16] Vinson D, Quesenberry Jr . Telephone management of presumed cystitis in women: factors associated with recurrence. J Clin Outcomes 2007;14:41–6.
[17] Parsons JK, Newman V, Mohler JL, et al. The Men's Eating and Living (MEAL) study: a cancer and leukemia group B pilot trial of dietary intervention for the treatment of prostate cancer. Urology 2008;72:633–7.
[18] van Lankveld JJ, Leusink P, van Diest S, Gijs L, Slob AK. Internet-based brief sex therapy for heterosexual men with sexual dysfunctions: a randomized controlled pilot trial. J Sex Med 2009;6: 2224–36.
[19] Blozik E, Sommer-Meyer C, Cerezo M, von Overbeck J. Effectiveness and safety of telemedical management in uncomplicated urinary tract infections. J Telemed Telecare 2011;17:78–82.
[20] Leahy M, Krishnasamy M, Herschtal A, et al. Satisfaction with nurse-led telephone follow up for low to intermediate risk prostate cancer patients treated with radical radiotherapy. A comparative study. Eur J Oncol Nurs 2013;17:162–9.
[21] Mehrotra A, Paone S, Martich GD, Albert SM, Shevchik GJ. A comparison of care at e-visits and physician office visits for sinusitis and urinary tract infection. JAMA Intern Med 2013;173:72–4.
[22] Sjostrom M, Umefjord G, Stenlund H, Carlbring P, Andersson G, Samuelsson E. Internet-based treatment of stress urinary incontinence: a randomised controlled study with focus on pelvic floor muscle training. BJU Int 2013;112:362–72.
[23] Yu P, Hailey D, Fleming R, Traynor V. An exploration of the effects of introducing a telemonitoring system for continence assessment in a nursing home. J Clin Nurs 2014;23:3069–76.
[24] Chu S, Boxer R, Madison P, et al. Veterans affairs telemedicine: bringing urologic care to remote clinics. Urology 2015;86:255–60.
[25] Carrion Perez F, Rodriguez Moreno MS, Carnerero Cordoba L, Romero Garrido MC, Quintana Tirado L, Garcia Montes I. Telerehabilitation to treat stress urinary incontinence. Pilot study. Med Clin (Barc) 2015;144:445–8.
[26] Viers BR, Lightner DJ, Rivera ME, et al. Efficiency, satisfaction, and costs for remote video visits following radical prostatectomy: a randomized controlled trial. Eur Urol 2015;68:729–35.
[27] Sjostrom M, Umefjord G, Stenlund H, Carlbring P, Andersson G, Samuelsson E. Internet-based treatment of stress urinary incontinence: 1- and 2-year results of a randomized controlled trial with a focus on pelvic floor muscle training. BJU Int 2015;116:955–64.
[28] Jefferis H, Muriithi F, White B, Price N, Jackson S. Telephone follow-up after day case tension-free vaginal tape insertion. Int Urogynecol J 2016;27:787–90.
[29] Krhut J, Gartner M, Zvarova K, Desarno M, Zvara P. Validating of a novel method for electronically recording overactive bladder symptoms in men. Low Urin Tract Symptoms 2016;8:177–81.
[30] Paterson C, Jones M, Rattray J, Lauder W, Nabi G. What is the mechanism effect that links social support to coping and psychological outcome within individuals affected by prostate cancer? Real time data collection using mobile technology. Eur J Oncol Nurs 2016;21:126–33.
[31] Safir IJ, Gabale S, David SA, et al. Implementation of a tele-urology program for outpatient hematuria referrals: initial results and patient satisfaction. Urology 2016;97:33–9.
[32] Schimpf MO, Fenner DE, Smith TM, Tucker J, Berger MB. Patient satisfaction with nurse-led telephone follow-up in an ambulatory setting. Female Pelvic Med Reconstr Surg 2016;22:430–2.
[33] Asklund I, Nystrom E, Sjostrom M, Umefjord G, Stenlund H, Samuelsson E. Mobile app for treatment of stress urinary incontinence: a randomized controlled trial. Neurourol Urodyn 2017;36: 1369–76.
[34] Chambers SK, Occhipinti S, Foley E, et al. Mindfulness-based cognitive therapy in advanced prostate cancer: a randomized controlled trial. J Clin Oncol 2017;35:291–7.
[35] Galsky MD, Shahin M, Jia R, et al. Telemedicine-enabled clinical trial of metformin in patients with prostate cancer. JCO Clin Cancer Inform 2017;1:1–10.
[36] Hoffman V, Soderstrom L, Samuelsson E. Self-management of stress urinary incontinence via a mobile app: two-year follow-up of a randomized controlled trial. Acta Obstet Gynecol Scand 2017;96:1180–7.
[37] Lange L, Fink J, Bleich C, Graefen M, Schulz H. Effectiveness, acceptance and satisfaction of guided chat groups in psychosocial aftercare for outpatients with prostate cancer after prostatectomy. Internet Interv 2017;9:57–64.
