

# The rising burden of acute urological disease at an urban, academic hospital network

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Appendix available at [cuaj.ca](http://cuaj.ca)

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## Abstract

**Introduction:** Urological presentations to the emergency department (ED) can represent a significant burden of disease. We aimed to evaluate trends in the incidence, management, and followup of urological presentations to the ED at an urban, academic, tertiary-care hospital network over a 10-year period.

**Methods:** A retrospective cohort study was conducted to include all patients presenting with renal colic (RC), gross hematuria (GH), or acute urinary retention (AUR) to EDs in the University Health Network in 2008–2009 and 2018–2019. Patient demographics and outcomes were compared between these two periods and between urological presentations. Multilevel regression analyses identified predictors of in-patient admission, return to the ED, and clinic wait time.

**Results:** A total of 2751 patients and 3510 ED visits were included (991 visits from 2008–09 and 2519 visits from 2018–19). Over time, increases were observed in all three presentations, largely driven by an almost five-fold increase in RC presentations. Multilevel regression analyses showed that older patients were more likely to be admitted from the ED, while age, 2018–19 era, and residence within the “downtown core” independently predicted return to the ED within 30 days of initial visit. Time to be seen in urology clinic increased over time for the entire cohort, and 14.4% of clinic visits were preceded by multiple ED visits.

**Conclusions:** The incidence of acute urological presentations increased significantly over a 10-year period at a tertiary-care hospital network. These findings demonstrate an increasing burden of acute urological disease that is outpacing population growth and straining available resources.

## KEY MESSAGES

- Renal colic, gross hematuria, and acute urinary retention presentations to the ED have risen above and beyond population growth.
- Rates of return to the ED within 30 days of initial presentation have increased.
- Wait time to be seen in clinic for followup has also increased; a substantial percentage of clinic visits are preceded by multiple ED visits.
- With a growing and aging population, appropriate resources must be allocated to meet the rising burden of acute urological disease.

## Introduction

Renal colic (RC), gross hematuria (GH), and acute urinary retention (AUR) are common urological presentations in the emergency department (ED). Approximately 11% of men and 7% of women report a history of stone disease, with a significant proportion reporting a history of renal colic.<sup>1</sup> Given the association of benign prostatic hyperplasia (BPH) with age, AUR is becoming increasingly common with an aging population.<sup>2,3</sup> The cumulative incidence rate of urinary retention is approximately 2% without intervention and 0.5–1% with pharmaceutical treatment among men with symptoms related to BPH.<sup>4</sup> Gross hematuria is also associated with BPH, as well as urological malignancy, the prevalence of which increases with age.<sup>5,6</sup>

With a growing and aging population, healthcare institutions must carefully delineate the full burden of urological disease in the ED in order to successfully allocate resources and implement pathways for minimizing patient morbidity, all the while optimizing cost efficiency.<sup>7,8</sup> The main objective of our study was to evaluate, from a resource utilization perspective, trends in the incidence, management, and followup of patients presenting to the ED with RC, GH, and

AUR at an urban, academic hospital network between the years 2008–09 and 2018–19.

## Methods

### Study design

A retrospective cohort study was conducted at University Health Network (UHN) using administrative data, which was provided by the UHN Decision Support department. UHN is a large network of academic tertiary-care hospitals located in Toronto (Ontario, Canada) with two EDs: one at Toronto General Hospital (TGH) and the other at Toronto Western Hospital (TWH).

Adults presenting to either the TGH or TWH ED during the time periods of May 2008 to August 2009 or May 2018 to August 2019 with 1) RC; 2) GH; or 3) AUR were included in the study. Patients were managed according to the discretion of the attending ED physician and categorized into the aforementioned diagnostic groups based on either the discharge diagnosis or admission diagnosis. ED patient data was charted using a common electronic patient record (CPOE; EPR, QuadraMed Corporation).<sup>9</sup>

The following variables were collected: medical record number (used only initially for data linkage and capture of repeat visits), ED registration date, main diagnosis at ED visit (i.e., RC, GH, or AUR), age, gender, three-digit postal code (used to determine residential borough), if surgery occurred at UHN within 30 days before the initial ED visit, if the initial ED visit was by a new UHN patient, if the initial ED visit resulted in admission to the hospital, if the initial ED visit was associated with a followup visit at a UHN urology clinic, and the number of days from the initial ED visit to being seen in the clinic (capped at six months). While place of residence was captured for 10 different boroughs, we combined Downtown Toronto and Central Toronto to create a “downtown core” region in order to identify patients residing relatively near UHN EDs.

