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Implementation of a Ureteric Colic Telemedicine Service: A Mixed Methods Quality Improvement Study



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OBJECTIVE	To assess the effectiveness of a telemedicine service for ureteric colic patients in reducing the number of unnecessary face-to-face consultations and shortening waiting time for appointments.
METHODS	A telemedicine workflow was implemented as a quality improvement study using the Plan-Do-Study-Act method. All patients presenting with ureteric colic without high-risk features of fever, severe pain, and hydronephrosis, were recruited, and face-to-face appointments to review scan results were replaced with phone consultations. Data were prospectively collected over 3 years (January 2017 to December 2019). Patient outcomes including the reduction in face-to-face review visits, time to review, reattendance and intervention rates, were tracked in an interrupted time-series analysis, and qualitative feedback was obtained from patients and clinicians.
RESULTS	Around 53.2% of patients presenting with ureteric colic were recruited into the telemedicine workflow. A total of 465 patients (46.2%) had normal scan results and 250 patients (24.9%) did not attend their scan appointments, hence reducing the number of face-to-face consultations by 71.1%. A total of 230 patients (22.9%) required subsequent follow-up with urology, while 61 patients (6.1%) were referred to other specialties. Mean (SD) time to review was 30.0 (6.2) days, 6-month intervention rate was 3.4% ($n = 34$) and unplanned reattendance rate was 3.2% ($n = 32$). Around 93.1% of patients reported satisfaction with the service.
CONCLUSION	The ureteric colic telemedicine service successfully and sustainably reduced the number of face-to-face consultations and time to review without compromising on patient safety. The availability of this telemedicine service has become even more important in helping us provide care to patients with ureteric colic in the current COVID-19 pandemic. UROLOGY 147: 14–20, 2021. © 2020 Elsevier Inc.

Ureteric colic is one of the most common presenting complaints to medical units, occurring in 7% to 13% of people¹. While there have been countless efforts to fast-track the diagnostic process for patients presenting to the emergency department (ED),^{1,2} there is a lack of research into streamlining processes when these patients are seen in outpatient urology clinics. There has been a healthcare trend toward specialist services and a subsequent increase in demand for urology clinic appointments resulting in longer waiting times, hence we sought to explore new strategies to reduce the number of unnecessary outpatient urology consultations.³

Telemedicine, defined as the “provision of healthcare services over physically separate environments via information and communications technology,” has played an increasingly significant role in recent years as the healthcare landscape evolves.^{4,5} There have been reported successes of phone clinics in the follow-up of postsurgery and postcancer treatment patients.^{6,7} More recent studies have also explored the use of video consultations in urology clinics for hematuria referrals, as well as follow-up visits for various diagnoses including benign prostatic hyperplasia, nephrolithiasis, and urinary tract infections, with high levels of acceptance and satisfaction.⁸⁻¹⁰ Hence, we adopted a similar strategy of replacing face-to-face visits with telephone consultations in our clinical practice.

The objective of this quality improvement study was to implement a telemedicine service for ureteric colic patients to reduce the need for face-to-face review consultations, which would decrease waiting time for appointments and allow better allocation of our clinic resources to other patients.

Declaration of competing interest: The authors declare no competing interests in the conduct of this study.

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MATERIALS AND METHODS

This quality improvement study was reported using the SQUIRE (Standards for Quality Improvement Reporting Excellence) V2.0 guidelines.¹¹

Context

This was a single-center quality improvement study implemented after 2 successful pilot periods in the National University Hospital (NUH), a tertiary hospital in Singapore with 1239 beds. In NUH, cases of suspected ureteric colic seen at the emergency department that do not require admission or urgent intervention are discharged with analgesia and an outpatient urology appointment within one week. At clinic review, a noncontrast computed tomography of the kidneys, ureters, and bladders (CT KUB), which is the current gold standard investigation for urolithiasis, will be arranged with a follow-up appointment after.¹² Point-of-care ultrasound is routinely used at the emergency department and urology clinic to detect hydronephrosis, which guides disposition and earlier interventions.

