

ORIGINAL PAPER

WhatsApp-assisted telemedicine for ureteral stone management: A pilot study

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Summary *Background: Telemedicine has gained increasing importance in urology, particularly during the COVID-19 pandemic, enabling remote patient monitoring and reducing hospital visits. To evaluate the feasibility, safety, and effectiveness of a WhatsApp-based telemedicine follow-up model in patients with ureteral stones managed conservatively.*

Methods: A cross-sectional study was conducted between March and May 2020. Ninety-nine patients with a single ureteral stone < 10 mm were included. All patients received medical expulsive therapy and were followed for 30 days using a structured WhatsApp-based monitoring system. Pain scores, analgesic use, stone passage, complications, and patient satisfaction were recorded.

Results: The median age was 55 years, and the mean stone size was 6.1 ± 1.5 mm. Spontaneous stone passage occurred in 34.3% of patients, while 26.2% required JJ stent placement. Larger stone size ($p < 0.001$) and proximal location ($p = 0.002$) were associated with intervention. Pain scores and analgesic requirements decreased significantly over time ($p < 0.01$).

No major complications were observed. WhatsApp-based monitoring enabled timely clinical decision-making and reduced unnecessary hospital visits.

Conclusions: WhatsApp-assisted telemedicine is a feasible, safe, and cost-effective approach for managing ureteral stones. Larger prospective studies are required to validate these findings.

KEY WORDS: Digital health; Ureteral stones; Urolithiasis; Telemedicine; Remote monitoring.

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INTRODUCTION

Telemedicine is the use of electronic communication technologies to deliver clinical healthcare services remotely. It aims to improve patient outcomes by facilitating the exchange of medical information between healthcare providers and patients without the need for physical pres-

ence (1). The COVID-19 pandemic significantly accelerated the adoption of telemedicine, leading to the development of innovative applications aimed at enhancing health outcomes, lowering healthcare costs, and providing patients with equitable, high-quality care (2). With the advancements driven by the pandemic, the advantages of this field have increasingly been integrated into various aspects of urology (3). In endourology, it has been used to enhance clinical decision-making for patients with kidney and ureteral stones, assess its effectiveness in managing patients indicated for PCNL, and provide follow-up care for patients with urolithiasis (4).

WhatsApp Messenger, a cross-platform mobile messaging application, has increasingly been utilized within various domains of telemedicine. Its ability to transmit text, images, audio, and video over an internet connection has contributed to its widespread adoption in healthcare settings (5).

Although various telemedicine tools and applications are utilized in the literature, the use of WhatsApp in endourology has not been explored. Specifically, in stone disease, where patient-provider communication is frequent, we aimed to reduce face-to-face consultations, thereby minimizing unnecessary costs and time loss, by utilizing the WhatsApp application. This study aims to analyze the treatment course, active monitoring through WhatsApp follow-up, and patient satisfaction in patients diagnosed with ureteral stones.

MATERIALS AND METHODS

Study design

This cross-sectional study aimed to evaluate the feasibility and clinical outcomes of a WhatsApp-based telemedicine follow-up model in patients with renal colic due to ureteral stones. The primary goal was to assess symptom progression, treatment adherence, and patient satisfaction over a 30-day period, during which follow-up was performed remotely using mobile communication.

Study setting and participants

This study was conducted between March 11 and May 17, 2020, during the first wave of the COVID-19 pandemic, at a high-volume tertiary care center. As part of our institutional pandemic response to minimize hospital visits, the WhatsApp-based remote follow-up was offered as a standard protocol to all eligible patients. Following the completion of the 30-day follow-up period for the last enrolled patient, the clinical charts and the transcribed digital database of 107 consecutive patients presenting with symptoms of renal colic during the study timeframe were retrospectively screened and evaluated.

All patients underwent a standardized diagnostic protocol including non-contrast *computed tomography* (CT) and routine blood and urine tests to confirm the presence of ureteral stones. Patients were eligible if they were over 18 years old and had a single ureteral stone < 10 mm without signs of infection. Exclusion criteria included solitary kidney, fever (> 37.5°C), leukocytosis, or urinoma formation.

Participants were divided into two groups. The first group consisted of patients who were followed up or spontaneously passed stones. The second group included patients who required JJ stent placement.

Data collection and follow-up protocol

All eligible patients were prescribed *medical expulsive therapy* (MET) consisting of Tamsulosin (0.4 mg/day) and instructed to use Diclofenac (75 mg) up to three times daily for pain control, as needed.