We compared characteristics and outcomes between the 2008–09 and 2018–19 periods in order to evaluate whether there were differences in the incidence, management, and followup of urological presentation to the ED. Institutional ethics board approval was obtained for this study. Analyses were performed for combined and individual urological presentations.

### Statistical analyses

Continuous variables were summarized with mean, median, and standard deviation (SD), and compared using Welch's t-test or the Mann-Whitney U test. Categorical variables were reported with counts and percentage, and compared using Chi-squared test or Fisher's exact test.

Multilevel regression analyses were performed using a generalized linear mixed model by setting a random y-intercept for each patient, as some patients contributed to multiple ED visits. Patient age was scaled and centered to allow for model fit, and then re-transformed and exponentiated. Maximum likelihood using Laplace approximation was also used for model fit. Models were adjusted for age (per decade), gender, year of presentation, and patient residence (within vs. outside “downtown core”). For combined presentations, models were additionally adjusted for type of urological presentation. Adjusted odds ratio (aOR) or incidence rate ratio (IRR) was calculated for each model, along with standard error (SE), 95% confidence interval (CI), and p-value. A p-value of less than 0.05 was considered statistically significant. Regression analyses were performed using the *lme4* package (R statistical software),<sup>10</sup> while Microsoft Excel was used for other statistics.

## Results

In 2008–09, TGH had 32 545 ED visits and 398 beds in operation, while TWH had 47 108 ED visits and 247 beds.<sup>11</sup> In 2018–19, TGH had 54 794 ED visits and 451 beds, while TWH had 71 215 ED visits and 283 beds.<sup>12</sup>

A total of 3510 urological ED visits were included, of which 991 were from 2008–09 and 2519 were from 2018–19 (Table 1). The incidence of RC presentations to the ED increased from 248 in 2008–09 to 1138 in 2018–19, as did the incidence of GH presentations (n=370 in 2008–09 vs. n=702 in 2018–19) and AUR presentations (n=373 2008–09 vs. n=679 in 2018–19) (Supplementary Table 1; available at [cuaj.ca](http://cuaj.ca)).

In 2008–09, mean (SD) age was 62.6 (18.5) years and 80.5% of ED visits were by male patients (Table 1). Most visits occurred in the summer (37.1%), followed by the spring (28.7%), fall (17.8%), and winter (16.4%). Most visits were by patients residing in the Downtown Toronto borough (25.8%), and 35.6% of visits were by patients residing in the “downtown core.” In the 2018–19 cohort, urological ED patients were younger (60.1 years,  $p<0.001$ ) and less likely to be male (76%,  $p=0.0036$ ). Most visits in 2018–19 also occurred in the summer (34.2%), followed by the spring (29.7%), fall (18.5%), and winter (17.6%). Likewise, most visits were by patients residing in the Downtown Toronto borough (27.5%), and 38.7% of visits were by patients residing in the “downtown core.”

Surgical data was only available for the 2018–19 cohort. For the entire cohort, 7.9% of ED visits occurred within 30 days of surgery (urological and non-urological procedures): 2.3% of RC, 14.7% of GH, and 10.5% of AUR presentations. Differences in proportions between strata were significant at  $p<0.001$ . Likewise, hospital admission data was only available for the 2018–19 cohort. For combined presentations, 10.2% of visits resulted in admission. Patients presenting to

**Table 1. Characteristics of 2751<sup>†</sup> unique patients presenting to the ED with RC, GH, or AUR stratified by year of ED visit and summarized for combined urological presentations (tallied as ED visits unless indicated otherwise)**

