

Evaluation of a multifunctional cloud-based comprehensive stent registry (UroSTENTBOOK) to prevent forgotten ureteric stents, specifically tailored for developing

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Abstract:

Background: With a quest to prevent morbidity associated with forgotten ureteric stent (FUS), a multidimensional cloud-based stent registry (UroSTENTBOOK, a highly secure point-of-care application) was developed with a multimodal reminder system with voice, SMS and postal letters, which can even be used in regional or preferred language, to track the stents until they are removed. This study evaluated the functional effectiveness of UroSTENTBOOK.

Materials and Methods: UroSTENTBOOK was designed for logging stent insertion, scheduling the date of anticipated stent extraction, and confirming stent removal, provision to record stent symptoms. It is accessible via a mobile phone application or web browser interface. This study consecutively enrolled all patients who underwent ureteral stent insertion for any indication by urologists from February, 2018, to January, 2019. A retrospective chart review was performed.

Results: A total of 254 patients were included. The mean age of 42.5 years, 57.9% (n=147) were males, and the most common procedure performed was ureteroscopy for stone disease (83%). The median indwelling ureteral stent time for short standing stents was 16 days (interquartile range: 8-65 days) and for long-standing stents was 185 days (175-206 days). A total of 247 stents were extracted in time (n=231, our hospital; n=16, outside hospitals), two patients died (malignant disease) with stents in-situ, and two were missing despite these reminders. Four patients were traced via postal letters. Mild stent-related symptoms were reported in 186 patients, with the most common being frequency with urgency; however, 12 patients had severe stent-related symptoms. In total, 87% of patients preferred voice reminder system to text-based reminders, and 91% preferred reminders in their regional or native language.

Conclusion: Use of UroSTENTBOOK application resulted in the increased in-time extraction of stents.

Key Word: Language, reminder system, stent removal, text, voice.

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I. Introduction

Forgotten ureteric stents (FUS) can be a source of significant distress and financial burden to the patient; additionally, it has dire medicolegal implications to the surgeon as well.¹⁻⁴ The lack of effective reminder systems coupled with ignorance of the patients contribute to the burden of the disease. Potential of simple reminders that render information regarding schedule and location of appointments in maintaining a better patient compliance with regard to attending their appointments has been showcased in several previous studies.⁵⁻⁷ However, a notable failure rate with the persistent advancement in these reminder systems has paved a way for assessing different perspective in the development of reminder systems.⁸

With a quest to prevent FUS and associated morbidity, development of a multidimensional cloud-based stent registry with multimodal reminder system that included voice, short messaging system (SMS), and postal letters was carried out. UroSTENTBOOK is an automated interactive voice messaging system (highly secure point-of-care application) that aids to communicate with the patients in their regional or preferred language (Tamil, Telugu, Hindi, and English), and to track the stents until they are removed. It has additional features to educate, score, analyse, and advise patients regarding stent-related symptoms and study stent-related characteristics. It can also be used as an electronic medical registry, accessible any time in the hand for a quick review of the case.

UroSTENTBOOK is developed a by Kate technologies using PHP software, hosted by AWS (amazon web services) using TWILIO calling and messaging solutions. This data will be stored in a secure Database (MySQL). The application can be used by hospital/institution-based accounts where it can be accessed by multiple doctors in a single institution or individual consultant-based account who works in a single or multiple hospital. It is designed for logging stent insertion, scheduling the date of anticipated stent removal date (SRD) and confirming stent removal. Provision to record stent symptoms and ureteral stent symptom questionnaire (USSQ) score are incorporated. Ability to override or extend the stent removal date has also been given- ESRD (ESRD-extended stent removal date). It is accessible via a mobile phone browser or web browser interface. The patient can preselect their preferred language of reminders either Tamil, Telugu, Hindi or English. It has additional features to save the radiological investigations and act as an electronic medical record, which can be accessed at any later date.

The present study assessed the functional effectiveness of UroSTENTBOOK application in Indian patients.

II. Material and Methods

This was a retrospective observational study conducted in the patients who underwent ureteral stent insertion for any indication by urologists from February, 2018 to January, 2019 at Meenakshi Medical College and Hospital, Kanchipuram, India. The study was conducted in accordance with the principles of Declaration of Helsinki and approved by Institutional Ethics Committee. Informed consent was taken from all the patients prior to enrollment.

