Implementation of a clinical practice guideline for assessment and management of renal colic in the emergency department

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Cite as: Pham CT, Hui N, Yan R, et al. Implementation of a clinical practice guideline for assessment and management of renal colic in the emergency department. *Can Urol Assoc J* 2023 April 11; Epub ahead of print. http://dx.doi.org/10.5489/cuaj.8136

Published online April 11, 2023

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KEY MESSAGES

- Implementation of a clinical practice guideline for ureteric stones reduces the emergency department length of stay and the total number of CT scans a patient receives on average over the course of their acute illness.
- Standardizing assessment and management of ureteric stones can potentially improve patient and hospital outcomes without compromising the quality of care.

ABSTRACT

Introduction: Renal colic is a common emergency department (ED) presentation. Variations in assessment and management of suspected renal colic may have significant implications on patient and hospital outcomes. We developed a clinical practice guideline to standardize the assessment and management of renal colic in the ED. We subsequently compared outcomes before and after guideline implementation.

Methods: The guidelines standardized the analgesia regimen, urology consult criteria, imaging modality, patient education, and followup instructions. This is a single-center, observational cohort study of patients presenting to the ED with renal colic prospectively collected after guideline implementation (December 2018 to May 2019), compared to a control group retrospectively collected before guideline implementation (December 2017 to May 2018). A total of 528 patients (pre-guideline n=283, post-guideline n=245) were included. Statistical analysis was performed with SPSS using multivariate linear regression.

Results: ED length of stay (LOS) was significantly shorter after guideline implementation (pre-guideline 295.82±178.8 minutes vs. post-guideline 253.2±118.2 minutes, p=0.017). The number of

computed tomography (CT) scans patients received was significantly less after guideline implementation (pre guideline 1.35±1.34 vs. post-guideline 1.00±0.68, p=0.034). Patients discharged for conservative management had a lower re-presentation rate in the post-guideline group (12.6%) than the pre-guideline group (17.2%); however, this did not reach statistical significance (p=0.18).
Conclusions: Implementation of a clinical practice guideline for ureteric stones reduces the ED LOS and the total number of CT scan in patients who present with renal colic. Standardizing assessment and management of ureteric stones can potentially improve patient and hospital outcomes without compromising the quality of care.

INTRODUCTION

Renal colic is a common Emergency Department (ED) presentation. Lifetime risk of urolithiasis is 12% in men and 6% in women.[1] Despite the high incidence, there are no existing universal clinical practice guidelines at a local or national level and very few international guidelines.[2,3] Subsequent variations in assessment and management of suspected renal colic may have implications on patient and hospital outcomes, particularly quality and cost of care. We developed a clinical practice guideline for our local health district to standardise the assessment and management of ureteric stones in the ED. To the best of our knowledge, there is no literature reporting the benefits and improvements in quality of care after best practice guideline implementation. The aim of this study was to compare patient and hospital outcomes prior to and following implementation of clinical practice guidelines of ureteric stones.

METHODS

Clinical practice guideline

The clinical practice guidelines (see flowchart summary in Figure 1 and clinical practice guidelines in Appendix) were developed to standardise assessment and management of renal colic with best evidence-based practice. The guidelines were developed in consultation with the Urology, Emergency Medicine and Radiology departments. The guidelines were mandatory to follow. ED staff received in-person education on the guidelines and electronic and physical copies were made easily accessible. The guidelines recommend a standardised analgesia regimen of paracetamol, indomethacin and oxycodone as required. The imaging modality was standardised so that all patients with CT-confirmed stones received an X-ray. For those with radio-opaque stones visible on X-ray, X-ray was used as the follow-up imaging modality to minimise radiation exposure. Patients with stones not visible on X-ray received CT-KUB as their subsequent follow-up imaging. The Urology consult criteria was streamlined, including signs of sepsis, stone size >5mm, multiple or bilateral ureteric stones, solitary or transplant kidney, or creatinine >200µmol/L. For patients who met discharge criteria for conservative management, patient and general practitioner factsheets were developed to standardise patient education and follow-up instructions for analgesia and repeat imaging in 4-6 weeks to ensure stone passage. These factsheets were translated from English into Vietnamese, Arabic, and Chinese, the four most commonly spoken languages in the local health district.