Characteristic	Full sample	2008–2009	2018–2019	Change	p
ED visits	3510	991	2519	+1528 visits	
Mean age in years (SD)	60.8 (19.2)	62.6 (18.5)	60.1 (19.4)	-2.5 years <sup>‡</sup>	<0.001**
Median age in years (min, max)	63.8 (15.4, 101.9)	64.4 (15.4, 97.7)	63.3 (17.2, 101.9)	-1.1 years <sup>‡</sup>	
Gender					0.0036*
Female	798 (22.7%)	193 (19.5%)	605 (24%)	+4.5%	
Male	2712 (77.3%)	798 (80.5%)	1914 (76 %)	-4.5%	
Season					0.43
Spring	1033 (29.4%)	284 (28.7%)	749 (29.7%)	+1.1%	
Summer	1229 (35%)	368 (37.1%)	861 (34.2%)	-3.0%	
Fall	642 (18.3%)	176 (17.8%)	466 (18.5%)	+0.7%	
Winter	606 (17.3%)	163 (16.4%)	443 (17.6%)	+1.1%	
Borough					0.0016*
Downtown Toronto	948 (27%)	256 (25.8%)	692 (27.5%)	+1.6%	
Central Toronto	379 (10.8%)	97 (9.8%)	282 (11.2%)	+1.4%	
East Toronto	84 (2.4%)	21 (2.1%)	63 (2.5%)	+0.4%	
West Toronto	625 (17.8%)	169 (17.1%)	456 (18.1%)	+1.0%	
North York	243 (6.9%)	80 (8.1%)	163 (6.5%)	-1.6%	
East York	70 (2%)	22 (2.2%)	48 (1.9%)	-0.3%	
York	376 (10.7%)	133 (13.4%)	243 (9.6%)	-3.8%	
Etobicoke	190 (5.4%)	69 (7%)	121 (4.8%)	-2.2%	
Scarborough	103 (2.9%)	22 (2.2%)	81 (3.2%)	+1.0%	
Other	492 (14%)	122 (12.3%)	370 (14.7%)	+2.4%	
Downtown core					0.096
Within core	1327 (37.8%)	353 (35.6%)	974 (38.7%)	+3.1%	
Outside core	2183 (62.2%)	638 (64.4%)	1545 (61.3%)	-3.1%	

<sup>†</sup>Patients who visited the ED on more than one occasion were counted only once. <sup>‡</sup>Despite age increasing over time for all individual urological presentations (Supplementary Table 1; available at [cuaj.ca](http://cuaj.ca)), age decreased for combined presentations, which is explained by renal colic patients being much younger than AUR and GH patients, and RC visits making up a larger proportion of all ED visits in 2018–19 than in 2008–09 (i.e., 25.0% vs. 45.2%, respectively). \*Significant difference between 2008–2009 and 2018–2019 at p<0.05. \*\*Significant difference at p<0.001. AUR: acute urinary retention; ED: emergency department; GH: gross hematuria; RC: renal colic.

the ED with GH were most likely to be admitted: 19.5% of visits resulted in admission, while 6.7% of RC and 6.3% of AUR presentations resulted in admission. Differences in proportions between strata were significant at p<0.001.

A significantly greater proportion of GH presentations by new UHN patients occurred in 2008–09 (15.1%) than in 2018–19 (7.7%) (p<0.001) (Table 2). No significant differences were observed between the two periods for combined (2008–09: 18.1% vs. 2018–19: 18.5%), RC (2008–09: 32.3% vs. 2018–19: 30.7%), or AUR (2008–09: 11.5% vs. 2018–19: 9.3%) presentations. A significantly greater proportion of ED visits by new UHN patients was associated with residence within vs. outside the “downtown core” for both combined (within: 16.2% vs. outside: 19.7%, p<0.05)

and AUR (within: 6.7% vs. outside: 12.3%, p<0.05) cohorts, but not for RC (within: 29.1% vs. outside: 32.0%, p=0.25) or GH (within: 9.7% vs. outside: 10.6%, p=0.68) cohorts.

In 2018–19, significantly greater proportions of GH and AUR presentations were associated with return to the ED within 30 days of the initial visit; 35.9% of GH and 44.5% of AUR presentations were followed by a return visit in 2018–19 compared to 28.1% and 37.5%, respectively, in 2008–09 (p<0.05 for each cohort) (Table 2). No significant differences were observed between the two periods for combined (2008–09: 30.3% vs. 2018–19: 31.8%) or RC (2008–09: 22.6% vs. 2018–19: 21.6%) presentations.

