Impact of travel distance on short-term outcomes in patients receiving treatment for urolithiasis: A population-based study

Danielle Jenkins[1], Greg Hosier[1], Marlo Whitehead[2], Darren Beiko[1], Thomas McGregor[1], Joseph Nashed[1], D. Robert Siemens[1]
[1]Department of Urology, Queen's University, Kingston, ON, Canada, [2] ICES-Queen's, Queen's University, Kingston, ON, Canada

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Corresponding author: Dr. Robert Siemens, Department of Urology, Queen's University, Kingston, ON, Canada; robert.siemens@kingstonhsc.ca

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ABSTRACT

Introduction: We aimed to assess the relationship between the distance traveled to receive treatment for urolithiasis and early outcomes.
Methods: This is a population-based study of patients who received interventions for urolithiasis in Ontario between 2003 and 2019 using administrative data. Patients were stratified into three groups according to the distance travelled. Descriptive statistics and the Chi-squared test were used to examine differences between these groups based on the urolithiasis treatment of

choice. The primary outcomes were reoperation rates and readmission rates. To identify the factors associated with the co-primary outcomes, both univariate and multivariable logistic regression models were employed.
Results: A total of 127 195 patients were included in the final analysis, with the majority of patients (n=100 124, 78.7%) having their stone procedure within 30 km from their residence, whereas 9586 patients (7.5%) travelled a distance greater than 90 km. Most of those that travelled >90 km were for extracorporeal shock wave lithotripsy (ESWL) (59%). Type of procedure and region of residence were the only variables that appeared to have a clinically relevant association with greater distance travelled. Unadjusted analysis suggested longer distance travelled was associated with a decrease in the need for a repeat procedure; however, this was likely confounded by an association between distance traveled and procedure type. In adjusted analysis, early post-procedure health resource use did not appear to be dramatically increased with greater distance from care. Indeed, readmission rates at 30 days were marginally lower among those who travelled 30–60 km vs. <30 km (odds ratio [OR] 0.86, 95% confidence interval [CI] 0.80–0.92, and had no detectable difference at >90 km vs. <30 km (OR 0.97, 95% CI 0.88, 1.08). These observations of fewer or no difference in readmissions and emergency visits for those that travelled the greatest distances generally held true in the subgroup analysis for each surgical procedure.
Conclusions: This population-based study found no clinically remarkable associations between the distance travelled for urolithiasis treatment and early outcomes. In fact, some marginal decreases in resource use were observed with greater travel distance perhaps reflecting some effect of travel to higher volume referral centers or enhanced processes for those that needed to travel farther for care. This information could be important for clinicians to help appropriate counselling and health systems planning.

INTRODUCTION

In many jurisdictions, it is common for patients to travel significant distances in order to receive health care. This centralization of care, as in the case of complex surgery, is at times intentional with the goal of improving outcomes by directing patients to higher-volume institutions (1,2). In other situations, it is a result of limited human or technical resources and the impracticality of offering all services in every community. Populations living in non-urban areas are often required to travel to receive treatment, particularly when they require specialized services that are beyond what is offered by their local or regional institutions. The impact of this distance traveled on outcomes and costs is an important factor for physicians, patients and administrative bodies to consider for counseling and health system planning. In urological oncology, previous investigations on the impact of distance for surgical care have produced varied results, however there has been a trend demonstrating a positive association of distance travelled and survival outcomes (3-7). These observations are likely to be, at least in part, a consequence of the optimized care received at the centralized, receiving higher-volume centers for those that travel greater distances.

The surgical management of urolithiasis is an interesting model in which to study these effects of the need to travel for health care. Kidney stones affect approximately 10% of the population in developed countries, with a significant impact on quality of life and mental health (8, 9). Although many patients will ultimately pass smaller stones spontaneously, a significant proportion of patients will require some form of surgical treatment. There are multiple accepted options for any single stone presentation with equipoise for one surgical approach over another. However, these options in some regions are limited by availability of surgical expertise and technology, specifically shockwave lithotripsy (SWL) (10).

A recent study suggested quality of life consequences for those requiring care for urolithiasis at a distance (11). The study suggested that patients with active stone symptoms reported worse health-related quality of life with increased distance traveled to their treatment site. However, other short-term outcomes and subsequent health care utilization relevant to travel for care, with its important economic implications (12), have not been studied. The objective of our study was to investigate the relationship between the distance traveled by patients to receive their urolithiasis treatment and early clinical outcomes. To the best of our knowledge, this represents the first study assessing the impact of distance traveled on patient outcomes following endourologic procedures for urolithiasis.