Study population

This was a single-centre, quality improvement study. We performed an observational cohort study of consecutive patients presenting to the ED of a metropolitan teaching hospital with renal colic between December 2018 to May 2019, prospectively collected after guideline implementation. A control group of patients were retrospectively collected prior to guideline implementation between December 2017 to May 2018, in a time matched period to account for the seasonal variations on incidence of renal colic.[4] Patients who were <18 years of age or pregnant were excluded from the study. The study was approved by the South Western Sydney Local Health District Human Research Ethics Committee (ETH09934).

Statistical analysis

IBM SPSS Statistics® version 28 (IBM®, Armonk, USA) was used for the statistical analysis. Continuous variables were reported as mean (standard deviation) or median (interquartile range) whereas categorical variables were expressed in total number (percentage) as appropriate. Depending on the assumption of normal distribution, continuous variables between pre- and post-guideline groups were compared using independent t-test or Mann-Whitney U test. In addition, multivariate linear regression was performed to identify risk factors of length of stay in ED and total number of CT scans. Regression coefficient and its 95% confidence interval (95% CI) were calculated.

RESULTS

A total of 528 patients were included in this study. There were 283 patients in the pre-guideline group and 245 patients in the post-guideline group. The patient demographics and clinical characteristics are summarised in table 1. The mean age was 47.8 ± 15.0 years and 24.1% of subjects were female. The post-guideline group had a significantly higher percentage of X-ray and stone identified on X-ray (table 1).

The mean ED length of stay (LOS) (time from ED presentation to discharge or ward admission) was 295.82±178.8 minutes in the pre-guideline group and 253.2±118.2 minutes in the post-guideline group. The ED LOS was significantly shorter after guideline implementation (p=.017, mean difference 0.72, 95% CI 0.29-1.14) (table 2, figure 2A). The association between guideline implementation and ED LOS was statistically significant (p=.022), after controlling for age, gender, X-ray in ED, ultrasound in ED, does not meet urology consult criteria, and urology consult for stone >5mm (table 3). Moreover, ultrasound in ED was associated with longer ED LOS (p=.001).

The mean total number of CT scans patients received over the course of their care was 1.35±1.34 in the pre-guideline group and 1.00±0.68 in the post-guideline group. There was a significant reduction in the number of CT scans in the post-guideline group (p=0.034, mean difference 0.35, 95% CI 0.17-0.53) (table 2, figure 2B). The association between guideline implementation and total number of CT scans remained significant (p<0.0001), after controlling for age, gender, X-ray in ED, ultrasound in ED, does not meet urology consult criteria, and urology consult for stone >5mm (table 3).

There were no differences in admission rate (p=.66), surgery rate (p=.12), time to surgery (p=.094), hospital LOS (p=.43) and re-presentation to ED (p=.18) between the pre- and post-guideline groups.

Patients discharged for conservative management of a ureteric stone had a lower rate of representation in the post-guideline group (12.6%) compared with the pre-guideline group (17.2%), however this did not reach statistical significance (p=.18).

DISCUSSION

To the best of our knowledge, our study is the first to demonstrate the effects of best evidence guideline implementation for renal colic on ED LOS. Managing overcrowding in ED and shortening ED LOS, without compromising patient care, is an important target for any public healthcare system. It has been reported that extended stay in ED results in increased inpatient mortality rate up to 30 days post-admission.[5] Our findings show that these guidelines reduced ED LOS by 42 minutes. This is a clinically significant reduction in the LOS, given the state-based Emergency Treatment Performance target aims for patients to be admitted, transferred, or discharged from ED within 4 hours.[6] A reduced ED LOS has benefits for both patients and the healthcare system. For patients, there were lower rates of left-without-being-seen, ED mortality, inpatient mortality and 30-day mortality.[7,8] At an institutional level, a reduction in ED LOS reduces hospital spending.[9] Unfortunately, these outcomes were not measured in our study.