Multilevel regression analyses identified older patients as significantly more likely to be admitted to the hospital at the

**Table 2. Number and percentage of visits by new UHN patients and visits resulting in return to the ED within 30 days stratified by year of visit for each cohort: Combined urological presentations, renal colic, gross hematuria, and acute urinary retention**

Outcome or characteristic	Combined presentations		Renal colic		Gross hematuria		Acute urinary retention	
	2008–2009	2018–2019	2008–2009	2018–2019	2008–2009	2018–2019	2008–2009	2018–2019
New patient	179 (18.1%)	466 (18.5%)	80 (32.3%)	349 (30.7%)	56 (15.1%)**	54 (7.7%)**	43 (11.5%)	63 (9.3%)
Return within 30 days	300 (30.3%)	800 (31.8%)	56 (22.6%)	246 (21.6%)	104 (28.1%)*	252 (35.9%)*	140 (37.5%)*	302 (44.5%)*

\*Significant difference between 2008–2009 and 2018–2019 frequencies for cohort at p<0.05. \*\*Significant difference at p<0.001.

initial ED visit (aOR 1.51 per decade of age, 95% CI 1.04–2.18,  $p=0.029$ ) (Supplementary Table 2; available at *cuaj.ca*). For pooled data, older patients (aOR 1.07 per decade of age, 95% CI 1.01–1.12,  $p=0.02$ ), 2018–19 patients (aOR 1.23, 95% CI 1.01–1.49,  $p=0.039$ ), and patients residing within the “downtown core” (aOR 1.34, 95% CI 1.12–1.60,  $p=0.001$ ) were significantly more likely to return to the ED within 30 days of the initial visit, while patients presenting with GH (aOR 0.65, 95% CI 0.53–0.80,  $p<0.001$ ) or RC (aOR 0.38, 95% CI 0.30–0.49,  $p<0.001$ ) were significantly less likely to return within 30 days (Table 3).

As shown in Table 4, 54.9% of ED visits had followup at a UHN urology clinic. Meanwhile, 40.8% of RC, 62.7% of GH, and 65.5% of AUR ED visits had clinic followup. Moreover, for pooled data, 14.4% of clinic visits were preceded by multiple (i.e.,  $>1$ ) ED visits. That figure was 14.4%, 13.9%, and 14.8% for RC, GH, and AUR cohorts, respectively, with no significant difference in distribution between the three cohorts ( $p=0.92$ ). From 2008–09 to 2018–19, the proportion of ED visits associated with clinic followup increased significantly only for the RC cohort (from 30.2% to 43.1%,  $p<0.001$ ) (Table 4).

Finally, mean number of days (SD) from the initial ED visit to being seen in clinic for followup increased significantly between 2008–09 and 2018–19 across the board: from 21.1 (25.5) to 29.8 (31.7) days in the full sample ( $p<0.001$ ), from 24.9 (33.5) to 29.7 (28.5) days for the RC cohort ( $p=0.0015$ ), from 21.6 (24.7) to 33.0 (33.8) days for the GH cohort ( $p<0.001$ ), and from 19.2 (22.7) to 26.9 (32.7) days for the AUR cohort (Table 4). For pooled data, multilevel regres-

sion analyses identified 2018–19 year of ED visit (IRR 1.46, 95% CI 1.30–1.63,  $p<0.001$ ) and GH (IRR 1.21, 95% CI 1.07–1.37,  $p=0.002$ ) as predictors of increased wait time for clinic followup (Supplementary Table 3; available at *cuaj.ca*). Patients presenting to the ED with RC (IRR 1.48, 95% CI 1.17–1.88,  $p=0.001$ ), GH (IRR 1.42, 95% CI 1.21–1.68,  $p<0.001$ ), or AUR (IRR 1.38, 95% CI 1.15–1.66,  $p<0.001$ ) in 2018–19 were also significantly more likely to experience longer wait time for clinic followup.