METHODS

Study design and population

This is a retrospective, population-based cohort study of all patients diagnosed with renal colic in Ontario between April 1, 2003 and December 31, 2019 using linked administrative databases. Patient cohorts were *a priori* divided into three groups (<30km, 30-90km, and > 90km) representing distances travelled to treatment institutions from their recorded residence. Those who did not receive any form of intervention (SWL, ureteroscopy (URS), or percutaneous nephrolithotomy (PCNL)) were excluded. Further exclusion criteria were patients who had a renal colic episode in the year prior to assess treatment and outcomes of a new, incident renal colic episode. This study was approved by the Queen’s University Health Sciences and Affiliated Hospitals Research Ethics Board. All data were fully anonymized before accessing them and requirement for informed consent was waived.

Data source

Linked administrative databases were accessed through ICES. These databases capture all family practitioner visits, emergency department visits, specialist clinic visits, inpatient stays and procedures. Each database is routinely used for research purposes and has been previously validated (13). Codes utilized in this study have been previously published (14) and the team accessed the dataset between August 2019 and January 2022. Assessment of the billing codes for

URS, comparing to the abstracted data from the Canadian Institute of Health Information (CIHI), demonstrated variation in coded surgical procedures. For this assessment, URS was determined to be performed if any retrograde procedure was coded in CIHI (including laser lithotripsy, basket extraction and stenting). Statistics Canada 2016 census data was used to infer income quintile by linking postal code of residence to the mean household income by dissemination area.

Covariates
Covariates utilized for the adjusted models were determined a priori and conceptualized as patient-related confounding variables such as age, sex, remote need for stone surgery (> 1 year prior to index renal colic) and comorbidities (Charlson index) [19]. Furthermore, as an assessment of the severity or complexity of the original colic episode, other covariates included total duration of the renal colic episode and number of emergency department and primary care visits during their renal colic episode. As time required for stone passage is variable, we estimated the duration of the acute stone event as the date of index urolithiasis diagnosis plus 30 days after the last urolithiasis visit or 30 days after any procedure date.

Outcomes
The co-primary outcomes defined a priori were reoperation rates and 30-day readmission rates. Other outcomes of interest such as emergency room visits post-surgery were also assessed. Reoperation rates were defined as a second stone procedure (URS, SWL or PCNL) within 6 months. Readmission rates and emergency department visits, for any diagnosis, were measured within both 30 days and 90 days following the initial surgical procedure.

Statistics
Descriptive statistics (means, SDs, medians, and IQRs for continuous characteristics; proportions for categorical characteristics) were used for demographic and baseline characteristics. To compare proportions between groups the Chi-square test was used. One-way ANOVA and the Kruskal-Wallis test were used to compare means and ranked values of continuous covariates between groups. To identify the factors associated with the co-primary outcomes, both univariate and multivariable logistic regression models were used. All patient-related and care-related variables included in the original models are noted. Given the large geographic area of Ontario, access to stone specialists and technology can be dispersed, specifically SWL with only three units for the entire province, so we performed a test of interaction terms of travel distance and procedure type with the co-primary outcomes. A two-sided p-value of <0.05 was considered statistically significant. Statistically significant interaction terms were left in the model. As per institutional policy, cells with <6 patients were not reported due to privacy concerns. Data were analysed using SAS/Stat. 14.3 (SAS Institute, Cary, NC, USA).

RESULTS
The dataset comprised a total of 127,195 patients receiving a stone procedure after exclusions were applied. Baseline characteristics are described in Supplementary Table 1. No clinically

relevant differences were observed across the three cohorts based on distance travelled for surgical care other than region of residence within the province which is reflective of relative rurality. The majority of patients (n=100,124, 78.7%) had their stone procedure within 30kms from their residence whereas 9,586 patients (7.5%) travelled a distance greater than 90kms. The most common intervention for the entire cohort was URS, whereas PCNL was the least common procedure. As expected, given the restricted availability to only three centers, more patients travelled greater than 90kms to receive SWL when compared to both URS and PCNL (Table 1).