[38] Jones G, Brennan V, Jacques R, Wood H, Dixon S, Radley S. Evaluating the impact of a 'virtual clinic' on patient experience, personal and provider costs of care in urinary incontinence: a randomised controlled trial. PLoS One 2018;13:e0189174.
[39] Schaffert R, Dahinden U, Hess T, et al. Evaluation of a prostate cancer ehealth tutorial: development and testing of the website prostata-information.ch. Urologe A 2018;57:164–71.
[40] Sener TE, Buttice S, Sahin B, et al. WhatsApp use in the evaluation of hematuria. Int J Med Inform 2018;111:17–23.
[41] Sherwood BG, Han Y, Nepple KG, Erickson BA. Evaluating the effectiveness, efficiency and safety of telemedicine for urological care in the male prisoner population. Urol Pract 2018;5:44–51.
[42] Trinh L, Arbour-Nicitopoulos KP, Sabiston CM, et al. RiseTx: testing the feasibility of a web application for reducing sedentary behavior among prostate cancer survivors receiving androgen deprivation therapy. Int J Behav Nutr Phys Act 2018;15:49.
[43] Zholudev V, Safir IJ, Painter MN, Petros JA, Filson CP, Issa MM. Comparative cost analysis: teleurology vs conventional face-to-face clinics. Urology 2018;113:40–4.
[44] Aydogdu O, Sen V, Yarimoglu S, Aydogdu C, Bozkurt IH, Yonguc T. The effect of additional telerounding on postoperative outcomes, patient and surgeon satisfaction rates in the patients who underwent percutaneous nephrolithotomy. Arch Esp Urol 2019;72: 69–74.
[45] Belarmino A, Walsh R, Alshak M, Patel N, Wu R, Hu JC. Feasibility of a mobile health application to monitor recovery and patient-reported outcomes after robot-assisted radical prostatectomy. Eur Urol Oncol 2019;2:425–8.

[46] Connor MJ, Miah S, Edison MA, et al. Clinical, fiscal and environmental benefits of a specialist-led virtual ureteric colic clinic: a prospective study. BJU Int 2019;124:1034–9.
[47] Gasparini ME, Chang TW, St Lezin M, Skerry JE, Chan A, Ramaswamy KA. Feasibility of a telemedicine-administered, pharmacist-staffed, protocol-driven, multicenter program for kidney stone prevention in a large integrated health care system: results of a pilot program. Perm J 2019;23, 19.023.
[48] Lee BJ, Park YH, Lee JY, Kim SJ, Jang Y, Lee JI. Smartphone application versus pedometer to promote physical activity in prostate cancer patients. Telemed J E Health 2019;25:1231–6.
[49] Lee DD, Arya LA, Andy UU, Sammel MD, Harvie HS. Willingness of women with pelvic floor disorders to use mobile technology to communicate with their health care providers. Female Pelvic Med Reconstr Surg 2019;25:134–8.
[50] Balzarro M, Rubilotta E, Trabacchin N, et al. A prospective comparative study of the feasibility and reliability of telephone follow-up in female urology: the Patient Home Office Novel Evaluation (PHONE) study. Urology 2020;136:82–7.
[51] Davis NJ, Clark 2nd PC, Johnson TM, Wyman JF. Feasibility of TelePrompt: a tablet-based prompted voiding intervention to support informal caregivers of older adults with urinary incontinence. Geriatr Nurs 2020, S0197-4572(20)30002-1.
[52] Goode PS, Markland AD, Echt KV, et al. A mobile telehealth program for behavioral treatment of urinary incontinence in women veterans: Development and pilot evaluation of MyHealtheBladder. Neurourol Urodyn 2020;39:432–9.
[53] Rastogi R, Martinez KA, Gupta N, Rood M, Rothberg MB. Management of urinary tract infections in direct to consumer telemedicine. J Gen Intern Med 2020;35:643–8.
[54] Stensland KD, Morgan TM, Moinzadeh A, et al. Considerations in the triage of urologic surgeries during the COVID-19 pandemic. Eur Urol 2020;77:663–6.
[55] Whetten J, Montoya J, Yonas H. ACCESS to better health and clear skies: telemedicine and greenhouse gas reduction. Telemed J E Health 2019;25:960–5.
[56] Vidal-Alaball J, Franch-Parella J, Lopez Seguí F, Garcia Cuyàs F, Mendioroz Peña J. Impact of a telemedicine program on the reduction in the emission of atmospheric pollutants and journeys by road. Int J Environ Res Public Health 2019;16:4366.
[57] Evans CR, Medina MG, Dwyer AM. Telemedicine and telerobotics: from science fiction to reality. Updates Surg 2018;70:357–62.
[58] Tian W, Fan M, Zeng C, Liu Y, He D, Zhang Q. Telerobotic spinal surgery based on 5G network: the first 12 cases. Neurospine 2020;17:114–20.