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

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ABSTRACT

Introduction: Urologic 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 urologic 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 urologic 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

KEY MESSAGES

- Renal colic, gross hematuria, and acute urinary retention presentations to the emergency department have risen above and beyond population growth.
- Rates of return to the emergency department 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 emergency department visits.
- With a growing and aging population, appropriate resources must be allocated to meet the rising burden of acute urologic disease.

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

INTRODUCTION

Renal colic (RC), gross hematuria (GH), and acute urinary retention (AUR) are common urologic 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.[1] Given the association of benign prostatic hyperplasia (BPH) with age, AUR is becoming increasingly common with an aging population.[2,3] 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.[4] Gross hematuria is also associated with BPH as well as urologic malignancy, the prevalence of which increases with age.[5,6]

With a growing and aging population, health care institutions must carefully delineate the full burden of urologic disease in the ED in order to successfully allocate resources and implement pathways for minimizing patient morbidity, all the while optimizing cost efficiency.[7,8] The main objective of our study was to evaluate, from a resource utilization perspective, trends in the incidence, management, and follow-up 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)*.[9]

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, 3-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 follow-up visit at a UHN urology clinic, and the number of days from the initial ED visit to being seen in the clinic (capped at 6 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 follow-up of urologic presentation to the ED. Institutional ethics board approval was obtained for this study. Analyses were performed for combined and individual urologic 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 urologic 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)[10] while Microsoft Excel was used for other statistics.

RESULTS

In 2008-09, TGH had 32545 ED visits and 398 beds in operation while TWH had 47108 ED visits and 247 beds.[11] In 2018-19, TGH had 54794 ED visits and 451 beds while TWH had 71215 ED visits and 283 beds.[12]

A total of 3510 urologic 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 S1).

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, urologic 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 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.

According to Table 2, 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). 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 initial ED visit (aOR 1.51 per decade of age, 95% CI: 1.04 – 2.18; p=0.029) (Supplementary Table S2). 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 follow-up at a UHN urology clinic. Meanwhile, 40.8% of RC, 62.7% of GH, and 65.5% of AUR ED visits had clinic follow-up. 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 follow-up 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 follow-up 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 regression 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 follow-up (Supplementary Table S3). 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 follow-up.

DISCUSSION

The results of our study demonstrate a significant increase in the incidence of common urologic presentations to the ED at an urban, academic, tertiary-care hospital network over a ten-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 urologic and non-urologic 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%.[13,14] Together, these data demonstrate a greater increase in the burden of acute urologic 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,[1–3,5,6] the aging population of our study sample may account for some of the variance. From 2020 to 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).[15] It is therefore imperative to allocate appropriate resources in anticipation this further increase in acute urologic disease. Second, the increase in acute urologic disease may be explained by an increase in stone disease and urologic malignancies in the general population.[1,16–20] Moreover, although the prevalence of stone disease and many urologic 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 urologic disease, but unfortunately, we are unable to be certain of this as post-operative data was only available for the more recent 2018-19 time period.

We found that urologic 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.[21,22] Several other studies have elucidated this association. Ordon et al.[23] reported higher ambient temperature to be associated with increased risk of ED visit for renal colic. Meanwhile, Cervellin et al. found a positive correlation between the mean number of ED visits for colic per day and mean daily temperature.[24] To the best of our knowledge, seasonal variability in GH or AUR ED presentations has 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 urologic care. For example, the establishment of more urology outpatient clinics within the "downtown core" might alleviate the rising burden of ED care associated with new UHN patients residing in this region.

Reported rates of admission to the hospital for acute urologic presentations are variable in the literature. Schoenfeld et al.[25] reported that of 306612 patients with RC presenting in 444 hospitals in the United States, 19% were admitted. Elder et al.[26] included 1061462 ED visits for RC from the United States Nationwide Emergency Department Sample, with only 8.0% of visits resulting in admission. Finally, Ghani et al.[27] included 3635054 ED visits for upper tract stones in the United States between 2006 and 2009; the reported admission rate was 12.0%. 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 health care 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 urologic 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).[28] Reasons for increasing revisit rates are restricted to speculation given the limited granularity of our data: limited home care resources[29] and delays to formal urologic consultation and 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 follow-up, 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 funding, such as longitudinal changes in the rate of medical expulsive therapy used by ED physicians, rate of RC admission, and mean size of stones.