With respect to the outcomes assessed (Table 1), the second stone procedure rate for the whole population was 49%. This rate is higher than other contemporary series and likely to be secondary to the inclusion of all retrograde ureteral procedures (potentially also reflecting "pre-stenting" in those with acute colic/septic patients). Admissions to hospital after the date of the surgical procedure was 7% and 12% at 30 and 90 days respectively. Emergency department (ED) visits were recorded for 13% of interventions at 30 days. At 90 days post procedure, 17% had an ED visit with 9% requiring the ED 2 or more times. There were no clinically remarkable differences observed between the three distance cohorts, although those that had surgery closer to home (0-30km) had statistically more frequent ED visits at 30 and 90 days. In unadjusted analysis, several patient-related factors were associated with either or both reoperation and readmission including age, sex and comorbidity (Supp Table 2 and Table 3). Furthermore, an assessment of the complexity of the initial renal colic episode (and an assumption of stone characteristics or pain experience as measured by duration and number of health provider visits) were also associated with reoperation and readmission rates. The exposure of interest, distance travelled for surgery, was associated with reoperation with an odds ratio (OR) 0.71 (95% confidence interval (CI) 0.68, 0.74) for those needing to travel >90kms (Supp Table 2). Those needing to travel <30kms had a repeat procedure 50% of the time compared to 41% in the >90km cohort. Interestingly, in unadjusted analysis there was an inverse association of distance traveled and readmission rates after 30 days [OR >90kms 0.88 (95% CI 0.81, 0.96)].

In adjusted analysis, several patient and renal colic/urolithiasis complexity variables remained significantly associated for the need for repeat surgery including age, comorbidity and duration of the renal colic episode (Supp Table 2). The most significant driver of reoperation appeared to be first procedure type which was noted to vary by distance traveled (p for interaction <0.001). Specifically, PCNL was associated with elevated odds of repeat surgery relative to URS at distances of 30 km or less (aOR 1.19, 95% CI 1.13 – 1.25) but with lower relative odds of repeat surgery at higher distances (Table 2). In this model, distances greater than 30 km were associated with lower relative odds of repeat surgery for patients who initially received PCNL, though there was little difference in adjusted ORs between the two higher distance categories (>30 – 90 KM aOR: 0.69, 95% CI 0.62 - 0.78; >90 km aOR: 0.64, 95% CI 0.55 - 0.76). Subsequent stratified analyses were performed by surgery type. For URS and SWL, distance was not associated with reoperation rates (Table 4). For PCNL, there was inverse association with those traveling greater distances having a lower requirement for reoperation

(reoperation rate 45% >90kms vs. 56% <30kms). Stent removal based on CCI codes from CIHI were documented as 9.8% for ESWL, 38.6% for PCNL and 38.2% from URS. There did appear to be fewer stent removal procedures documented based on distance from care: 0 – 30 kms (36.1%), >30 – 90 (34.1%), and >90 (23.4%) although it is likely these are underestimated based on patient self-removal.

With respect to the other co-primary outcome, several patient- and renal colic episode-related variables were associated with 30 day readmission after surgery (Table 3). Unsurprisingly, PCNL had a higher likelihood of readmission on adjusted analysis OR 1.79 (95% CI 1.67, 1.93). Interestingly, moderately greater distance for surgical care was associated with lower readmission to hospital, with no detectable difference for distances >90 kms. However, this was also likely reflective of the relationship between distance and type of surgery, though the test of interaction did not attain the traditional value for statistical significance (p=0.07). On the stratified analysis by surgery type, all the other short-term outcomes of readmissions and ED visits consistently trended to be associated with lower utilization for those that traveled greater distances (Supplemental Table 2).

DISCUSSION

In this population-based study of 127,195 patients who received surgical treatment for urolithiasis in the province of Ontario, we did not identify any clinically remarkable associations between early outcomes and the distance travelled by patients to receive their treatment. Nonetheless, certain interesting trends regarding health care utilization were noted for those that needed to travel greater distances. Unadjusted analysis suggested longer distance travelled was associated with a decrease in the need for a repeat procedure, however this was likely confounded by an association between distance traveled and SWL which is widely dispersed throughout the province. Indeed, longer travel distance was not remarkably associated with increased need for reoperation in stratified analysis. Interestingly, early post-procedure health resource utilization did appear to be decreased with greater distance from care. Readmission rates at 30 days were marginally lower amongst those who travelled further for care (>30 km), and this held true in the subgroup analysis for each surgical procedure. As far as we are aware, this is the first study that sought to assess the impact of distance traveled on early clinical outcomes in patients receiving treatment for urolithiasis.