Data sampling of our clinic attendance was performed for the prior 6 months from July to December 2015. It was found that although 28% to 46% of the appointments were for ureteric colic, most patients did not eventually require intervention. Around 26% to 34% of these patients defaulted their follow-up appointments due to symptom resolution, while 36% to 40% were discharged on subsequent appointments for insignificant CT KUB findings. Further analysis also revealed a delay in diagnosis and subsequent intervention in those that required treatment due to the 8- to 12-week waiting time for nonurgent follow-up consultations. Thus, there was a need to streamline our processes to improve the allocation of limited clinic resources.

With the implementation of this telemedicine service, we aimed to reduce the number of face-to-face review appointments for patients with ureteric colic by 25%, and shorten the time interval between presentation and follow-up visit after definitive diagnosis to 4 weeks.

Intervention

Two pilot periods of 2 weeks each were conducted in February and May 2016. All doctors and clinic staff involved were briefed on the protocol. In order to standardize processes, a copy of the workflow was printed and placed in each consultation room. Recruited patients were handed an information sheet regarding the objectives, advice on what to expect, and a contact number should any issues arise (*Appendix A*). The Plan-Do-Study-Act cycle, a commonly-used 4-stage iterative model for continuous improvement,¹³ was chosen to guide our evaluation at multiple time points before and after the intervention. Feedback was also regularly sought from the quality improvement team — comprising of urologists, nurse clinicians, senior patient service associates, and operations managers — to identify issues with clinical workflow.

Following the 2 pilot periods, the new telemedicine workflow was fully incorporated from January 2017. All patients presenting with ureteric colic to our clinics were offered participation. Patients with high-risk features of fever (>38°C), severe pain not adequately controlled with simple analgesia, and hydronephrosis on point-of-care ultrasonography, were excluded. These exclusion criteria were carefully chosen as they are indicators of patients who are more likely to become ill or require intervention.

Patients enrolled into this new workflow had a CT KUB scheduled at the third week and were contacted in the fourth week for a phone review. This telephone consultation review clinic was conducted weekly by a senior resident, who will review the electronic medical records (EMRs) and CT results prior to calling the patients. Patients with normal scan findings were discharged, whereas those with clinically significant stones were given face-to-face appointments to discuss further management. In cases of nonurological findings, referrals were made to the appropriate disciplines. Patients who did not attend the CT KUB were contacted to ensure that they were asymptomatic, with scan appointments rescheduled if needed. Patients who remained uncontactable despite multiple attempts were sent a “no-show” letter (*Appendix B*). Outcomes of the phone consultation review were documented in the patient’s EMR. The final workflow is illustrated in *Figure 1*.

Measures and Analysis

A mixed methods design was employed to evaluate the impact of our intervention. We prospectively collected quantitative data to demonstrate an objective reduction in the number of face-to-face visits, and qualitative data to provide important insights into the effect of this change.

Quantitative. A quasi-experimental, interrupted time series analysis was carried out to measure the impact of our intervention on the number of face-to-face visits and time to review. Each patient was followed up for 6 months to determine the rate of intervention and unplanned reattendance, defined as unscheduled clinic visits and readmissions before the planned phone consultation. Data were continually tracked over 3 years to ensure sustained improvement.

Qualitative. An anonymous satisfaction survey was conducted among patients to evaluate their experience and gather feedback on the new workflow. The survey consisted of 3 questions: one “yes/no” question to evaluate if they preferred the new arrangement to a traditional face-to-face consultation, and 2 qualitative questions on the benefits accrued and suggestions for improvement.

Ethical Considerations

Patients who qualified for the telephone consultation review clinic were offered participation with informed consent, and provided a standardized information sheet (*Appendix A*). Frequent review of EMRs ensured that patients were not receiving suboptimal care as a result of the intervention. Patient satisfaction surveys were conducted according to the hospital’s policy for personal data protection. This quality improvement study was not subject to the oversight of our institution review board.