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 follow-up 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 urologic 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 follow-up 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, post-operative presentation rates, and time to follow-up in urology clinic.

CONCLUSIONS

The incidence of common acute urologic presentations to the ED, such as renal colic, gross hematuria and acute urinary retention, 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 5-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 follow-up for all presentations. These findings demonstrate an increasing burden of acute urologic 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.

REFERENCES

1. Scales CD, Smith AC, Hanley JM, Saigal CS. Prevalence of kidney stones in the United States. *Eur Urol*. 2012;62(1):160-165. doi:10.1016/J.EURURO.2012.03.052
2. Jacobsen SJ, Jacobson DJ, Girman CJ, et al. Natural history of prostatism: Risk factors for acute urinary retention. *J Urol*. 1997;158(2):481-487. doi:10.1016/S0022-5347(01)64508-7
3. Meigs JB, Barry MJ, Giovannucci E, Rimm EB, Stampfer MJ, Kawachi I. INCIDENCE RATES AND RISK FACTORS FOR ACUTE URINARY RETENTION: THE HEALTH PROFESSIONALS FOLLOWUP STUDY. *J Urol*. 1999;162(2):376-382. doi:10.1016/S0022-5347(05)68563-1
4. McConnell JD, Roehrborn CG, Bautista OM, et al. The long-term effect of doxazosin, finasteride, and combination therapy on the clinical progression of benign prostatic hyperplasia. *N Engl J Med*. 2003;349(25):2387-2398. doi:10.1056/NEJMOA030656
5. Hicks D, Li CY. Management of macroscopic haematuria in the emergency department. *Postgrad Med J*. 2008;84(996):539-544. doi:10.1136/emj.2006.042457
6. Dy GW, Gore JL, Forouzanfar MH, Naghavi M, Fitzmaurice C. Global Burden of Urologic Cancers, 1990-2013. *Eur Urol*. 2017;71(3):437-446. doi:10.1016/J.EURURO.2016.10.008
7. Kessler CS, Bauml J. Non-traumatic urologic emergencies in men: a clinical review. *West J Emerg Med*. 2009;10(4):281-287.
8. Pruthi RS, Neuwahl S, Nielsen ME, Fraher E. Recent trends in the urology workforce in the United States. *Urology*. 2013;82(5):987-994. doi:10.1016/j.urology.2013.04.080
9. Choi J, Ensafi S, Chartier LB, Van Praet O. A Quality Improvement Initiative to Decrease the Rate of Solitary Blood Cultures in the Emergency Department. *Acad Emerg Med*. 2017;24(9):1080-1087. doi:10.1111/acem.13161
10. Bates D, Mächler M, Bolker BM, Walker SC. Fitting Linear Mixed-Effects Models Using lme4. *J Stat Softw*. 2015;67(1):1-48. doi:10.18637/JSS.V067.I01
11. University Health Network Annual Report 2008/09. https://www.uhn.ca/corporate/AboutUHN/Documents/UHN_AR_2009.pdf. Published 2009. Accessed March 6, 2022.
12. Report to our community: 2018/19 University Health Network. https://www.uhn.ca/corporate/AboutUHN/Documents/report-to-our-community-2018-19.pdf. Published 2019. Accessed March 6, 2022.
13. Statistics Canada. Table 17-10-0009-01 Population estimates, quarterly. https://doi.org/10.25318/1710000901-eng. Published 2022. Accessed March 6, 2022.
14. Macrotrends. Toronto, Canada Metro Area Population 1950-2022. https://www.macrotrends.net/cities/20402/toronto/population. Accessed March 6, 2022.
15. Chart 5: Proportion of population aged 0–14, 15–64 and 65+ in Ontario, 1971 to 2046. https://www.ontario.ca/page/ontario-population-projections. Accessed May 18, 2022.
16. Khan SR, Pearle MS, Robertson WG, et al. Kidney stones. *Nat Rev Dis Prim*. 2016;2. doi:10.1038/NRDP.2016.8
17. Kittanamongkolchai W, Vaughan LE, Enders FT, et al. The Changing Incidence and Presentation of Urinary Stones Over 3 Decades. *Mayo Clin Proc*. 2018;93(3):291-299. doi:10.1016/J.MAYOCP.2017.11.018
18. Znaor A, Lortet-Tieulent J, Laversanne M, Jemal A, Bray F. International variations and trends in renal cell carcinoma incidence and mortality. *Eur Urol*. 2015;67(3):519-530. doi:10.1016/J.EURURO.2014.10.002