The need for early reoperation was chosen a priori as a primary outcome of interest given its established role as a quality indicator (16) and its impact on health resources given its relative frequency in stone management. When assessed globally, increased travel distance was associated with a decreased need for re-treatment. However, this observation was modified on adjusted analysis as those travelling greater distances were more likely receiving SWL with observed lower re-treatment rates. Indeed, those who travelled the greatest distance for SWL and URS had no significant effect on need for repeat procedures. Those that travelled longer distances for PCNL had a decreased need for repeat surgery compared to those who had PCNL close to home (<30 kms). The underlying mechanisms for this is unclear, however one could hypothesize that this could be secondary to patient selection or counseling in that those who chose to take on the burden of additional travel to receive care such as PCNL may be managed differently to avoid further surgical interventions, with a higher likelihood of treatment success. These observations may reflect appropriate shared decision making but might also be relevant for health systems planning given the economic implications (12).

The other primary outcome for this study did not demonstrate higher rates of 30-day readmission associated with increased travel distance and, in fact, these outcomes favored those treated further away from home. Most of the other early outcomes assessed tended to lower resource utilization with longer distance travelled for surgery. These statistically significant, though clinically marginal, differences were consistent with all procedures. These observations are difficult to reconcile but may be driven by enhanced post-operative information and follow-up arrangements for patients who are living at a distance from their procedure provider, leading to less ED visits and subsequently admissions to hospital. Access to care and thresholds for seeking care post treatment for those that need to travel a fair distance may also contribute to these observations.

In alignment with previous studies, particularly in complex urological cancer surgery that have demonstrated a tendency towards improved outcomes in those who travel further distances, these data demonstrate a similar trend in those receiving treatment for urolithiasis. Those previous observations likely reflect a benefit of passive centralization, capitalizing on the volume outcome paradigm for more complex care in higher volume centers of expertise (1). Although based on the strong volumes-outcomes literature, such regionalization can result in a complex relationship with quality outcomes with potential for access issues for a substantial proportion of patients in the population and worsen existing disparities between patients based on rurality (17). In the context of renal stone management, many aspects of care are within the skill set of practicing urologists, and the variations in surgical expertise and institutional protocols may be less impactful. However, given the results from Narang et al (11) suggesting a worse health-related quality of life in patients who travelled further to receive their urolithiasis treatment, these current results suggests that these trends of equivalent post-procedure period may be reassuring.

One of the main strengths of this study is the large population reflecting routine care of patients with urolithiasis in the province of Ontario. It is important to recognize that this large sample size and its subsequent high power to identify subtle differences amongst the groups may not be clinically relevant. Additionally, Ontario is served by three fixed lithotripter machines rather than the mobile units seen in other jurisdictions, perhaps making these findings less relevant to those populations. Other limitations include those associated with retrospective, observational studies. Although this dataset does include general information regarding disease state, treatments obtained and related outcomes it does lack patient specific details such as specific individual pre-operative risk, imaging data, and patient preferences. Additionally, the primary outcomes were selected as surrogates for more definitive clinical measures such as stone-free rates following treatment. The rates of re-operation were higher than expected from contemporary surgical series, specifically for URS. This likely reflects the fact that this cohort was defined by any retrograde procedure after a renal colic diagnosis and may reflect stenting in the acute setting or those presenting with a possible septic picture. Further, reoperation could have included any retrograde procedure including stent removal. Finally, distance to care was conceived a priori as a categorical variable, given the geographic population in the province and the concern with linearity as a continuous variable.

CONCLUSIONS

In conclusion, this population-based study found no clinically remarkable associations between the distance travelled by patients to receive their urolithiasis treatment and early outcomes. Indeed, some marginal decreases in resource utilization were observed with greater travel distance and this information could be important for clinicians to help appropriate counselling and future health systems planning.

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FIGURES AND TABLES

Table 1. Surgical and early outcome characteristics by travel distance to surgical institution