Furthermore, our guidelines were found to reduce the total number of CT scans a patient receives over the course of their care. Non-contrast computed tomography scan of the kidneys, ureter and bladder (CT-KUB) is the gold-standard imaging modality for renal colic.[2] Patients often receive more than one CT-KUB during the course of their acute illness. Broder et al. (2007) reported 74% of patients who presented with renal colic received a CT scan and 79% had more than 2 scans.[10] Furthermore, the majority of patients will have stone recurrence within five years of an initial stone.[11] This raises concerns regarding potential health impacts associated with radiation exposure. Although low dose or ultra-low dose CT-KUB can be used with preserved sensitivity and specificity,[12] cumulative radiation exposure may increase overall lifetime risk of malignancy by 0.7%.[13] Follow-up imaging is essential to ensure passage of the stone. Patients with ureteric stones who do not report stone passage and do not receive follow-up imaging are at risk of silent obstruction, whereby the presence of renal obstruction is painless.[14,15,16] Plain X-ray KUB is able to identify radiopaque stones, which account for upwards of 60% of stones.[17] Therefore, X-ray KUB may be a suitable follow-up imaging modality for patients with radiopaque stones as it may reduce radiation dose by 7-14-fold.[18] Our guidelines recommend dual initial imaging modalities (CT-KUB and plain X-ray KUB) to identify patients with radio-opaque stones who can then be followed up solely with plain X-ray KUB. Our study has shown that this reduces the number of CT scans by 0.35 total scans on average per patient without any significant changes in the admission rate, time to surgery, hospital LOS, and re-presentation rate. As such, our guidelines may reduce unnecessary radiation exposure without compromising patient safety.

Many patients can be discharged safely from ED for conservative management as approximately 80% of ureteric stones pass spontaneously.[19] However, a significant proportion of patients discharged home to await stone passage often represent to ED due to inadequate pain management or a misunderstanding of their conservative management plan. In an effort to reduce ED re-presentations, we streamlined conservative management by standardising the analgesia regimen to ensure that all patients are discharged with sufficient analgesia. Poor health literacy and language barriers lead to poor adherence to medication instructions, higher hospital re-presentation rates, and poorer health outcomes.[20-22] This is particularly prevalent in our institution as the catchment area includes a large proportion of culturally and linguistically diverse patients, with 62% of residents speaking a language other than English at home.[23] We endeavoured to provide culturally competent care and improve health literacy by developing patient and GP factsheets, available in English, Arabic, Chinese, and Vietnamese, for patients discharged for conservative management of a ureteric stone. These strategies lead to a lower re-presentation rate in the post-guideline group (12.6%) than the pre-guideline group (17.2%).

Our study found that the use of ultrasound KUB was associated with a longer ED LOS (table 3). Ultrasound KUB is performed as a formal ultrasound in the radiology department at our institution, hence, there can be delays in obtaining an ultrasound due to awaiting allocated appointment slots and transfer to the radiology department. Furthermore, ultrasound has limited sensitivity of 70.2% and specificity of 75.4% for ureteric stones, which may influence treatment decisions.[24,25] Hydronephrosis is not an accurate predictor of the presence or passage of ureteric stones with no hydronephrosis in 18% of patients presenting with renal colic and 60% of patients with a persistent stone at follow-up CT.[16] Whilst point-of-care ultrasound may be a useful adjunct to identify patients with hydronephrosis and streamline them to immediately proceed to a CT scan, it should only be performed by appropriately accredited staff and should not routinely replace CT as the imaging modality of choice. Hence, POCUS was not included in the assessment algorithm of our guidelines unless patients were pregnant.

There were several limitations in our study. This study was conducted in a tertiary hospital in a metropolitan Australian centre. There may be variations due to institutional or geographic factors and a multi-centre study should be considered to confirm our findings. We plan to do so once we have implemented these clinical practice guidelines across other hospitals in the local health district. Our clinical practice guidelines standardise a number of parameters in the assessment and management of renal colic. It is difficult to pinpoint which of these specifically led to the improvements in hospital and patient outcomes. Furthermore, outcomes such as morbidity and mortality rate and cost analysis were not included in this study. These are important parameters in determining the efficiency of any intervention implemented in a healthcare system.

The implementation of a clinical practice guideline for ureteric stones reduces the ED LOS and the total number of CT scans in patients who present with renal colic. Standardising the assessment and management of ureteric stones can potentially improve patient and hospital outcomes without compromising the quality of care.