Creating a new case was at the point-of-care and real-time. In each “stent case”, details such as demographics, primary and alternate phone number, stent size, length, laterality, manufacturer, date of its insertion and removal were entered in the database. Subsequently, all the information got updated in the stent dashboard by itself. This information was available for audit and gave the entire information as per the requirement with various search options. Four reminders (interactive voice response [IVR] and SMS) in their preferred language were sent in with a flow pattern before 1 week, 3 days, penultimate day of SRD and on the SRD (Figure 1, 2 and 3).

Figure 1.Flow pattern of reminders

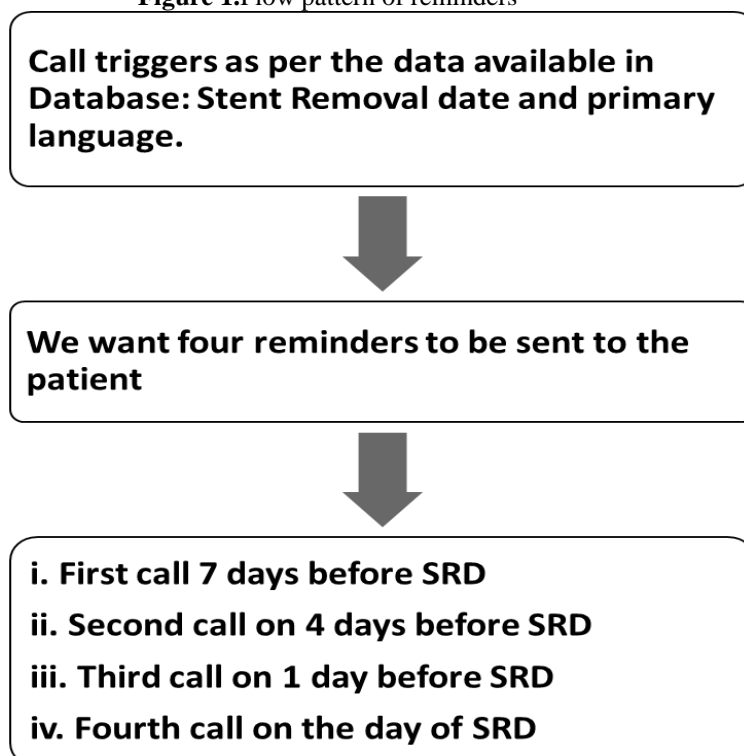


Figure 2. Call flow of message (English)