RESULTS

The first and second pilot periods took place from 1 to 12 February 2016 and 18 to 31 May 2016 respectively. Ninety-six patients attended the clinic for ureteric colic symptoms and 56 patients (58.3%) were recruited; 23 patients (41.1%) had normal CT scan findings and 15 patients (26.8%) did not attend the CT scan appointment. This represented a reduction of 67.9% of traditional face-to-face reviews. Sixteen patients (28.6%) required another urology appointment and 2 patients (3.6%) required referral to other disciplines.

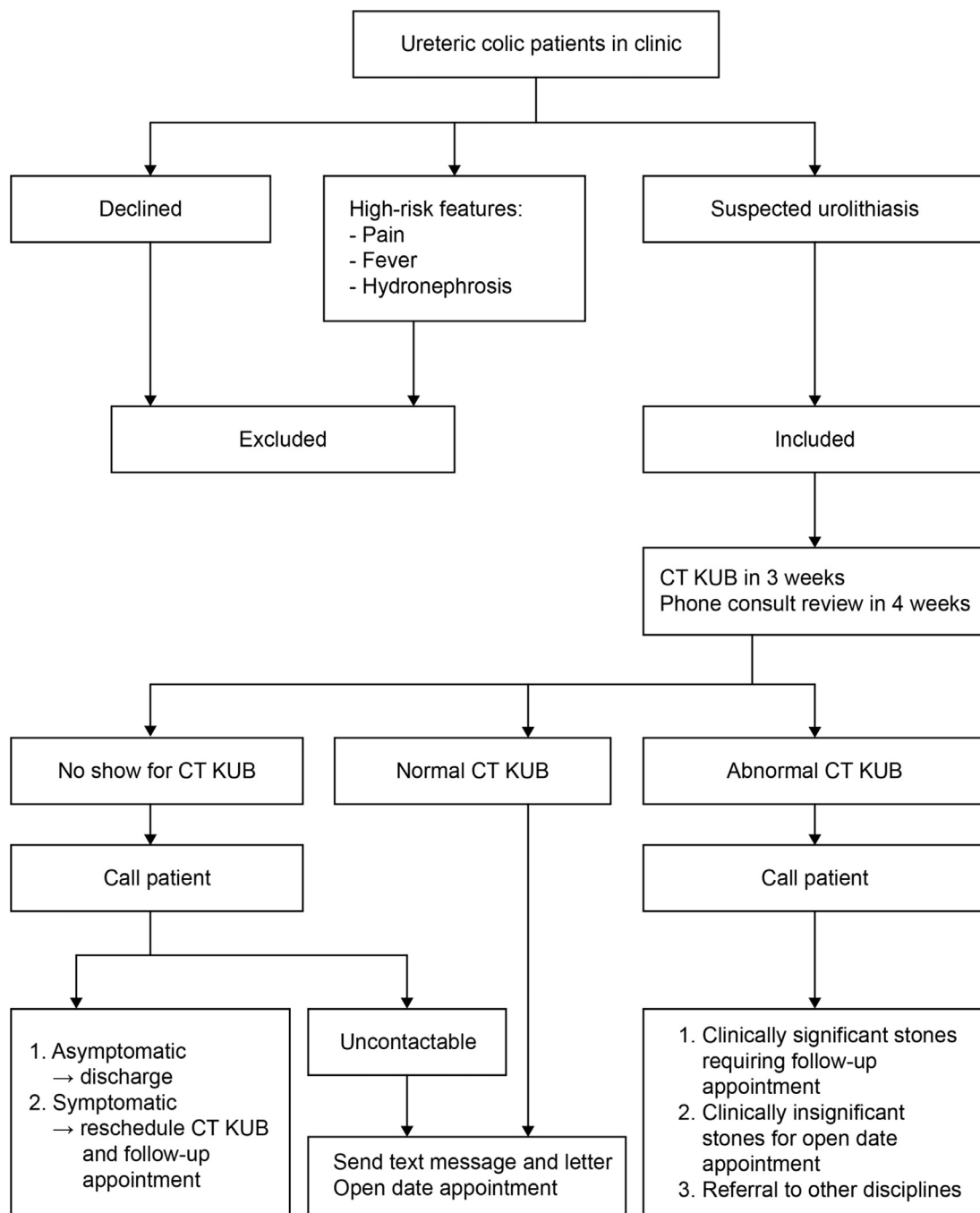


Figure 1. Workflow of telephone consultation review clinic for patients with ureteric colic.