19. Antoni S, Ferlay J, Soerjomataram I, Znaor A, Jemal A, Bray F. Bladder Cancer Incidence and Mortality: A Global Overview and Recent Trends. *Eur Urol*. 2017;71(1):96-108. doi:10.1016/J.EURURO.2016.06.010
20. Hugosson J, Roobol MJ, Månsson M, et al. A 16-yr Follow-up of the European Randomized study of Screening for Prostate Cancer. *Eur Urol*. 2019;76(1):43-51. doi:10.1016/J.EURURO.2019.02.009
21. Geraghty RM, Proietti S, Traxer O, Archer M, Somani BK. Worldwide Impact of Warmer Seasons on the Incidence of Renal Colic and Kidney Stone Disease: Evidence from a Systematic Review of Literature. *J Endourol*. 2017;31(8):729-735. doi:10.1089/END.2017.0123
22. Fukuhara H, Ichiyanagi O, Kakizaki H, Naito S, Tsuchiya N. Clinical relevance of seasonal changes in the prevalence of ureterolithiasis in the diagnosis of renal colic. *Urolithiasis*. 2016;44(6):529-537. doi:10.1007/s00240-016-0896-3
23. Ordon M, Welk B, Li Q, et al. Ambient Temperature and the Risk of Renal Colic: A Population-Based Study of the Impact of Demographics and Comorbidity. *J Endourol*. 2016;30(10):1138-1143. doi:10.1089/end.2016.0374
24. Cervellin G, Comelli I, Comelli D, et al. Regional short-term climate variations influence on the number of visits for renal colic in a large urban Emergency Department: Results of a 7-year survey. *Intern Emerg Med*. 2011;6(2):141-147. doi:10.1007/s11739-011-0518-6
25. Schoenfeld EM, Pekow PS, Shieh MS, Scales CD, Lagu T, Lindenauer PK. The diagnosis and management of patients with renal colic across a sample of us hospitals: High CT utilization despite low rates of admission and inpatient urologic intervention. *PLoS One*. 2017;12(1). doi:10.1371/journal.pone.0169160
26. Elder JW, Delgado MK, Chung BI, Pirrotta EA, Wang NE. Variation in the Intensity of Care for Patients with Uncomplicated Renal Colic Presenting to U.S. Emergency Departments. *J Emerg Med*. 2016;51(6):628-635. doi:10.1016/j.jemermed.2016.05.037
27. Ghani KR, Roghmann F, Sammon JD, et al. Emergency department visits in the United States for upper urinary tract stones: trends in hospitalization and charges. *J Urol*. 2014;191(1):90-96. doi:10.1016/J.JURO.2013.07.098
28. Fisher E, Subramonian K, Omar MI. The role of alpha blockers prior to removal of urethral catheter for acute urinary retention in men. *Cochrane Database Syst Rev*. 2014;2014(6). doi:10.1002/14651858.CD006744.pub3
29. MacAdam M. Progress toward integrating care for seniors in Canada: "We have to skate toward where the puck is going to be, not to where it has been."1. *Int J Integr Care*. 2011;11(Special 10th Anniversary Edition):e016.