	Travel Distance <30 km	**Travel distance 30–90 km**	**Travel distance >90 km**	p[a]
	n=100 124	**n=17 485**	**n=9586**	
1st surgery type				
SWL	6655 (7%)	2761 (16%)	5643 (59%)	<0.001
PCNL	7204 (7%)	1429 (8%)	656 (7%)	
URS	86 265 (86%)	13 295 (76%)	3287 (34%)	
Time to surgery from index visit				
Mean ± SD	19.68±35.41	20.68±37.13	19.15±34.58	<0.001
Median (IQR)	3 (0–21)	3 (0–24)	2 (0–23)	<0.001
Need for repeat procedure				
No	50 117 (50%)	9104 (52%)	5614 (59%)	<0.001
Yes	50 007 (50%)	8381 (48%)	3972 (41%)	
2nd surgery type				
SWL	6101 (12%)	1010 (12%)	809 (20%)	<0.001
PCNL	2577 (5%)	402 (5%)	199 (5%)	
URS	41 329 (83%)	6969 (83%)	2964 (75%)	
# readmissions within 30 days post-surgery				
0	93 243 (93%)	16 324 (93%)	9001 (94%)	0.012
1+	6881 (7%)	1161 (7%)	585 (6%)	
# readmissions within 90 days post-surgery				
0	87 778 (88%)	15 430 (88%)	8561 (89%)	<0.001
1+	12 346 (12%)	2055 (12%)	1025 (11%)	
# ED visits within 30 days post-surgery				
0	83 033 (83%)	13 998 (80%)	7704 (80%)	<0.001
1	12 674 (13%)	2468 (14%)	1315 (14%)	
2+	4417 (4%)	1019 (6%)	567 (6%)	
# ED within 90 days post-surgery				

0	75 605 (76%)	12 525 (72%)	6889 (72%)	<0.001
1	16 223 (16%)	3086 (18%)	1667 (17%)	
2+	8296 (8%)	1874 (11%)	1030 (11%)	

[a]Chi-squared test for categorical variables, one-way ANOVA for means, Kruskal-Wallis test for medians. Column percentages, may not add to 100% due to missing or unrepresented data. IQR: interquartile range; ED: emergency department; PCNL: percutaneous nephrostolithotomy; PCP: primary care physician; SD: standard deviation; SWL: shockwave lithotripsy; URS: ureteroscopy

Table 2. Associations of distance and first surgery type and reoperation, including interaction terms

		Interacting characteristic	**Interacting characteristic level**	**Odds ratio (95% CI)**
1st surgery type	URS	N/A		1.00 (Ref.)
	ESWL	Distance from surgery	0–30	0.56 (0.53–0.59)
			>30–90	0.60 (0.55–0.65)
			>90	0.58 (0.53–0.64)
	PCNL	Distance from surgery	0–30	1.19 (1.13–1.25)
			>30–90	0.84 (0.75–0.94)
			>90	0.80 (0.68–0.95)
Distance from surgery	0 - 30	N/A		1.00 (Ref.)
	>30–90	1st surgery type	ESWL	1.05 (0.96 –1.15)
			PCNL	0.69 (0.62–0.78)
			URS	0.99 (0.95–1.02)
	>90	1st surgery type	ESWL	1.00 (0.92–1.07)
			PCNL	0.64 (0.55–0.76)
			URS	0.95 (0.89–1.02)

[a]Controlled in logistic regression for all covariates including interaction term. PCNL: percutaneous nephrostolithotomy; SWL: shockwave lithotripsy; URS: ureteroscopy.

Table 3. Associations between patient and stone characteristics and 30-day readmission rates after stone surgery

		Unadjusted model		**Adjusted model[a]**	
	Rate (%)	**Odds ratio**	**p**	**Odds ratio**	**p**
Age at index date					
0–18	9.98	1.54 (1.27–1.87)	<0.001	1.52 (1.24–1.86)	<0.001
19–39	6.70	Reference	–	Reference	–
40–59	5.66	0.84 (0.78–0.89)	–	0.98 (0.92–1.05)	–
60–79	7.43	1.12 (1.05–1.19)	–	1.33 (1.24–1.43)	–
80+	11.67	1.84 (1.68–2.02)	–	1.99 (1.80–2.20)	–
Sex					
Female	6.94	1.04 (1.00–1.09)	0.06	1.13 (1.07–1.18)	<0.001
Male	6.67	Reference	–	Reference	–
Distance (km)					
<30	6.87	Reference	0.01	Reference	<0.001
>30–90	6.64	0.96 (0.90–1.03)	–	0.86 (0.80–0.92)	.
>90	6.10	0.88 (0.81–0.96)	–	0.97 (0.88–1.08)	.
Charlson Index					
0	6.06	Reference	<0.001	Reference	<0.001
1–2	11.41	2.00 (1.87–2.13)	–	1.92 (1.79–2.06)	–
3+	15.26	2.79 (2.54–3.07)	–	2.66 (2.40–2.95)	–
Remote history stone surgery					
No	6.77	0.90 (0.77–1.05)	0.17	0.73 (0.62–0.85)	<0.001
Yes	7.46	Reference		Reference	.
Surgery type					
SWL	3.86	0.55 (0.50–0.60)	<0.001	0.80 (0.73–0.88)	<0.001
PCNL	11.20	1.73 (1.61–1.85)	–	1.79 (1.67–1.93)	–
URS	6.81	Reference	–	Reference	–
Duration renal colic episode (days)					
<60	7.23	1.46 (1.38–1.55)	<0.001	2.42 (2.26–2.59)	<0.001
≥60	5.06	Reference	.	Reference	.
# ED visits during renal colic episode					
0	2.78	0.11 (0.10–0.11)	<0.001	0.07 (0.06–0.08)	<0.001