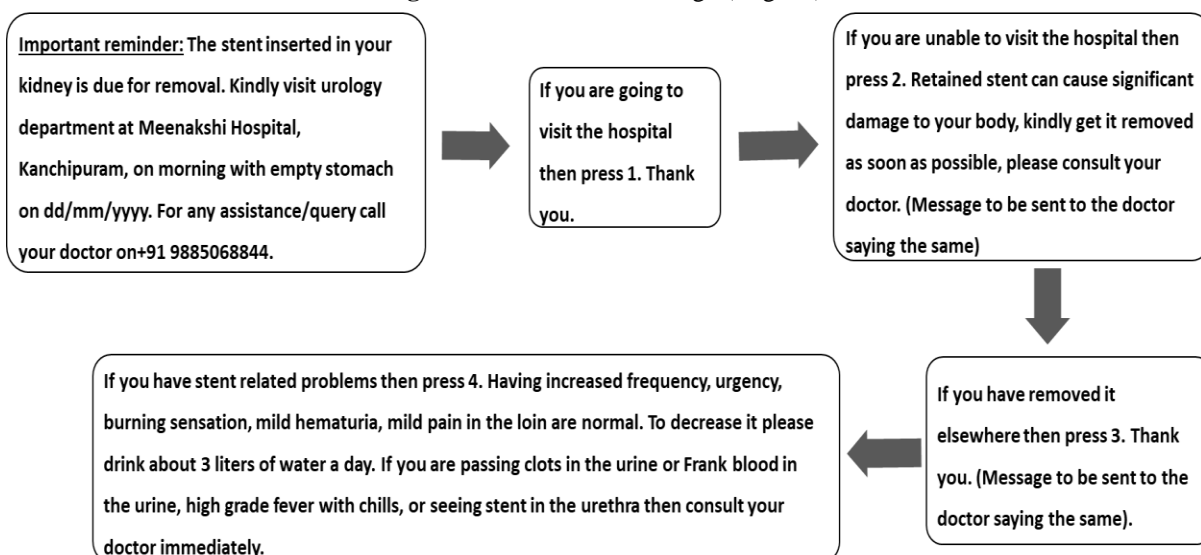
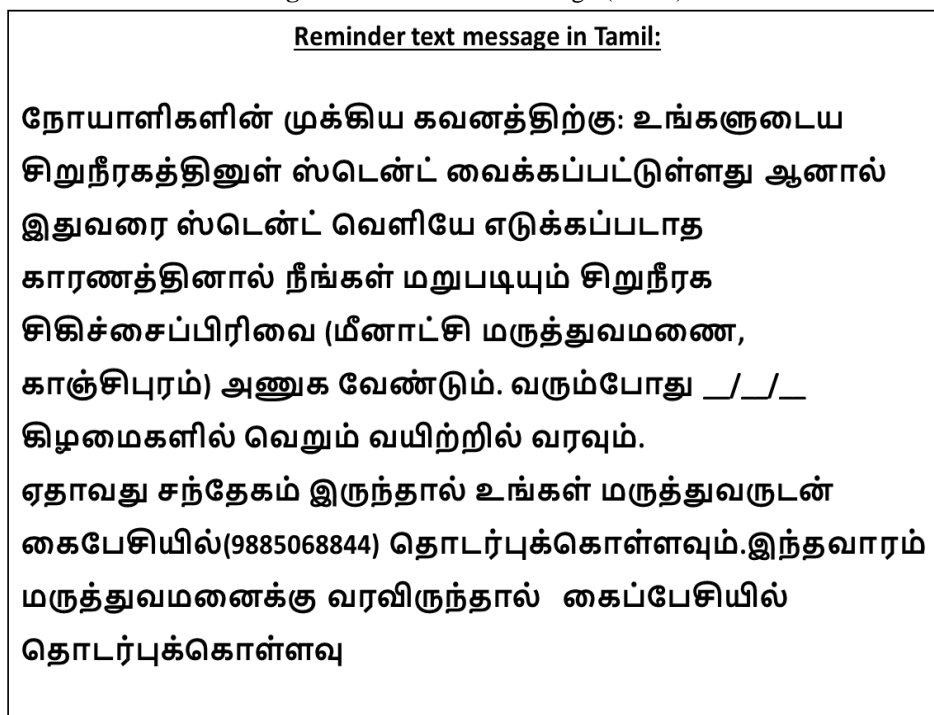


Figure 3. Call flow of message (Tamil)



Patients were given an additional option to give feedback for the stent related symptoms, if present. When a patient reports for stent removal, the entry was updated as “removed” in the stent dashboard, which was again password authenticated (Figure 4 and 5).