Each patient received a standardized follow-up brochure designed to track key clinical parameters during the 30-day follow-up. This included the regular recording of pain severity using the *Visual Analogue Scale* (VAS) every five days, daily monitoring of body temperature, and notation of the presence or absence of visible hematuria and spontaneous stone expulsion. Additionally, patients were asked to document the number of analgesic doses taken each day. At the end of the 5-day follow-up period, total analgesic use was categorized as low (fewer than 5 doses), moderate (5 to 10 doses), or high (more than 10 doses).

Patients were instructed to complete the brochure every five days, take photographs of the filled pages, and send them via WhatsApp to an experienced urologist responsible for their care. Upon receiving these images, the urologist evaluated the data for immediate clinical management, and the parameters were subsequently transcribed into a secure digital database for retrospective analysis. In the event of fever exceeding 37.5°C or uncontrolled pain, patients were referred for in-person evaluation at the hospital.

Outcome measures

The primary objective of this study was to evaluate the safety and feasibility of using WhatsApp as a telemedicine tool in the follow-up of patients with ureteral stones. Secondary outcomes included changes in VAS pain scores, frequency of spontaneous stone passage, levels of analgesic consumption, and the incidence of complications requiring hospital admission. Additionally, patient satisfaction was assessed at 5-day intervals using a simplified three-point Likert scale (unsatisfied, partially satisfied, satisfied).

Statistical analysis

All statistical analyses were performed using R statistical software (version 4.4.2). The distribution of continuous variables was assessed using the Shapiro-Wilk test. For comparisons between two independent groups, the Student's t-test was applied for normally distributed variables, whereas the Mann-Whitney U test was used for non-normally distributed data.

Categorical variables were compared using the Chi-square test. When the expected frequency in any cell was less than 5, Fisher's exact test was used instead. Ordinal variables were analyzed using the Mann-Whitney U test due to their non-parametric distribution. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 107 patients were initially enrolled in the study. However, one patient declined participation, and seven were excluded due to incomplete follow-up data. Consequently, 99 patients were included in the final analysis. All patients were afebrile at the time of presentation, with no clinical or radiological evidence suggestive of pyelonephritis.

The study population included 51 male patients (51.5%) and 48 (48.5%) female patients, in 50 cases (50.5%), the stone was located in the right ureter, while in 49 cases (49.5%), it was located in the left ureter. With respect to stone localization, 39 patients (39.4%) had proximal ureteral stones, 35 (35.4%) had mid-ureteral stones, and 25 (25.3%) had distal ureteral stones. The median age was 55(47-61) years, the mean *body mass index* (BMI) was 25.2 ± 3.9 kg/m², and the average stone size was 6.1 ± 1.5 mm (Table 1).

Among the remaining patients, 39 completed the full 30-day follow-up, and 34 passed their stones spontaneously during the observation period. JJ stents were placed in 26 patients, primarily indicated for febrile episodes (n = 21), persistent pain unresponsive to medical management (n = 4), or professional obligations limiting treatment delays (n = 1) (Figure 1). Of the 21 patients who developed febrile episodes, 10 presented to the emergency department with fever and subsequently underwent JJ stent placement following evaluation. Additionally, 11 patients who developed fever were initially identified through a WhatsApp-based remote assessment; these patients were then called to the hospital and underwent JJ stent placement.

There were no significant differences between the group requiring JJ stent placement and the other group in terms of age, gender, BMI, stone side, initial VAS score at presentation, or the presence of hematuria at presentation. However, the stone diameter was found to be significantly larger in the group requiring JJ stent placement (p < 0.001). Additionally, in terms of stone location, stones were observed to be more proximally located in the group requiring JJ stent placement (p = 0.002) (Table 1).

In the stented group, the mean time to JJ stent placement was 15.1 ± 6.7 days, whereas the mean time to stone expulsion in the spontaneous passage group was 13.8 ± 8.1 days.