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FIGURES AND TABLES

Figure 1. Emergency department flowchart for first presentation of renal colic.

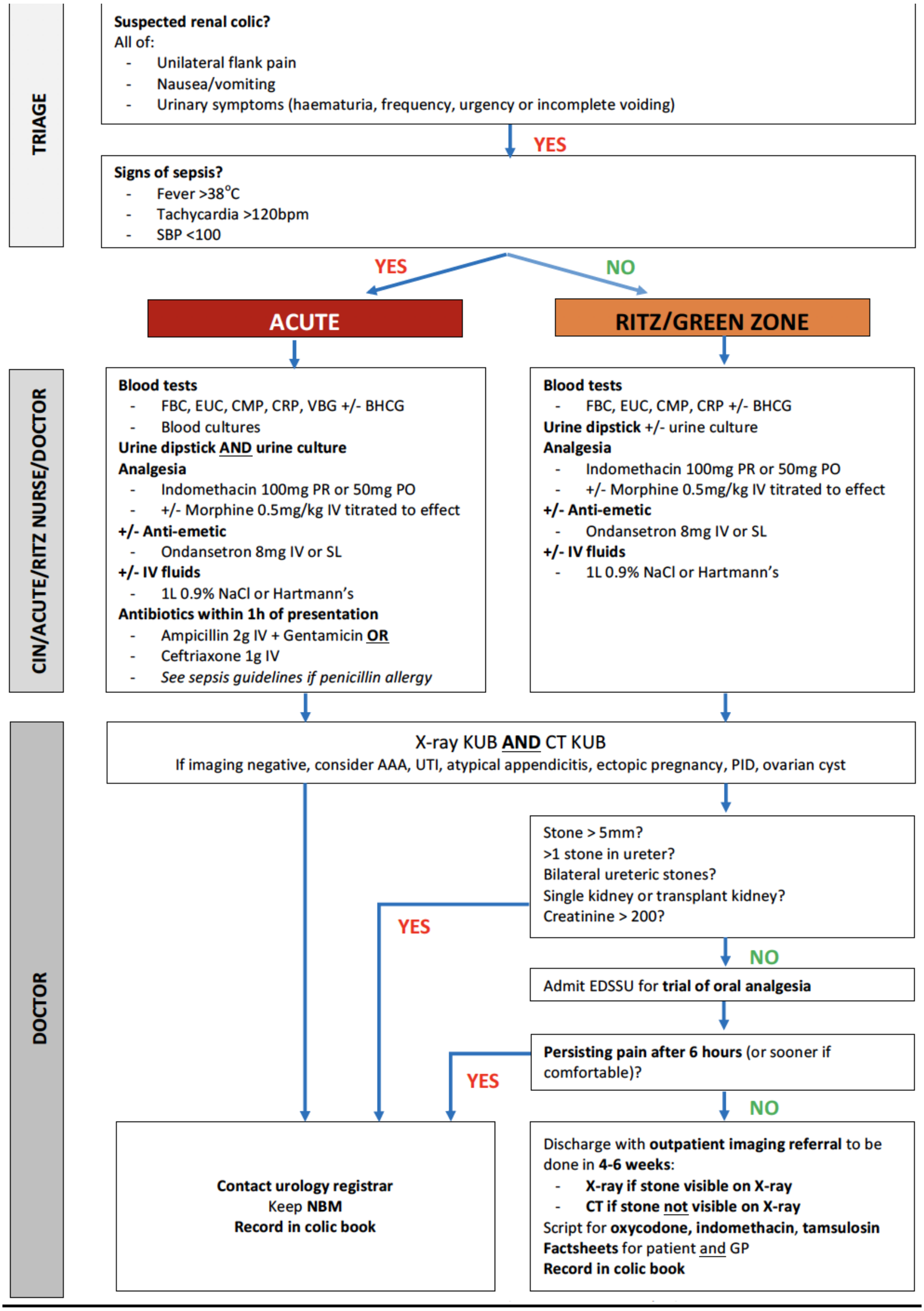

Figure 2. Control charts showing (A) Emergency department length of stay and (B) total number of CT scans per patient. CT: computed tomography; LCL: lower control limit; UCL: upper control limit.