## Discussion

The results of our study demonstrate a significant increase in the incidence of common urological presentations to the ED at an urban, academic, tertiary-care hospital network over a 10-year period. Between 2008–09 and 2018–19, ED visits associated with RC increased by nearly five-fold, whereas nearly a two-fold increase was observed for both GH and AUR cohorts. In comparison, the total number of ED visits (associated with urological and non-urological presentations) increased by only 60%, while the number of beds in operation at the same hospital network increased by 10%. Notably, between 2008–09 and 2018–19, the population of both Ontario and the Greater Toronto Area (GTA) increased by approximately 10%.<sup>13,14</sup> Together, these data demonstrate a greater increase in the burden of acute urological disease than expected merely based on the increase in ED utilization and population growth.

Several factors may be at play. First, since stone disease is more common with increasing age,<sup>1–3,5,6</sup> the aging popula-

**Table 3. OR, 95% CI, and p-values of predictors of return to the ED within 30 days of the initial ED visit modeled by multilevel regression analysis for combined urological presentations, RC, GH, and AUR**

Cohort	Predictor	Adjusted OR	95% CI	p
Combined presentations	Age (per decade)	1.07	1.01–1.12	0.02*
	Male gender	0.89	0.72–1.11	0.311
	2018–2019 year	1.23	1.01–1.49	0.039*
	Within downtown core	1.34	1.12–1.60	0.001*
	Gross hematuria	0.65	0.53–0.80	<0.001**
	Renal colic	0.38	0.30–0.49	<0.001**
Renal colic	Age (per decade)	1.05	0.97–1.15	0.214
	Male gender	0.67	0.50–0.91	0.009*
	2018–2019 year	0.86	0.60–1.25	0.441
	Within downtown core	1.39	1.04–1.87	0.028*
Gross hematuria	Age (per decade)	1.05	0.96–1.15	0.249
	Male gender	1.14	0.77–1.69	0.528
	2018–2019 year	1.50	1.07–2.08	0.017*
	Within downtown core	1.33	0.97–1.84	0.078
Acute urinary retention	Age (per decade)	1.07	0.97–1.18	0.186
	Male gender	1.40	0.87–2.25	0.166
	2018–2019 year	1.30	0.99–1.72	0.060
	Within downtown core	1.31	1.00–1.71	0.054

\*Predictor significant at  $p<0.05$ . \*\*Significant at  $p<0.001$ . AUR: acute urinary retention; CI: confidence interval; ED: emergency department; GH: gross hematuria; OR: odds ratio; RC: renal colic.



**Table 4. Number and percentage of ED visits associated with a subsequent urology clinic visit and wait time for clinic visit after initial ED visit stratified by year of ED visit for each cohort: Combined urological presentations, RC, GH, and AUR**

Cohort	Outcome or characteristic	Full sample	2008–2009	2018–2019	p
Combined presentations	Urology clinic visit	1926 (54.9%)	528 (53.3%)	1398 (55.5%)	0.25
	Mean wait time for clinic visit in days (SD)	27.3 (30.3)	21.1 (25.5)	29.8 (31.7)	<0.001**
	Median wait time in days (min, max)	17 (0, 180)	12 (0, 162)	21 (0, 180)	
Renal colic	Urology clinic visit	565 (40.8%)	75 (30.2%)	490 (43.1%)	<0.001**
	Mean wait time for clinic visit in days (SD)	29 (29.3)	24.9 (33.5)	29.7 (28.5)	0.0015*
	Median wait time in days (min, max)	22 (0, 176)	13 (0, 162)	23 (0, 176)	
Gross hematuria	Urology clinic visit	672 (62.7%)	221 (59.7%)	451 (64.2%)	0.17
	Mean wait time for clinic visit in days (SD)	29.1 (31.4)	21.6 (24.7)	33 (33.8)	<0.001**
	Median wait time in days (min, max)	19 (0, 171)	12.5 (0, 139)	22 (0, 171)	
Acute urinary retention	Urology clinic visit	689 (65.5%)	232 (62.2%)	457 (67.3%)	0.11
	Mean wait time for clinic visit in days (SD)	24.2 (29.8)	19.2 (22.7)	26.9 (32.7)	0.0015*
	Median wait time in days (min, max)	13 (0, 180)	11 (0, 120)	15 (1, 180)	