Figure 4. Flowchart of UroSTENTBOOK operating procedure

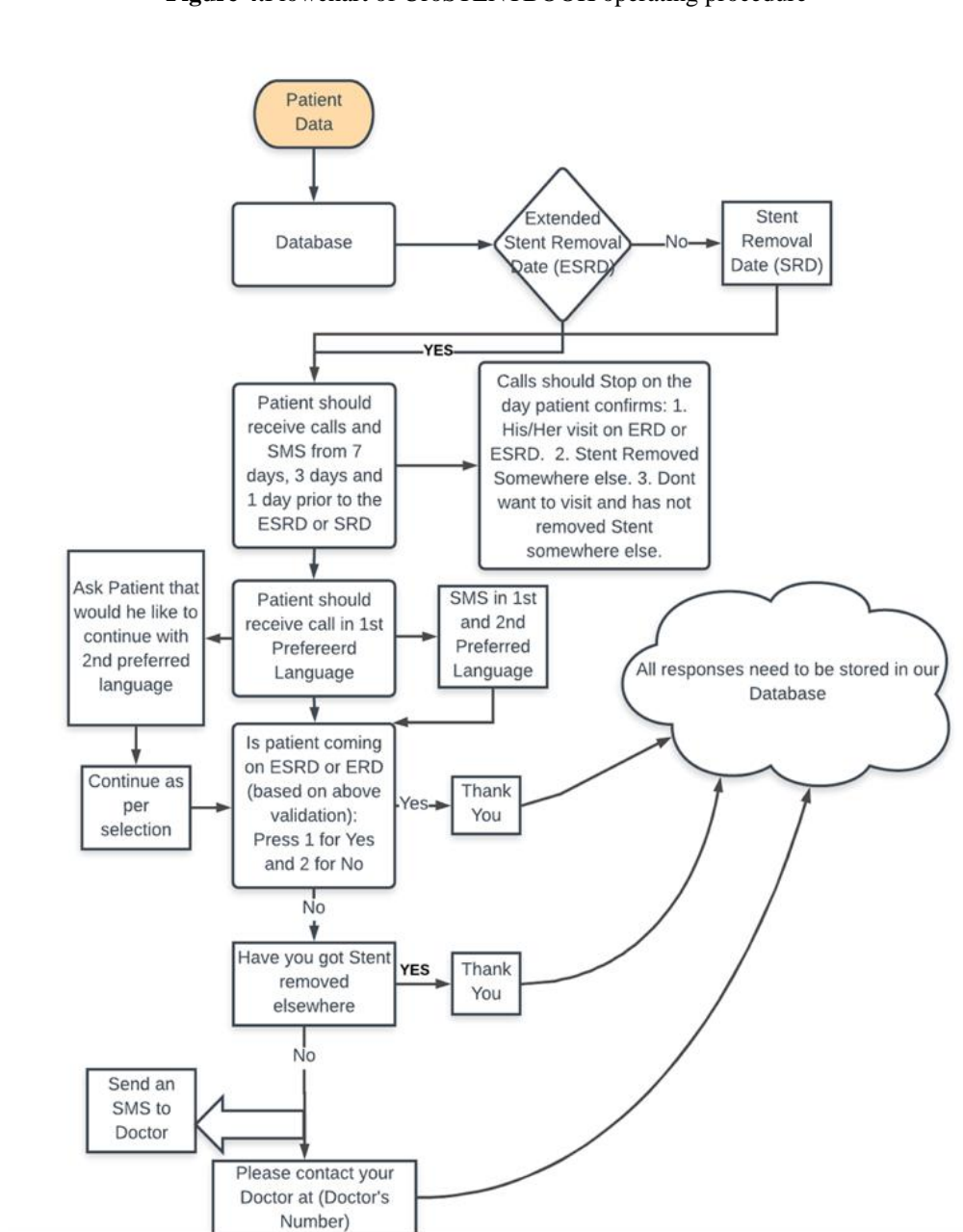
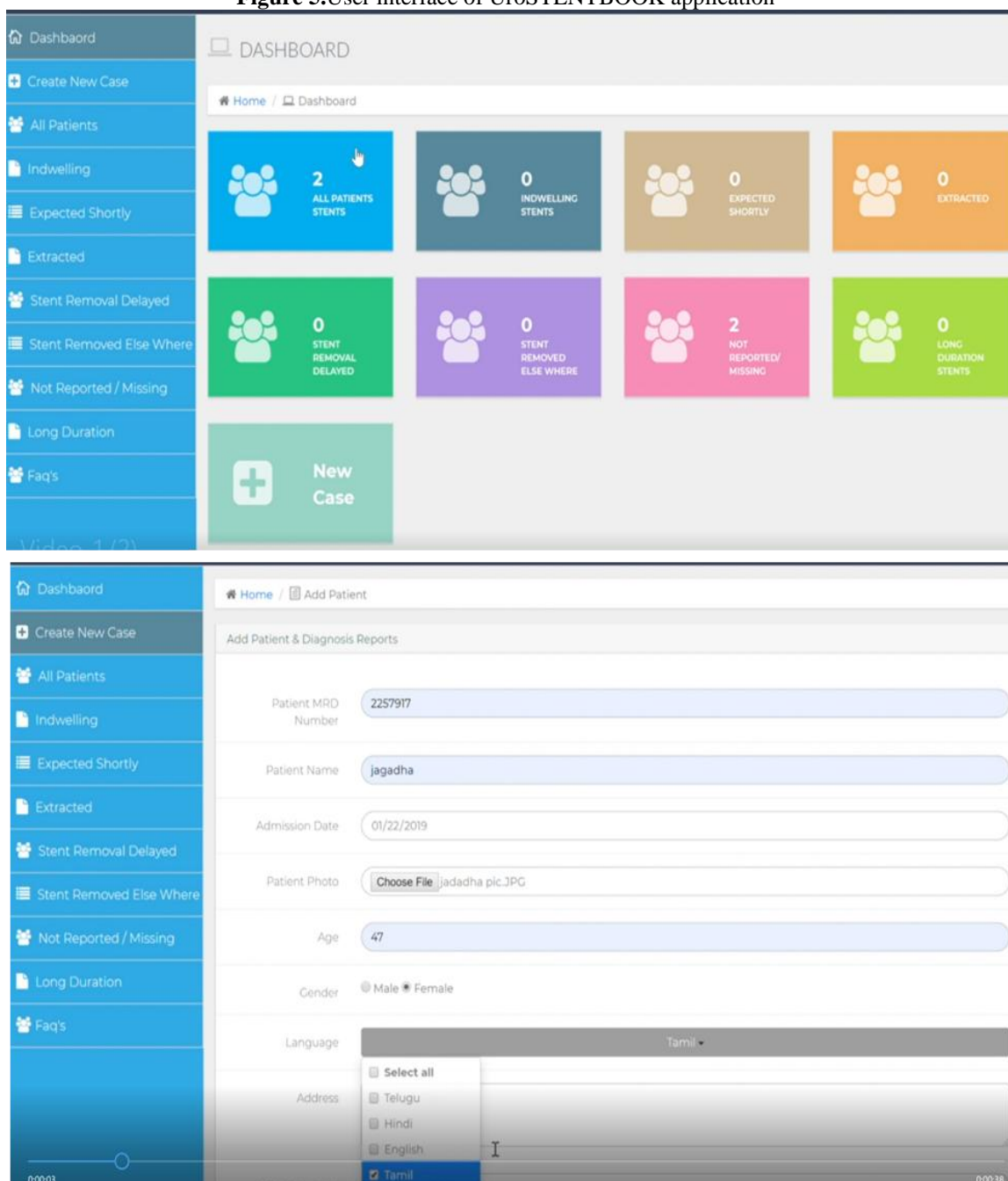