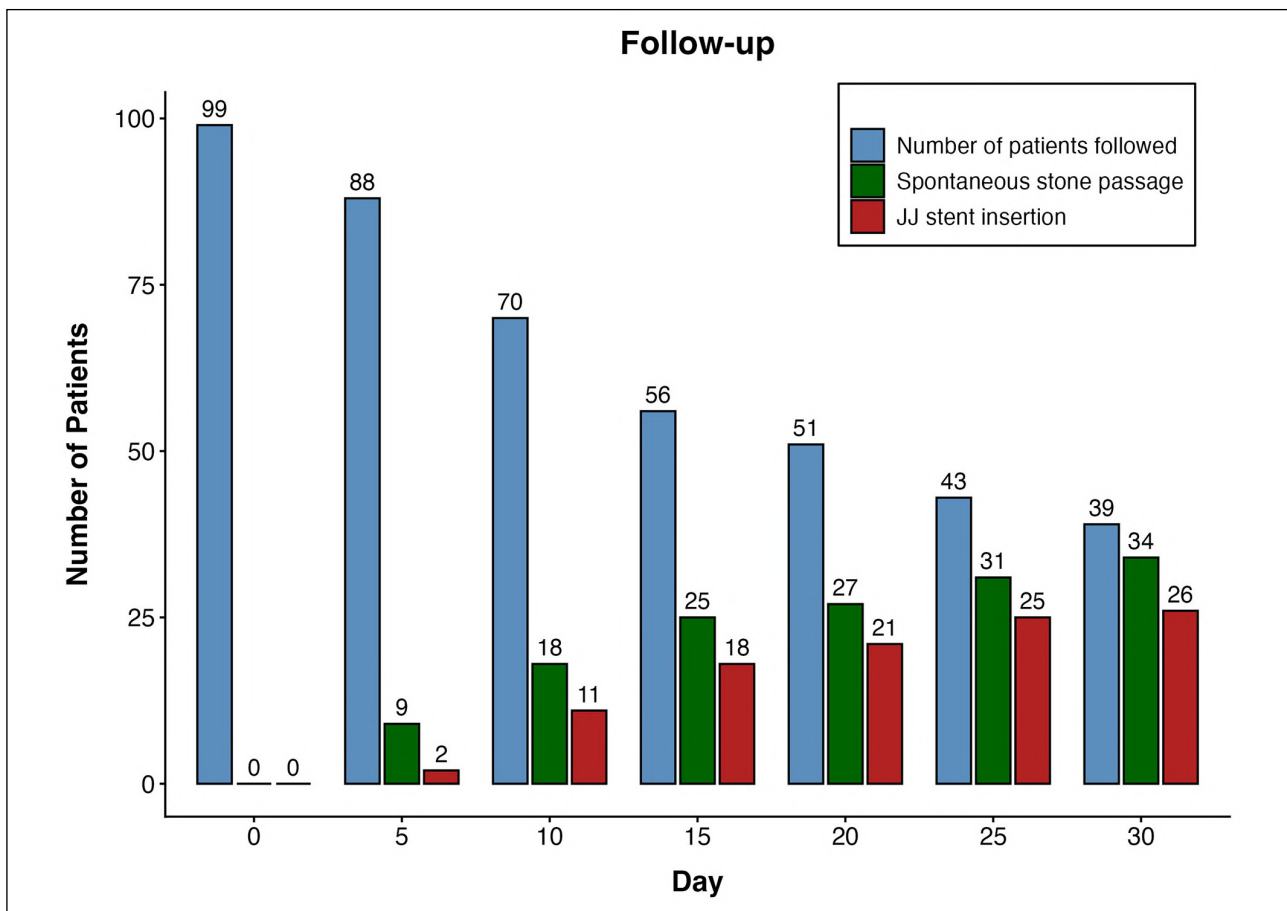
Analgesic requirements also declined significantly over time (p < 0.01). On Day 5, 37.4% of patients required

	Total Population (n = 99)	Stone passage or follow-up (n = 73)	JJ stent placement (n = 26)	p-value
Age (Median, IQR) (year)	55 (47-61)	54.5 (47-61)	55 (44-61)	0.675*
Sex				
Male	51 (51.5%)	36 (49.3%)	15 (57.7%)	0.774**
Female	48 (48.5%)	37 (50.7%)	11 (42.3%)	
BMI (Mean $\pm$ SD (kg/m ²))	25.2 $\pm$ 3.9	25.4 $\pm$ 4.1	24.6 $\pm$ 3	0.296***
Stone Diameter (Mean $\pm$ SD) (mm)	6.1 $\pm$ 1.5	5.7 $\pm$ 1.4	7 $\pm$ 1.2	< 0.001***
Side				
Right	50 (50.5%)	38 (52.1%)	12 (46.2%)	0.602**
Left	49 (49.5%)	35 (47.9%)	14 (53.8%)	
Location				
Proximal	39 (39.4%)	22 (30.1%)	17 (65.4%)	0.002****
Mid	35 (35.3%)	27 (37%)	8 (30.8%)	
Distal	25 (25.3%)	24 (32.9%)	1 (3.8%)	
VAS (Day 0, Median, IQR)	7 (6-8)	7 (6-8)	7 (6-8)	0.575 *****
Hematuria (Day 0)				
No	92 (93%)	68 (93.2%)	24 (92.3%)	1 ****
Yes	7 (7%)	5 (6.8%)	2 (7.7%)	

* Mann-Whitney U test. ** Pearson's Chi-squared. *** T test. **** Fisher's Exact. ***** Wilcoxon.