FIGURES AND TABLES

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.

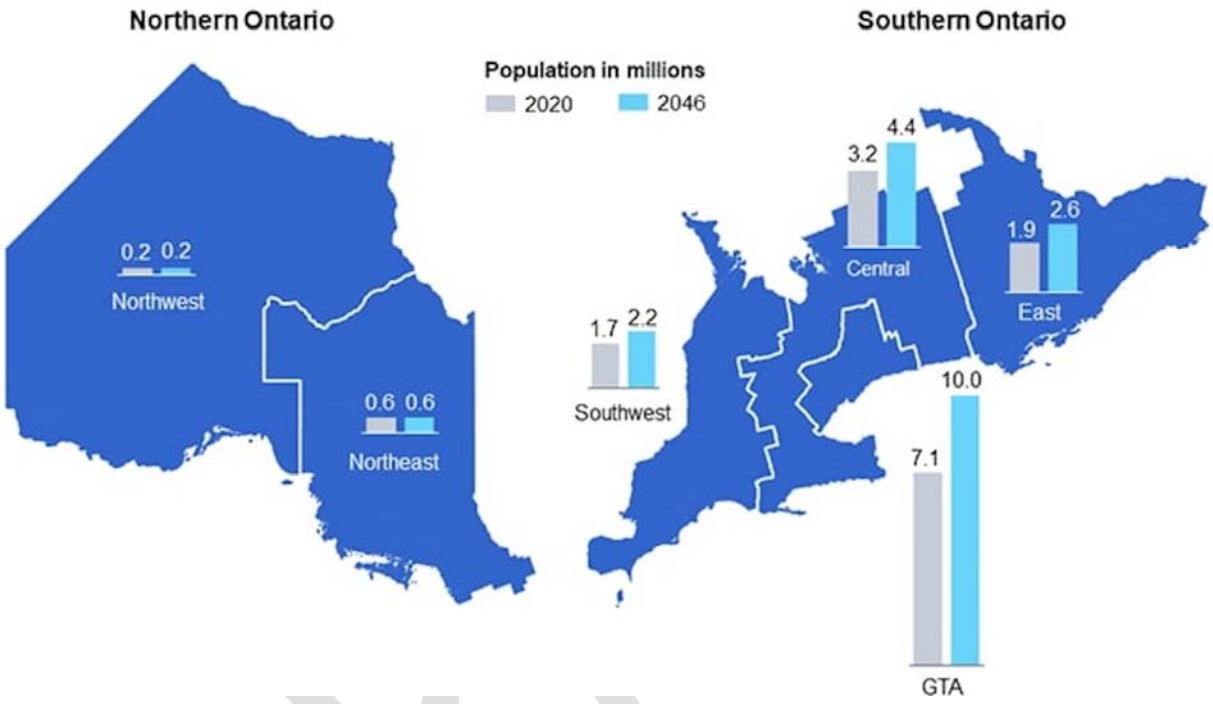

Table 1. Characteristics of 2751† unique patients presenting to the ED with renal colic, gross hematuria, or acute urinary retention stratified by year of ED visit and summarized for combined urological presentations (tallied as ED visits unless indicated otherwise)

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‡	<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‡	
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%	

†Patients who visited the ED on more than one occasion were counted only once. ‡Despite age increasing over time for all individual urological presentations (Supplementary Table S1), age decreased for combined presentations, which is explained by renal colic patients being much younger than acute urinary retention and gross hematuria patients, and renal colic 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 $p<0.001$.

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 $p<0.001$.

Table 3. Odds ratios, 95% confidence intervals, 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, renal colic, gross hematuria, and acute urinary retention

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	0.9–1.15	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 $p<0.001$. CI: confidence interval; OR: odds ratio.

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, renal colic, gross hematuria, and acute urinary retention.

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 $p<0.001$.