Figure 5. User interface of UroSTENTBOOK application



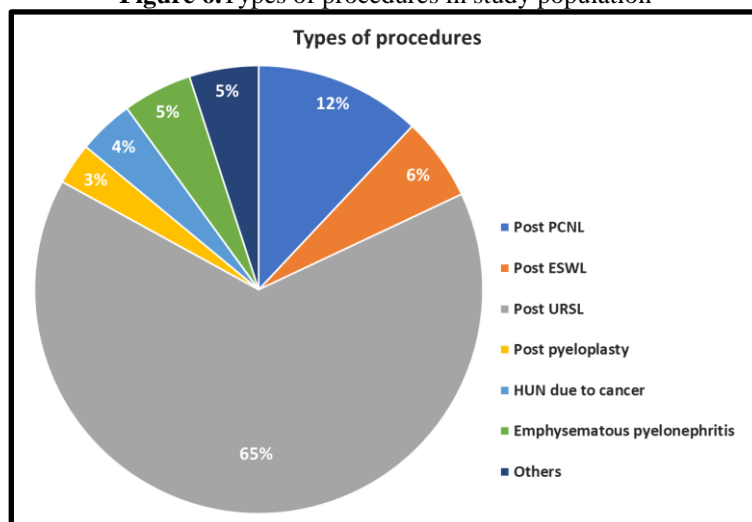
All patients who failed to turn up for stent removal were immediately sent reminders in the form of automated SMS to the primary and alternate number, followed by letters through the stent registry.

Data extracted from the stent registry included patient demographics, diagnosis, procedure, stent removal times, and stent symptoms. A retrospective chart review was performed for all patients.

III. Result

A total of 254 patients were included. The mean age of the patients was 42.5 years and 57.9% (n=147) were males. The most common procedure performed was ureteroscopy for stone disease (n=211, 83%). Details of types of procedure is summarized in Figure 6.

Figure 6.Types of procedures in study population



ESWL, extracorporeal shock wave lithotripsy; HUN, hydronephrosis; PCNL, percutaneous nephrolithotomy; URSL, ureteroscopic lithotripsy.

The median indwelling ureteral stent time for short-standing stents was 16 days (interquartile range: 8-65 days) and for long-standing stents was 185 days (175-206 days). The majority of patients had mild stent related symptoms (n=186, 73.2%). Unilateral and bilateral procedures were performed in 223 (87.7%) and 31 (12.3%) patients, respectively (Table 1).