Table 1.
Demographic and clinical characteristics of the total population, stone passage/follow-up group, and JJ stent placement group.

Figure 1.
Flowchart of patient outcomes during the 30-day observation period.



high-dose analgesics, 53.5% medium-dose, and 9.1% low-dose. By Day 15, these proportions had shifted to

8.6%, 28.6%, and 62.9%, respectively. On Day 30, 88.4% of patients were using only low-dose analgesics,

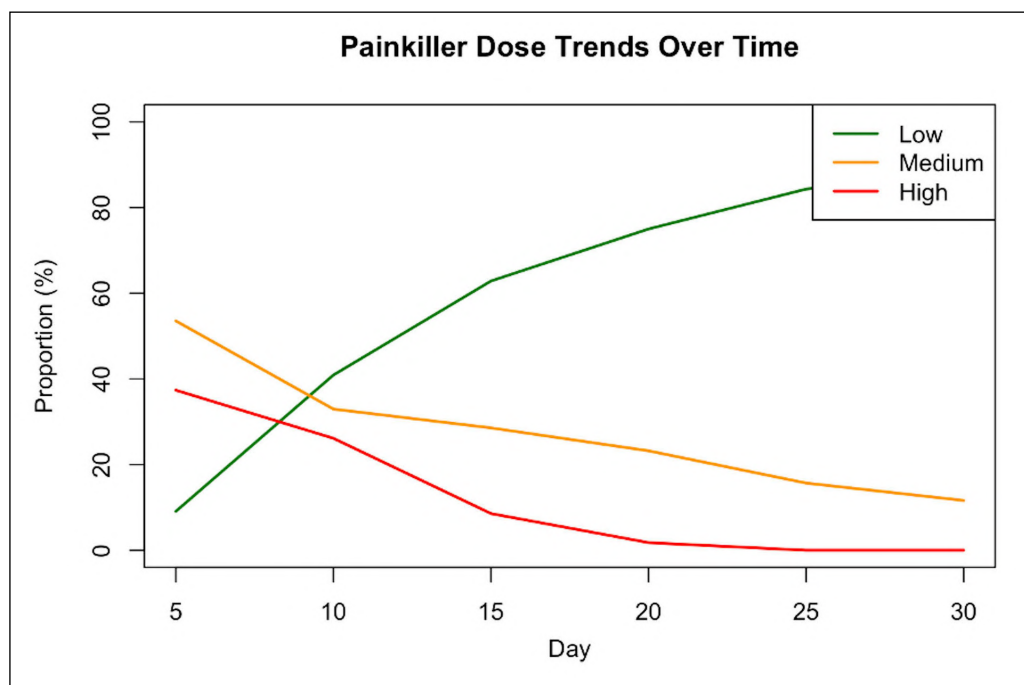


Figure 2.
Temporal trend in analgesic requirements over the 30-day follow-up period.