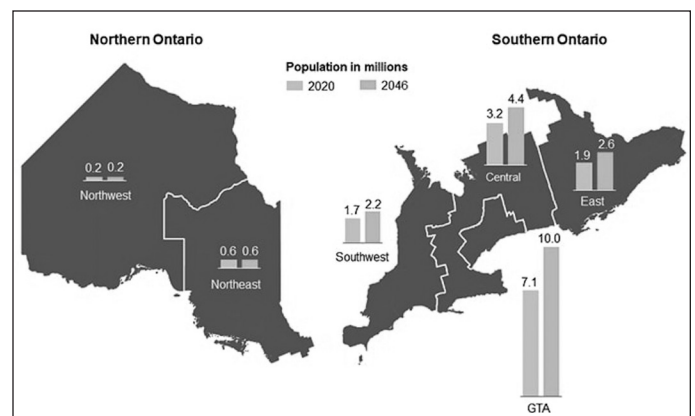
\*Significant difference at  $p < 0.05$  between the proportions of visits or number of days from ED visit to clinic visit in 2008–2009 vs. 2018–2019. \*\*Significant difference at  $p < 0.001$ . AUR: acute urinary retention; ED: emergency department; GH: gross hematuria; RC: renal colic.

tion of our study sample may account for some of the variance. From 2020–2046, the populations of Ontario and the GTA are expected to further increase by 5.3 and 2.9 million people, respectively (Figure 1), with the number of seniors in Ontario aged 65 and over projected to increase from 2.6 million (17.6 % of the population) to 4.5 million (22.2% of the population).<sup>15</sup> It is therefore imperative to allocate appropriate resources in anticipation of this further increase in acute urological disease. Second, the increase in acute urological disease may be explained by an increase in stone disease and urological malignancies in the general population.<sup>1,16–20</sup> Moreover, although the prevalence of stone disease and many urological malignancies remains higher in men, increasing incidence rates in females may account for the higher proportional increase of ED visits by female patients in our study. Third, higher surgical volumes in the recent era may contribute to the increase in acute urological disease, but unfortunately, we are unable to be certain of this, as postoperative data was only available for the more recent 2018–19 time period.

We found that urological presentations were more common in the summer months. Ambient temperature is known to be positively associated with the incidence of stone disease and related events.<sup>21,22</sup> Several other studies have elucidated this association. Ordon et al reported higher ambient temperature to be associated with increased risk of ED visit for renal colic.<sup>23</sup> Meanwhile, Cervellin et al found a positive correlation between the mean number of ED visits for colic per day and mean daily temperature.<sup>24</sup> To the best of our knowledge, seasonal variability in GH or AUR ED presentations have not been reported in the literature. Independent of stone disease, we do not think the biology of these presentations would be significantly impacted by temperature variation. Many Canadian hospitals have scheduled summer closures, often resulting in reduced access to ambulatory clinics and operating rooms. Any variance in

increased GH and AUR presentations during the summer months not explained by higher rates of stone disease may simply reflect this seasonal change in resource allocation.

The most ED visits in both 2008–09 and 2018–19 were by patients residing in the Downtown Toronto borough. The Downtown Toronto and Central Toronto boroughs are located most proximally to UHN EDs (hence our decision to combine them into the “downtown core” region). Geographical proximity to an ED is likely a key factor that influences at least some patients to avail themselves of emergency care rather than wait for primary care consultation or wager on symptoms resolving. Indeed, this might explain why residence within the “downtown core” independently predicted return to the ED within 30 days of initial visit in our study. Our main rationale for looking at place of residence was to support UHN, as well as other organizations in re-allocating resources in response to changing trends in acute urological care. For example, the establishment of more urology outpatient clinics within the “downtown core” might alleviate



**Figure 1.** Projected population growth from 2020–2046 for Ontario, presented by region. GTA: Greater Toronto Area. Adapted from <https://www.ontario.ca/page/ontario-population-projections>.

the rising burden of ED care associated with new UHN patients residing in this region.