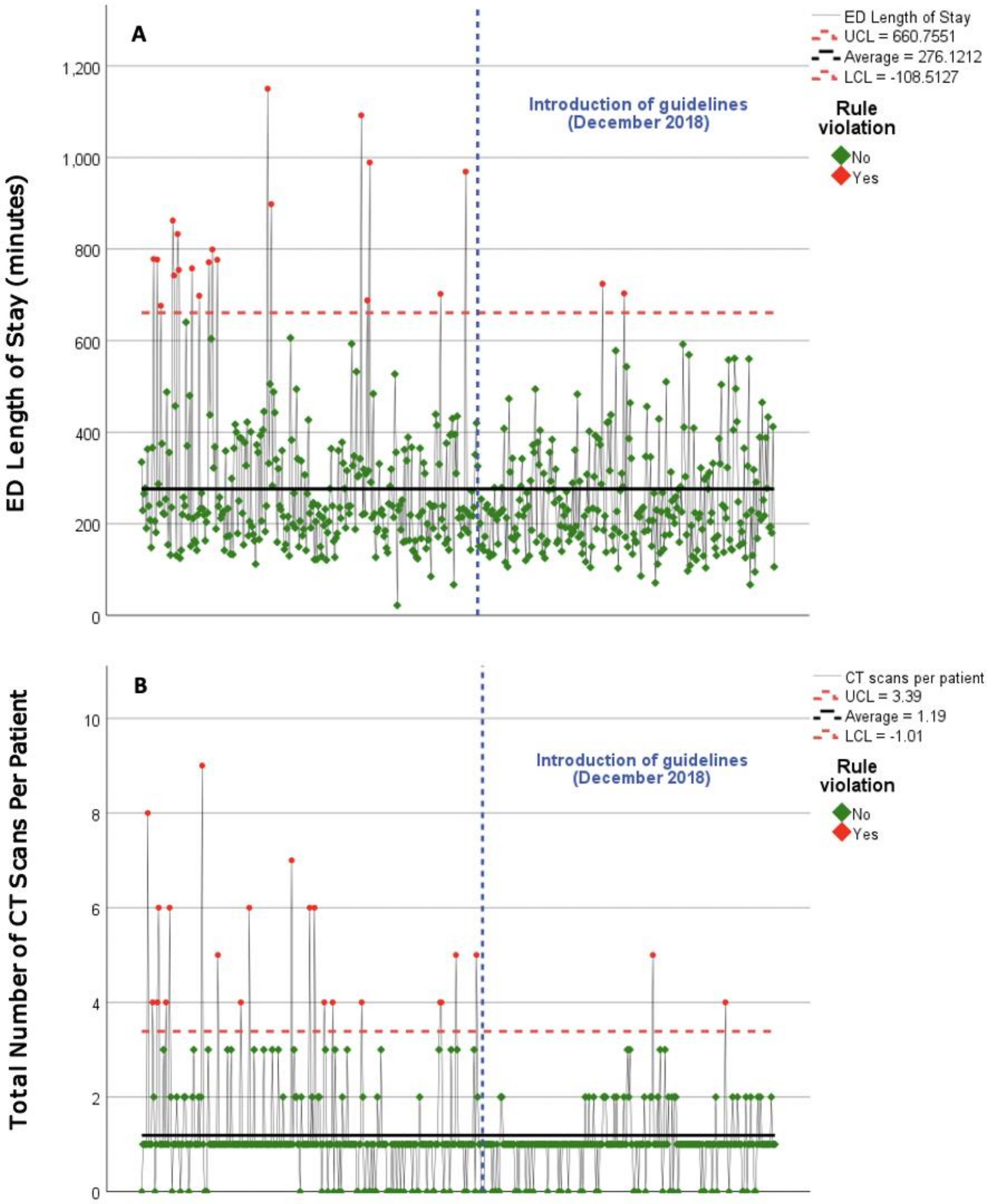

Table 1. Patient demographics and clinical characteristics				
	Mean ± SD or n (%)			**p**
	Pre-guideline	**Post-guideline**	**Total**	
Age (years)	48.5±15.0	47.0±15.0	47.8±15.0	0.28
Female	64 (22.6%)	63 (25.7%)	127 (24.1%)	0.41
X-ray in ED	17 (6.0%)	142 (58.2%)	159 (30.2%)	<0.0001*
Stone on X-ray	11 (73.3%)	60 (42.3%)	71 (45.2%)	0.028*
Stone size on X-ray	3.80±1.30	3.69±2.68	3.70±2.56	0.93
CT in ED	217 (76.7%)	195 (79.6%)	412 (78.0%)	0.42
Stone on CT	174 (81.3%)	154 (79.8%)	328 (80.6)	0.70
Stone size on CT	4.0 (3.0–7.0)	4.0 (3.0–6.0)	4.0 (3.0–6.0)	0.065
Alternative findings on CT	4 (2.4%)	5 (4.0%)	9 (3.0%)	0.42
Incidental CT findings	47 (26.9%)	39 (23.2%)	86 (25.1%)	0.44
Ultrasound in ED	14 (5.0%)	10 (4.1%)	24 (4.6%)	0.64
Urology consult criteria				0.34
No	159 (69.1%)	180 (76.3%)	339 (72.7%)	
Signs of sepsis	5 (2.2%)	1 (0.4%)	6 (1.3%)	
Stone >5 mm	51 (22.2%)	45 (19.1%)	96 (20.6%)	
>1 stone in ureter	4 (1.7%)	1 (0.4%)	5 (1.1%)	
Bilateral stones	3 (1.3%)	2 (0.8%)	5 (1.1%)	
Creatinine >200	5 (2.2%)	3 (1.3%)	8 (1.7%)	
Intractable pain	3 (1.3%)	4 (1.7%)	7 (1.5%)	

*Statistically significant. Results are expressed as mean ± standard deviation, median (interquartile range) or number (percentage). CT: computed tomography; ED: emergency department; SD: standard deviation.

Table 2. Comparison of outcomes before and after clinical practice guideline implementation				
	Pre-guideline	**Post-guideline**	**Total**	**p**