The patient satisfaction survey conducted during the pilot periods showed that 93.1% of the 29 patients were satisfied with the new workflow and preferred this to a traditional face-to-face consultation. The most commonly cited reasons included convenience, time saved from traveling and waiting, cost savings on traveling and consultation fees, and obviating the need to take leave from work. In terms of possible improvements, patients suggested using video calls, avoiding medical jargon, giving an estimated time for calls, and a shorter time between scans and phone reviews.

After 2 successful pilot periods which far exceeded the target reduction of 25% of face-to-face consultations, this new workflow was fully incorporated from January 2017. The phone consultations occurred at a mean (SD) interval of 30.0 (6.2) days

after the initial first visit. Out of 1890 patients who presented with ureteric colic in our clinics from January 2017 to December 2019, 1006 patients (53.2%) were recruited into this telemedicine workflow. Demographic data are shown in [Table 1](#). The majority of those who were not recruited did not fulfill the inclusion criteria or were deemed unsuitable by the reviewing clinician (95.2%); only 42 patients (4.8%) declined participation. A total of 465 patients (46.2%) had normal CT KUB results and 250 patients (24.9%) did not attend their CT KUB appointments due to symptom resolution. This represented a total of 715 (71.1%) face-to-face consultations saved. 230 patients (22.9%) required subsequent follow-up with urology, while 61 patients (6.1%) required referrals to other specialties. The above results are summarized in [Table 2](#).

Table 1. Demographic data of patients recruited into study

	Mean	SD
Age	42.3	12.5
	N	%
Gender		
Male	692	68.8
Female	314	31.2
Race		
Chinese	505	50.2
Malay	162	16.1
Indian	206	20.5
Caucasian	18	1.8
Others	115	11.4

Thirty-four patients (3.4%) required intervention within 6 months of initial consultation; 19 patients underwent ureteroscopy, 13 underwent extracorporeal shockwave lithotripsy and one had cystoscopy and basket removal of bladder stone. Other than one patient who had appendicitis and underwent an emergency appendectomy, all urological interventions were performed electively. Twenty-one patients (63.6%) required procedures for ureteric stones with a mean (SD) stone size of 6.4 (1.6) mm. Mean (SD) sizes of renal stones requiring intervention was 7.7 (2.3) mm. The mean (SD) time to intervention was 74.7 (33.2) days.

The unplanned reattendance rate was 3.2% ($n = 32$). This was due to the recurrence of painful colic ($n = 27$) and miscommunication during scheduling of the teleconsultation ($n = 5$).

Over the 3 years since implementation, the favorable outcomes of this telemedicine service continue to be sustained. Monthly recruitment rates averaged between 33.3% and 80.9%, the percentage of clinic consultations saved per month was stable between 52.9% and 89.5%, and monthly average time to phone consultation review was between 26.5 and 35.8 days (Figs. 2a and 2b).

DISCUSSION

This novel telemedicine service for ureteric colic patients has successfully reduced the number of follow-up consultations by 71.1% over 3 years, far surpassing the initial goal of 25%. These outcomes were also sustainable with a low rate of 4.8% declining participation, reflecting the acceptability of this service by patients.

Benefits were enjoyed by both the hospital and patients. This intervention streamlined and better allocated our limited resources by saving an average of 238 clinic slots per year, thus decreasing the waiting time for patients who require traditional face-to-face consultations.