Reported rates of admission to the hospital for acute urological presentations are variable in the literature. Schoenfeld et al reported that of 306 612 patients with RC presenting in 444 hospitals in the U.S., 19% were admitted.<sup>25</sup> Elder et al included 1 061 462 ED visits for RC from the U.S. Nationwide Emergency Department Sample, with only 8.0% of visits resulting in admission.<sup>26</sup> Finally, Ghani et al included 3 635 054 ED visits for upper tract stones in the U.S. between 2006 and 2009; the reported admission rate was 12.0%.<sup>27</sup> The overall hospital admission rate in our study was 10.2%, with 6.7% of RC, 19.5% of GH, and 6.3% of AUR presentations resulting in admission. Unfortunately, we cannot comment on changes in admission rates over time, but our noticeably lower admission rate for RC, in particular, may reflect differences in resource use in a publicly funded and administered healthcare system. Also, older age was independently associated with higher likelihood of admission in our study. This was likely due to disease burden being greater in older patients.

Our results demonstrated significantly greater ED revisit rates for GH and AUR presentations in 2018–19 compared to 2008–09. There is limited literature on changes in ED revisit rates over time for urological presentations; however, a Cochrane review evaluating alpha-blockers in patients with AUR reported 50.7% of patients in the placebo arm to experience recurrent AUR (a proxy measure of ED revisit).<sup>28</sup> Reasons for increasing revisit rates are restricted to speculation, given the limited granularity of our data; limited home-care resources<sup>29</sup> and delays to formal urological consultation may partly account for these trends. Indeed, our results did show that patients presenting to the ED with RC, GH, or AUR in 2018–19 were more likely to experience longer wait time for clinic followup, with 14.4% of all clinic visits being preceded by multiple ED visits. Additionally, a shortage of primary care physicians in the GTA may also have played a role in increasing ED return rates.

Future studies should aim to delineate factors associated with the management and outcomes of patients presenting to the ED with AUR and GH. Interestingly, ED return rates for RC presentations did not change significantly over time in our study, even though a significantly higher proportion of RC presentations were from those residing in the “downtown core” and time to be seen in a urology clinic had increased for the RC cohort. Due to lack of more granular data, we are unable to comment on factors that may explain this finding, such as longitudinal changes in the rate of medical expulsive therapy used by ED physicians, rate of RC admission, and mean size of stones.

## Strengths and limitations

This study has several strengths. First, we applied a unique identifier to each patient, allowing for adjustment at the patient level. Several patients contributed to multiple ED visits resulting in a natural clustering of data. Performing a multilevel analysis prevents patients with certain predictors, such as male gender or older age, to artificially skew outcomes leading to spurious results. Second, the extent of analyses performed enabled us to empirically reinforce some of our discussion points. For example, having evaluated trends in clinic followup and wait time, we were able to posit more confidently that longer wait time contributed to increased ED return rates. Finally, for each analysis, we included consecutive patients by not applying any exclusion criteria, which reduced selection bias.

Nonetheless, our study has some limitations. First, surgical and hospital admission data were unavailable for 2008–09. We were therefore unable to evaluate these variables longitudinally. Second, since we did not capture patient- or disease-specific characteristics, we cannot comment on how such factors may have affected outcomes. Third, we were unable to reliably determine if urological consultation had occurred for patients in the ED, nor were we able to ascertain if and when consultation had occurred after discharge from the ED, which may have impacted outcomes such as rates of return to ED and time to followup in urology clinic. Fourth, we were unable to capture presentations that occurred outside of UHN, which may have affected outcomes, such as rates of return to ED, postoperative presentation rates, and time to followup in urology clinic.

## Conclusions

The incidence of common acute urological presentations to the ED, such as RC, GH, and AUR, increased significantly over a 10-year period at a tertiary-care hospital network in a large metropolitan area; this was largely driven by an almost five-fold increase in renal colic presentations. Importantly, we saw increased rates of return visit to the ED within 30 days of initial ED presentation and longer wait times for urology clinic followup for all presentations. These findings demonstrate an increasing burden of acute urological disease that is outpacing population growth and straining available resources. Future studies should quantify the amount of resources needed to meet this rising burden and elucidate means of efficient resource allocation, particularly with our aging population.

**Competing interests:** The authors do not report any competing personal or financial interests related to this work.

This paper has been peer-reviewed.

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