Table 1. Patient’s demographics

Parameters	N=254
Mean age (years)	42.5
Sex	
Men	147 (57.9)
Women	107 (42.1)
Short duration stents	246 (96.9)
Long duration stents	8 (3.1)
Median indwelling time (days) (range)	
Short duration stents	16 (8-65)
Long duration stents	185 (175-206)
Unilateral procedures	223 (87.7)
Bilateral procedures	31 (12.3)
Data shown as n (%), unless otherwise specified.	

A total 226 patients (88.9%) expressed willingness to extract stent in the scheduled time for the initial IVR call; however, 22 (8.6%) patients reported late after serial reminders. Out of five patients who were unable to visit the hospital during their stent extraction date, four patients changed their mind and visited the hospital after receiving the warning message. A total of 247 stents were extracted in time (n=231, our hospital; n=16, outside hospitals), two patients died (malignant disease) with stents in-situ, three had long-standing stents plans in progress, and only two patients (0.78%) were missing at the end of the study period despite these reminders. Four patients were traced via postal letters (Table 2).

Table 2.Patients’ responses and feedback

Characteristics	N (%)
IVR	
Patients with an initial IVR response of willingness to extract stent in the scheduled time	226 (88.9)
Patients who reported late after serial reminders	22 (8.6)
Patients who reported that they were unable to visit hospital	5 (1.9)
Patients who changed their mind after listening to the warning message	4 (1.5)

Patients whose stent removal date is delayed/overridden due to stone residue or for additional procedures	22 (8.6)
Patients who removed stents at other hospitals	16 (62.9)
Not reported with mobile phone communication	6 (2.3)
Patients reported with postal communication	4 (1.5)
No of patients missing	2 (0.7)
Plan in progress	3 (1.1)
Patients who expired before their scheduled removal date	2 (0.7)
Patients who had severe stent-related symptoms	12 (4.7)
Patients who had mild stent-related symptoms	186 (73.2)
Patients preferred	
Reminders in their regional or native language	232 (91.3)
Voice reminder system to text-based reminders	221 (87.0)
IVR, interactive voice response.	

Mild stent-related symptoms were reported in 186 patients (73.2%), with the most common being frequency with urgency. However, 12 patients (4.7%) had severe stent-related symptoms. In total, 87.0% of patients preferred voice reminder system to text-based reminders, and 91.3% preferred reminders in their regional or native language (Table 2).

IV. Discussion

Worldwide, use of ureteral stent is a predominantly accepted technique in the field of urology. It has a wide spectrum of advantages such as assistance in urolithiasis treatment, ureteral healing, management of urinary leak and aid in alleviating benign or malignant obstruction. However, complications associated with their long-term use cannot be ignored and need to be considered as a significant obstacle in achieving improved clinical outcomes by patients as well as urologists. If patients forget the placement of ureteral stents, the resulting complications can be persistently present for long duration leading to a substantial morbidity and a greater economic burden on the patients themselves. The list of long-term complications comprises occlusion, encrustation, fragmentation, extrusion, abscess formation, renal failure, and sepsis while pain, hematuria, lower urinary tract symptoms, and stent migration are the short-term sequelae arise due to forgotten stents.¹ A previous retrospective analysis of 187 patients with ureteric stents demonstrated men at a higher risk (2.8 times) of having forgotten stents than females. Further, authors also reported patients without health insurance were the higher-risk patient to have forgotten stents than patients with insurance.² Therefore, stent morbidities need to be carefully managed with appropriate solutions.

On the other hand, medicolegal consequences of FUS are also important. Along with patients, surgeons are also equally responsible for the complication arising from FUS. Several studies identified and demonstrated that among the malpractice claims against urologists, claims due to retained DJ stents were present. Duty et al. reported that in the State of New York, the four claims against urologists were due to retained DJ stents and 27% of dismissed cases were due to failure to arrange proper follow-up resulting in retained DJ stents.³ Another report from the analysis of 14 years of successful claims from Urological litigation in the UK National Health Service revealed that the postoperative-related claims were the most commonly observed category for dissatisfaction with care and 23 cases of FUS were present amongst the 168 claims.⁴