Not only did patients save on the cost and time spent on travel and follow-up clinic visits, but they were also able to get earlier reviews at an average of 30.3 days, a vast improvement from the 60 to 90 days previously. Our findings corroborate with a study by Zholudev *et al*, which compared the costs associated with telemedicine vs face-to-face consultations. On top of direct cost and time savings, other indirect benefits include scheduling flexibility, increasing space availability in clinics and parking areas, reducing traffic, as well as decreasing the emission of greenhouse gases.^{14,15} Smith *et al* and Connor *et al* have also previously reported the implementation of virtual stone clinics in the National Health Service, United Kingdom, and have shown benefits in reducing waiting time for first visit appointments, cost savings, and reduction of environmental impact.^{16,17}

Ureteric colic is an ideal diagnosis for phone consultation as its clinical course is relatively benign, and symptoms can be assessed and scan results communicated over the phone without the need for physical examination at a follow-up visit. Other urological conditions that could similarly benefit from telemedicine include the surveillance of renal cysts, kidney stones, and chronic management of lower urinary tract symptoms.^{18,19} On the contrary, conditions which require physical examination or complex discussions should not be conducted under a telemedicine framework. Those with sexual health-related diagnoses may also be less willing to engage in telemedicine due to privacy concerns.⁹

The diagnostic strategy we employed in managing our renal colic patients was also important in the success of this quality improvement study. In our hospital, we routinely utilize point-of-care ultrasonography in both the ambulatory and emergency settings to guide management and disposition of ureteric colic patients. Although point-of-care ultrasound is not the standard-of-care globally, it is deemed an important tool in our workflow. This is also supported by Sorensen *et al*, who demonstrated that

Table 2. Outcomes of telephone consultation review clinic for patients with ureteric colic

	Pilot Period 1 Feb 2016	Pilot Period 2 May 2016	Full Implementation			TOTAL 2017 to 2019
			2017 n (%)	2018 n (%)	2019 n (%)	
<i>Total recruited</i>	n (%) 29	n (%) 27	335	376	295	1006
Normal CT KUB	10 (34.5)	13 (48.1)	168 (50.1)	180 (47.9)	117 (39.7)	465 (46.2)
Did not attend CT KUB	9 (31.0)	6 (22.2)	89 (26.6)	78 (20.7)	83 (28.1)	250 (24.9)
Urology follow-up	8 (27.6)	8 (29.6)	66 (19.7)	93 (24.7)	71 (24.1)	230 (22.9)
Referral to other specialties	2 (6.9)	0 (0.0)	12 (3.6)	25 (6.6)	24 (8.1)	61 (6.1)
<i>Unnecessary consultations saved</i>	19 (65.5)	19 (70.4)	257 (76.7)	258 (68.6)	200 (67.8)	715 (71.1)