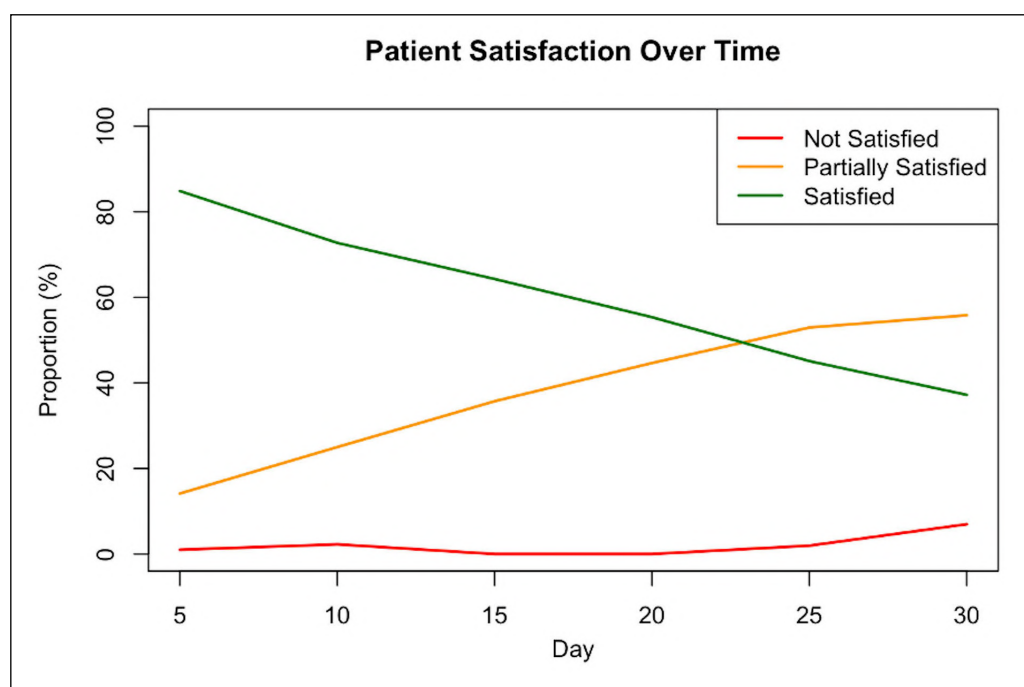


Figure 3.
Temporal distribution of patient satisfaction levels during follow-up.

and 11.6% required medium-dose; no patients required high-dose analgesia at this stage (Figure 2). Pain levels, as assessed by the VAS, showed a statistically significant decrease throughout the follow-up period ($p < 0.01$). Patient satisfaction, assessed at 5-day intervals, also varied over time. On Day 5, 84.8% of patients reported being satisfied, 14.1% partially satisfied, and 1% not satisfied. On Day 15, 64.2% were satisfied and 35.7% partially satisfied. By Day 30, 37.3% of patients remained satisfied, 55.8% were partially satisfied, and 6.9% reported dissatisfaction (Figure 3). Importantly, no adverse events or unexpected complications were observed during the entire follow-up period.

DISCUSSION

Ureteral stone disease remains a prevalent urological condition with a wide spectrum of treatment options ranging from conservative management to surgical intervention. The choice of therapy depends on multiple factors, including stone size, anatomical location, the degree of urinary obstruction, and the presence of infection or other comorbidities. In recent years, advances in MET, endourological techniques, and imaging technologies have significantly improved both clinical outcomes and patient comfort (6). Concurrently, telemedicine has emerged as a valuable tool in modern healthcare, offering increased accessibility, reduced costs, and improved patient satisfaction, particu-

larly in the management of chronic and non-complicated conditions such as urinary stone disease (7). Various modalities of telemedicine are currently in use, including real-time video consultations, telephone follow-ups, mobile health applications, and remote patient monitoring systems. These methods enable healthcare providers to assess symptoms, monitor patient progress, and adjust treatment plans without requiring in-person visits, thereby streamlining care delivery and enhancing patient convenience (8, 9). Among these tools, the use of WhatsApp as a cost-effective, quick, reliable, and user-friendly tool has been increasingly widespread across various fields of medicine in recent years (10). The app's key feature is that it allows users to send and receive messages without paying per message, unlike traditional SMS. Its reliance solely on a mobile internet connection has contributed greatly to its global popularity (11). Beyond WhatsApp, other telemedicine approaches have also proven to be economically advantageous. For example, in a study by Hughes et al., telephone-based follow-up for asymptomatic renal stones conducted through a nurse-led *Virtual Stone Clinic* (VSC) demonstrated a 93% reduction in clinic appointment costs, amounting to a total saving of £12,006 over the study period (12). Similarly, in our study – where frequent monitoring was required – patients were safely followed up via WhatsApp, which is entirely free of charge, thus minimizing financial burden.

The use of telemedicine in endourology is not only cost-effective but also important for environmental conservation. In the study by Connor et al., a single video consultation resulted in a saving of over 9,000 patient travel miles. Additionally, it prevented the emission of 0.70-2.93 metric tonnes of carbon dioxide – an amount that would require the planting of approximately 14.7 trees to offset (13).