Providing patients with the appropriate and required information may also be challenging. Previous studies have established the evidence in support of the patients' dissatisfaction about the information they had received regarding their ureteral stent and patients preferred information to be provided in written format with illustrative drawings.⁹ Further, increasing incidence of FUS is mainly attributed to two factors; i) poor compliance of the patient and ii) failure of the physician to adequately counsel the patient. A recently published study that evaluated the types of patients who were more likely to forget about their DJ stents, and the complications associated with forgotten DJ stents had specifically indicated physician's failure to assist in scheduling return visits or providing reminders as an important responsible factor for forgotten DJ stents. Therefore, authors have emphasized on the need of giving greater attention with regards to tracking and recalling DJ stents in high-risk patients to prevent forgotten DJ stents and associated complications.¹⁰

Several previous studies and metanalysis have provided a significant evidence that reminders in the form of text, call or letter are efficacious in achieving a good patient compliance with regard to attending their follow-up appointments.^{5-7,11,12} A systematic review of 33 independent studies pertaining to telephone, SMS or automated telephone reminders reported a benefit from sending reminders and suggested a weighted mean relative change of 34% from the baseline non-attendance rate.¹² Another metanalysis by Free et al. also revealed beneficial effect of text message (SMS) reminders on the appointment attendance compared with no reminder, with a relative risk (RR) of 1.06 [95% confidence interval (CI) 1.05 to 1.07].⁶

Electronic stent registries have also been assessed for their use and efficacy in providing improved adherence to patient attendance at follow-up visits. These studies have demonstrated substantial reductions in the retained stents indicating benefits of using computer-based registries in better management of complications related to FUS.^{13,14} Due to failure of identifying all the cases with ureteric stents with available computer registries, there is a requirement of developing a more robust tracking system that will efficiently aid in providing timely reminders for extraction of FUS.⁸ A recently published study by Ilie VG and Ilie VI concluded that major complications can be avoided if the number of forgotten stents is minimized and all efforts need to be made in the direction of medical records, tracking software and patient education arrangements to avoid this serious patient safety issue.¹⁵ In the present study, with the use of UroSTENTBOOK reminder system, the majority of patients showed willingness to extract stent in the scheduled time at first reminder and removal of ureteral stents was achieved in total of 97.2% of patients, while the non-adherence rate was only 0.78%. These observations substantially demonstrate ability of this software to achieve improved patient compliance in attending the clinics for timely removal of stents.

Even though there are several patient safety, economic, and medico-legal implications of forgotten stents, very few studies have addressed sending multiple voice reminders to patients in their native language, and collecting feedback until they are tracked and removed. In a study by Morse and Mitchell, authors evaluated the communication preferences and the telephone, text, and e-mail usage of women with limited English proficiency who attended an outpatient women's health clinic. They showed that more than half of the survey population either not receiving an appointment reminder in English or reported difficulty understanding the reminder they did receive. In addition, majority (90%) of women preferred appointment reminders in their primary language regardless of their ability to read, write, speak, or understand English.¹⁶ Previous survey related to language barrier between patient and physician impacting overall healthcare quality indicated that although patients' language proficiency is important to health care quality ratings, what may matter more is when patient and provider speak the same language. When patients and providers speak the same language, patients report less confusion and better health care quality.¹⁷ In concordance with these observations, the present study population also expressed their preference for reminders in their regional or native language.

Voice is a vital part of natural communication among humans as well as between machines and humans. With the advancement of technologies, native voice-based systems have a great potential to reduce the incidence of FUS. The present study demonstrated that patients expressed more inclination and preference towards voice reminder system than text-based reminders and thus corroborating the fact that native voice-based reminder systems may benefit more than other kinds of reminder systems.

Apart from addressing the FUS, UroSTENTBOOK also aimed to obtain feedback from patients regarding stent related symptoms. Mild stent-related symptoms were reported in majority of patients (73.2%). General advice was given to them to ameliorate the symptoms and most of them had reported that the advice/measures prescribed were beneficial in decreasing the discomfort. Therefore, UroSTENTBOOK can be used as an important tool to obtain feedback and objectively compare different stent parameters resulting in development of better ureteric stents. One of the limitations of UroSTENTBOOK is that it is not integrated to the institutional electronic medical record.

V. Conclusion

Tracking with technology tailored to the region is the most effective solution to prevent the issue of retained ureteric stents. The use of UroSTENTBOOK, a voice-based reminder application resulted in an increased in-time extraction of stents, which could greatly reduce incidence of FUS in patients. Therefore, UroSTENTBOOK is a comprehensive and secure cloud-based application, which once integrated into the routine practice not only prevents this menace of retained ureteric stents but also has numerous value-added benefits to the urologist.

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