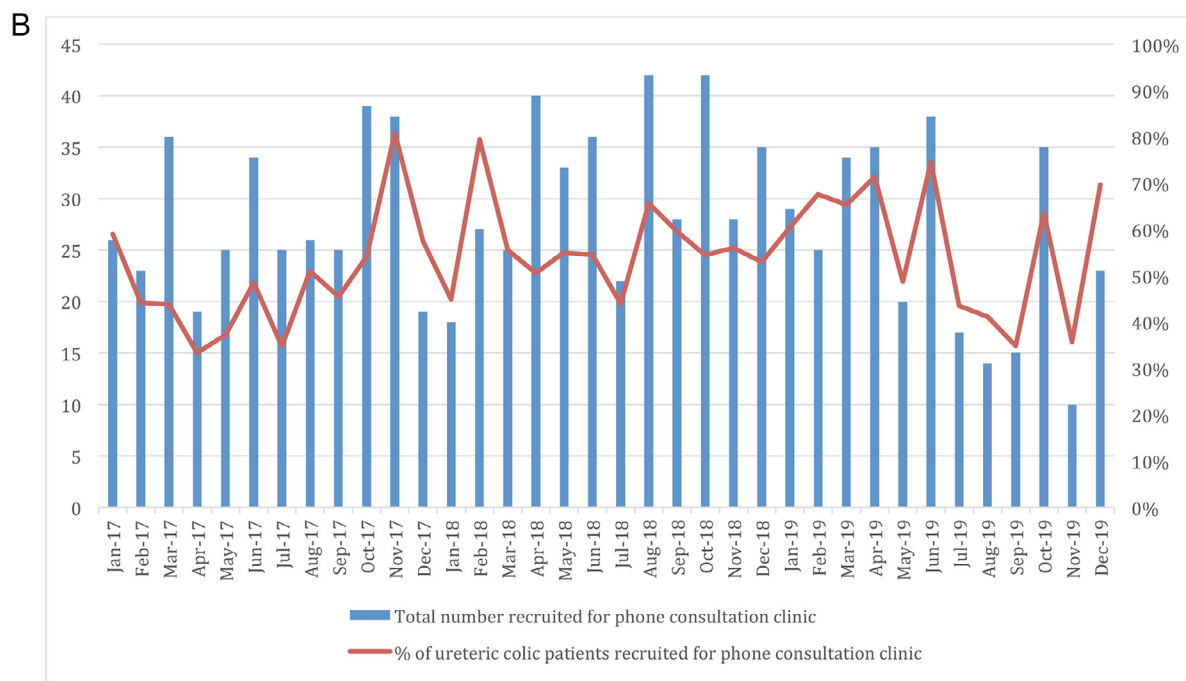
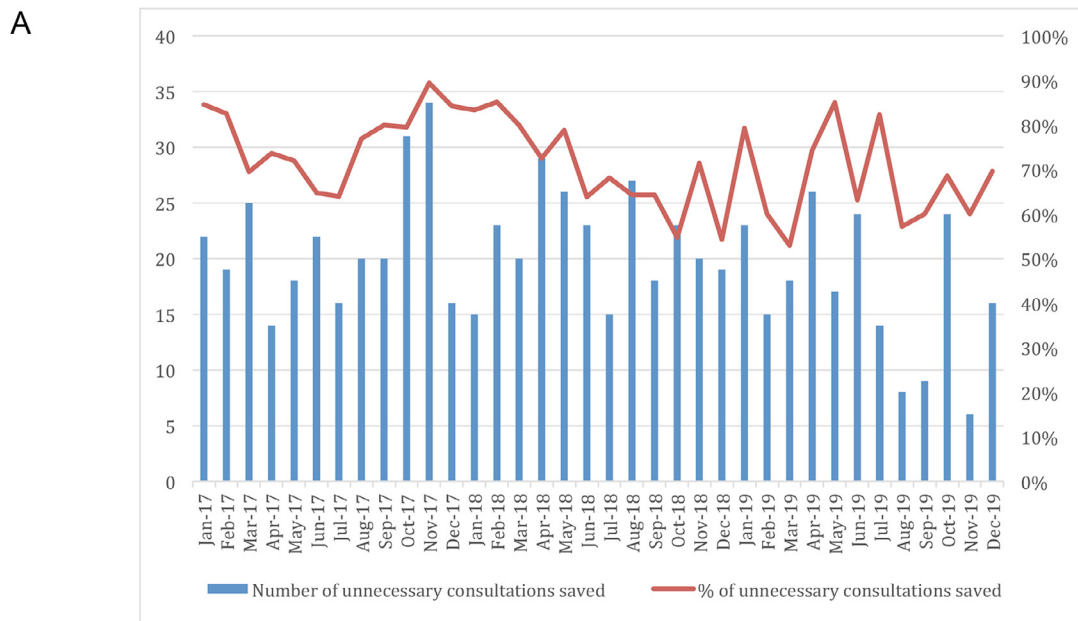


Figure 2. (A) Unnecessary consultations saved per month (B) Monthly recruitment rate into phone consultation clinic. (Color version available online.)

point-of-care ultrasonography was significant enough to change the treatment course in 33% of patients treated at a tertiary kidney stone center.²⁰

The gold standard investigation of CT KUB was performed 4 weeks after initial presentation to evaluate our ureteric colic patients – to decide on stone intervention or document stone passage. It could be argued that this may overinvestigate this subgroup of patients with likely passage of stone. However, in a series of patients who had resolution of symptoms, it was found that up to 26% of

patients could still have persistent ureteral stones.²¹ The catastrophic outcome of the silently obstructing ureteric stone and consequent loss of the renal unit must be avoided.^{22,23} The low intervention and reattendance rates in our study show that the outcome of a telemedicine workflow can still be safely achieved in our group of patients.