1	11.49	0.48 (0.45–0.52)	–	0.37 (0.35–0.40)	–
2	16.76	0.75 (0.69–0.81)	–	0.64 (0.59–0.70)	–
>2	21.23	Reference	–	Reference	–
# PCP visits during renal colic episode					
0	6.11	0.79 (0.74–0.85)	<0.001	0.98 (0.91–1.06)	0.22
1	7.34	0.97 (0.90–1.04)	–	1.04 (0.96–1.13)	–
2	7.41	0.98 (0.90–1.06)	–	0.99 (0.91–1.09)	–
>2	7.57	Reference	–	Reference	–

[a]Controlled in logistic regression for all covariates listed. ED: emergency department; PCNL: percutaneous nephrolithotomy; PCP: primary care physician; SWL: shockwave lithotripsy; URS: ureteroscopy.

Table 4. Stratified analysis of distance travelled and short-term outcomes by surgery type

	Distance travelled <30 km	**Distance Travelled 30–90 km**	**Distance travelled >90 km**	
SWL	**6655**	**2761**	**5643**	**p[a]**
Reoperation				
No	4288 (64%)	1766 (64%)	3617 (64%)	0.883
Yes	2367 (36%)	995 (36%)	2026 (36%)	
Readmission 30 days post-surgery				
0	6413 (96%)	2663 (96%)	5401 (96%)	0.111
1 +	242 (4%)	98 (4%)	242 (4%)	
Readmission 90 days post-surgery				
0	6220 (93%)	2577 (93%)	5233 (93%)	0.259
1 +	435 (7%)	184 (7%)	410 (7%)	
ED within 90 days post-surgery				
0	5345 (80%)	2159 (78%)	4367 (77%)	0.001
1	904 (14%)	401 (15%)	859 (15%)	
2 +	406 (6%)	201 (7%)	417 (7%)	
URS	n=86 265	n=13 295	n=3287	
Reoperation				
No	42 671 (49%)	6576 (49%)	1636 (50%)	0.942
Yes	43 594 (51%)	6719 (51%)	1651 (50%)	
Readmission 30 days post-surgery				
0	80 429 (93%)	12 384 (93%)	3029 (92%)	0.052
1 +	5836 (7%)	911 (7%)	258 (8%)	

Readmission 90 days post-surgery				
0	75 665 (88%)	11 694 (88%)	2812 (86%)	<0.001
1 +	10 600 (12%)	1601 (12%)	475 (14%)	
ED within 90 days post-surgery				
0	65 091 (75%)	9371 (70%)	2073 (63%)	<0.001
1	14 030 (16%)	2429 (18%)	686 (21%)	
2 +	7144 (8%)	1495 (11%)	528 (16%)	
PCNL	n=7204	n=1429	n=656	
Reoperation				
No	3158 (44%)	762 (53%)	361 (55%)	<0.001
Yes	4046 (56%)	667 (47%)	295 (45%)	
Readmission 30 days post-surgery				
0	6401 (89%)	1277 (89%)	571 (87%)	0.285
1 +	803 (11%)	152 (11%)	85 (13%)	
Readmission 90 days post-surgery				
0	5893 (82%)	1159 (81%)	516 (79%)	0.13
1 +	1311 (18%)	270 (19%)	140 (21%)	
ED within 90 days post-surgery				
0	5169 (72%)	995 (70%)	449 (68%)	0.053
1	1289 (18%)	256 (18%)	122 (19%)	
2 +	746 (10%)	178 (12%)	85 (13%)	

[a]Chi-squared test. ED: emergency department; PCNL: percutaneous nephrolithotomy; SWL: shockwave lithotripsy; URS: ureteroscopy.