ED LOS				0.017*
Mean ± SD	4.93±2.98	4.22±1.97	4.60±2.59	
Median (IQR)	3.92 (3.12–5.98)	3.73 (2.79–5.21)	3.83 (2.92–5.57)	
Admission, n (%)	67 (23.8%)	62 (25.4%)	129 (24.5%)	0.66
Surgery, n (%)	44 (15.5%)	39 (21.2%)	83 (17.8%)	0.12
Time to surgery	n=38	n=37		0.094
Mean ± SD	24.5±34.0	24.6±15.0	24.5±26.2	
Median (IQR)	15.5 (4.50–32.0)	23 (14.0–28.5)	20.0 (8.0–30.0)	
Hospital LOS, mean ± SD	1.74±1.38	1.92±1.14	1.81±1.29	0.43
Re-presentation, n (%)	41 (17.2%)	26 (12.6%)	67 (15.1%)	0.18
Total number of CT scans				0.034*
Mean ± SD	1.35±1.34	1.00±0.68	1.19±1.10	
Median (IQR)	1.0 (1.0–1.0)	1.0 (1.0–1.0)	1.0 (1.0–1.0)	

*Statistically significant. Results are expressed as mean ± standard deviation, median (interquartile range) or number (percentage). CT: computed tomography; IQR: interquartile range; LOS: length of stay; SD: standard deviation.

Table 3. Multivariate linear regression analysis of emergency department length of stay and total number of CT scans

	Length of stay in ED		Total number of CT scans	
	Coefficient (95% CI)	**p**	**Coefficient (95% CI)**	**p**
Guideline	-0.64 (-1.18 to -0.092)	0.022*	-0.42 (-0.65 to -0.19)	<0.0001*
Age		0.58		0.35
Gender		0.82		0.95
X-ray in ED		0.68		0.14
Ultrasound in ED	1.77 (2.85 to 0.68)	0.001*		0.95
Does not meet urology consult criteria		0.82		0.65
Urology consult for stone >5 mm		0.64		0.16

*Statistically significant. CI: confidence interval; CT: computed tomography; ED: emergency department.