The rate of uptake of phone consult clinic and high level of patient satisfaction was a reflection of the widespread use of technology in our society. The mobile

population penetration rate in Singapore exceeded 150% in 2019.²⁴ Most of our patients possessed a handphone and used that as their contact number, making them easily contactable for consultation. The results and benefits of this study are likely to be reproducible when implemented in places with similar population demographics and level of connectivity. A greater uptake can be expected as the rapid digital transformation of our societies have led to increasing levels of mobile connectivity even in emerging economies.²⁵

We recognize several limitations in our study. First, our study was carried out in a single specialty in a single center within the small city-state of Singapore, which may limit its generalizability. Also, we would like to have performed an in-depth cost-benefit analysis for both the patients and hospital. The estimated cost savings for all patients since the start of implementation, accounting for consultation fees and approximate transportation costs, would amount to US \$62,784 in total (approximately US \$87.81 per visit). The opportunity cost savings by patients are less tangible but can be inferred from the positive responses from the patient satisfaction survey.

A recent survey among urologists conducted by Badalato *et al* highlighted that although 75% of respondents expressed interest in using telemedicine in their daily practice, only 14% were currently doing so.²⁶ Indeed, there remain several barriers to implementation which have to be addressed. First, the incorporation of technology into clinical practice does not necessarily result in immediate benefit. Time and effort are needed to streamline the workflow, educate all parties involved, and equip staff with new skills such as answering phone consultation clinic-related questions and following up with prescriptions or the scheduling of appointments postphone consultation.²⁷

In our postimplementation review, there was a proportion of patients who fulfilled the criteria but were not recruited into the workflow. The barriers to uptake that were identified included individual clinician preferences, as well as new doctors who were not familiar with the criteria and overlooked the recruitment of eligible patients.

To continue experiencing the benefits accrued from this telephone clinic, it is necessary to formulate strategies for sustainability. It is now part of our clinic workflow to automatically recruit all eligible patients into this intervention. Data and feedback from various stakeholders are continuously collected to track the success of this intervention and work on further improvements, and this information is shared at regular intervals in department meetings.

Reimbursement and regulation practices are a pertinent issue in the sustainability of telemedicine. As telemedicine is still in its infancy in Singapore, all cost savings in our study were experienced by the patient while the clinic absorbed additional expenses. The intervention was done with almost no capital outlay as we tapped on existing resources and teleinfrastructure. The opportunity cost for the clinic was the ability to see more first visit patients.

Moving forward, we have started to implement charges for teleconsultations. COVID-19 has allowed several billing regulations to be temporarily lifted and we are presenting our outcomes to administrators to allow reimbursements and payment to continue post-COVID-19.

In this current workflow, patients who require subsequent interventions are reviewed in a face-to-face consultation as we believe an in-depth discussion on the risks, benefits, and alternatives of the procedure are best conducted in person. Further developments include using video consultations for more complex patient-provider discussions, although logistics and manpower demands have to be factored in.

The availability of this ureteric colic telemedicine service has also become increasingly important in the current climate of the COVID-19 pandemic. We have been able to leverage on the existing availability of this service in this period to provide patients the option of teleconsultations in the safety of their own homes. Since the start of lockdown measures in Singapore, there has also been an increasing demand in replicating this workflow to other suitable urological conditions in our hospital.

CONCLUSION

In conclusion, the implementation of telemedicine service for ureteric colic patients successfully and sustainably reduced the need for face-to-face consultations and time to review with minimal capital expenditure and without compromising patient safety. Patients recruited into the study were satisfied with the new service mainly due to cost and time savings. The results of this study have hitherto been encouraging, and in view of the widespread availability of telephones and the common condition of ureteric colic, we believe that this intervention can be readily implemented in other clinics with minimal cost outlay and maximal benefit. Our telemedicine service has become even more important in helping us provide care to this group of patients in the current COVID-19 pandemic.

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at <https://doi.org/10.1016/j.urology.2020.10.010>.

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