Due to its accessibility, efficiency, and user-friendly interface, WhatsApp was deemed an appropriate platform for monitoring patients with ureteric colic – a condition characterized by a typically mild clinical course, where follow-up can be effectively conducted without the necessity of in-person physical examination (14). Similarly, in our study, all patients monitored over a 30-day period were successfully managed without any complications, using text message communication only. After detailed reporting of symptoms such as fever and pain, it was observed that the follow-up of ureteric stones could be effectively conducted via telemedicine. Nevertheless, we observed that 10 patients who developed febrile episodes presented directly to the emergency department without prior WhatsApp communication. This suggests that in the face of sudden and distressing symptoms like acute fever, or when symptoms peak during after-hours, patients may instinctively seek immediate physical care rather than utilizing a digital consultation.

In patients with uncontrolled pain, sepsis, or renal dysfunction, immediate intervention is typically required. However, in clinically stable patients presenting with acute ureteric colic who do not exhibit indications for urgent intervention, there remains uncertainty regarding the necessity of active treatment for their ureteric stone. In these patients, it has been observed that stones can pass spontaneously with close follow-up (15). In our study, the mean stone size in the group managed with MET without developing an infection was 5.7 ± 1.7 mm, whereas it was

7 ± 1.2 mm in the group that required JJ stenting (Table 1). Furthermore, 16 out of 25 patients (64%) who failed to pass the stone and eventually required surgical intervention had stones located in the proximal ureter. These findings highlight the need for more rigorous and attentive follow-up – especially for patients with larger stones or stones located in the proximal ureter – when utilizing a WhatsApp-based patient follow-up protocol. Consistent with our findings, a study involving 850 patients reported that the need for intervention increased with stone location: 25% for distal ureteral stones, 40% for mid-ureteral stones, and 52% for proximal ureteral stones (16).

Although there is no definitive guideline on the optimal duration of follow-up for ureteric stones, current evidence suggests that the majority of stones pass spontaneously within the first four weeks. Therefore, the 30-day follow-up protocol employed in our study may be considered a reasonable and effective approach for monitoring such cases (17). However, despite the overall safety and feasibility of the protocol, an increase in patient dissatisfaction was observed after the 25th day of follow-up. In light of this finding, incorporating an in-person clinical consultation around or after day 25 may help enhance patient satisfaction and address any concerns that may arise in the later stages of conservative management.

This study has several limitations that should be acknowledged. Although previous studies have suggested that WhatsApp and similar telemedicine tools may be cost-effective, we did not perform a formal cost-effectiveness analysis in our cohort. Furthermore, although the study was conducted at a high-volume tertiary care center, the sample size was relatively small and limited to a specific geographic region, which may reduce the generalizability of the findings. Broader, multi-center studies with larger and

DECLARATIONS

Ethical approval and consent to participate: This study was conducted in accordance with the Declaration of Helsinki and approved by the Mus Alparslan University Ethics Committee (Approval number: 247333). Informed consent was obtained from all individual participants included in the study.

Consent for publication: Not applicable.

Availability of data and material: The data supporting this study's findings are available from the corresponding author upon reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: RBE: Conceptualization, Methodology, Writing - Original Draft, Data Analysis. MFO and IT: Data Analysis, Writing - Review & Editing. SB and EC: Data Collection, Visualization, Writing - Review & Editing. APL: Critical Review. TES and LD: Manuscript Revision. TT: Supervision. All the authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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more diverse populations are needed to validate the applicability of our follow-up model. The lack of a standardized hydronephrosis grading system and the absence of detailed inflammatory marker analysis (such as C-reactive protein) in our dataset represent further limitations of our retrospective evaluation. Furthermore, since our study focused exclusively on the acute 30-day telemonitoring window, the long-term clinical outcomes and definitive treatments of patients who did not pass their stones within this period were not evaluated. Additionally, this was a single-arm study lacking a control group receiving traditional face-to-face follow-up. As a result, direct comparisons regarding clinical outcomes, patient satisfaction, or healthcare resource utilization between conventional and WhatsApp-based follow-up were not possible. Therefore, conclusions about the relative superiority or equivalence of this telemedicine approach should be interpreted with caution.

CONCLUSIONS

Our study demonstrates that a WhatsApp-based follow-up strategy is a practical, safe, and clinically useful method for managing ureteric stone patients who are stable and not in need of urgent intervention. This form of telemonitoring enabled close observation and prompt identification of cases requiring further treatment, while also decreasing the reliance on face-to-face consultations and reducing associated healthcare expenses. To further establish its effectiveness and broaden its application, future research involving larger, multicenter populations and controlled study designs is essential for determining the long-term value of telemedicine in the management of ureteral stone disease.

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