Characteristics and Outcomes of Patients Discharged Home from an Emergency Department with AKI

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Abstract

Background and objectives Patients discharged home from an emergency department with AKI are not well described. This study describes their characteristics and outcomes and compares these outcomes to two referent groups.

Design, setting, participants, & measurements We conducted a population-based retrospective cohort study in Ontario, Canada from 2003 to 2012 of 6346 patients aged ≥40 years who were discharged from the emergency department with AKI (defined using serum creatinine values). We analyzed the risk of all-cause mortality, receipt of acute dialysis, and hospitalization within 30 days after discharge. We used propensity score methods to compare all-cause mortality to two referent groups. We matched 4379 discharged patients to 4379 patients who were hospitalized from the emergency department with similar AKI stage. We also matched 6188 discharged patients to 6188 patients who were discharged home from the emergency department with no AKI.

Results There were 6346 emergency department discharges with AKI. The mean age was 69 years and 6012 (95%) had stage 1, 290 (5%) had stage 2, and 44 (0.7%) had stage 3 AKI. Within 30 days, 149 (2%) (AKI stage 1: 127 [2%]; stage 2: 15 [5%]; stage 3: seven [16%]) died, 22 (0.3%) received acute dialysis, and 1032 (16%) were hospitalized. An emergency department discharge versus hospitalization with AKI was associated with lower mortality (3% versus 12%; relative risk, 0.3; 95% confidence interval, 0.2 to 0.3). An emergency department discharge with AKI versus no AKI was associated with higher mortality (2% versus 1%; relative risk, 1.6; 95% confidence interval, 1.2 to 2.0).

Conclusions Patients discharged home from the emergency department with AKI are at risk of poor 30-day outcomes. A better understanding of care in this at-risk population is warranted, as are testing strategies to improve care.

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Introduction

AKI, defined as a sudden deterioration in kidney function, affects approximately 10% of hospitalized patients worldwide (1–3). Among hospitalized patients, AKI is associated with increased morbidity, mortality, and health care costs exceeding $10 billion annually in the United States (4–7). Furthermore, survivors of AKI hospitalization are at increased risk of cardiovascular disease (8), CKD (9), and ESRD (10,11).

AKI epidemiology is largely informed by studies conducted in hospitalized and critically ill patients (12). Less is known about patients who develop AKI as outpatients or who present to the emergency department (ED) with AKI and are managed in the community (13). ED visits are brief, and health care staff must decide whether a patient should be admitted to hospital or discharged home. A discharge home may mean the ED health care staff felt the AKI was reversible and could be managed in the community or it may represent an underappreciated population at risk of poor outcomes. We performed a detailed search of PubMed and other bibliographic databases in March of 2016 and found no study describing this population in detail.

We conducted this study to describe the characteristics and outcomes of patients discharged home from the ED with AKI and to compare outcomes to two referent ED groups: patients hospitalized with AKI and patients discharged home with no AKI. We hypothesize that an ED discharge with AKI will have lower risk of adverse outcomes compared with hospitalization with AKI, and a higher risk compared with an ED discharge with no AKI.

Materials and Methods

Study Design and Setting

We conducted a population-based, retrospective cohort study of adults in Southwestern Ontario, Canada, at the Institute for Clinical Evaluative Sciences Western facility. Our study was approved by the Research Ethics Board at Sunnybrook Health Sciences Centre in Toronto, Ontario. Southwestern

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Ontario has approximately 1.6 million residents with universal access to hospital care and physician services (14). Prescription drug coverage is a universal benefit for those aged ≥65 years. Participant informed consent was not required for this study. This study followed the STrengthening the Reporting of OBservational studies in Epidemiology guidelines (Supplemental Table 1) (15). To comply with privacy regulations for minimizing the chance of patient reidentification, results were suppressed in cells with five or fewer patients.

Data Sources

We ascertained patient and hospital characteristics, drug prescriptions, and outcome data from 13 health administrative databases (Supplemental Table 2). These datasets were linked using unique, encoded identifiers and analyzed at the Institute for Clinical Evaluative Sciences Western facility. We obtained vital statistics on all Ontario residents who were issued a health card from the Ontario Registered Persons Database. The Registered Persons Database mortality flag has a sensitivity of 94% and a positive predictive value of 100% (16). We used the Ontario Drug Benefit database to identify prescription drugs for eligible patients or those aged ≥65 years with an error rate <1% (17). We identified diagnostic and procedural information from the National Ambulatory Care Reporting System (ED visits) and the Canadian Institute for Health Information Discharge Abstract Database (hospitalizations). We used the International Classification of Diseases, ninth (pre-2002) and tenth revision (post-2002) codes to assess baseline comorbidities in the 5 years before the index date (Supplemental Table 3). We used the Ontario Health Insurance Plan database for health claims for physician services (Supplemental Tables 4–6). We used the Institute for Clinical Evaluative Sciences Physician Database to ascertain information on physician specialty. We derived total health care costs from several Institute for Clinical Evaluative Sciences databases (Supplemental Table 6) (18).

We obtained outpatient, ED, and inpatient serum creatinine, sodium, and potassium measurements from 13 hospitals (Supplemental Table 7) in Southwestern Ontario sharing the same electronic health record (Cerner, MO). Data are only available for patients aged ≥40 years. We also obtained outpatient serum creatinine and urine protein (albumin, total protein, and dipstick) measurements from Dynacare Medical Laboratories, which represents approximately one third of outpatient laboratory testing for Ontario residents. Dynacare does not have test results from the ED or hospital.

Patients

We established a cohort of Ontario residents aged ≥40 years who visited an ED and had at least one serum creatinine measurement at the ED visit and 7–365 days before the ED visit (pre-ED baseline) (Figure 1). We excluded patients who: (*1*) died on arrival or during the ED visit; (*2*) received dialysis 1 year before the ED visit (because AKI would not be relevant on dialysis and to ensure stable kidney function after the discontinuation of dialysis); (*3*) received a kidney transplant in the 5 years before the ED visit (to ensure AKI was not related to transplant rejection); (*4*) spent >48 hours in the ED (to exclude those without a disposition plan); (*5*) left against medical advice or without being seen by an ED physician; (*6*) were transferred to another facility; or (*7*) received palliative care 30 days before or 14 days after the ED visit (to exclude those who did not receive active medical management). The ED visit date served as the index or cohort entry date. If an individual had multiple ED serum creatinine measurements, we selected the highest value. If multiple pre-ED baseline serum creatinine values were available, we selected the most recent one.

Patients were assigned to one of three groups on the basis of AKI and ED disposition: (*1*) discharge home with AKI, (*2*) hospitalization with AKI, or (*3*) discharge home with no AKI (Figure 1). There was no crossover of patients between groups. Preference was given to the group discharged home from the ED with AKI if patients were also eligible for one of the other two groups. For all ED visits with AKI, we excluded patients with an improvement in AKI severity during the ED visit and those assigned AKI as the main ED diagnosis, in order to concentrate on patients less likely to be treated and resolved before discharge. For ED visits with no AKI, we selected the first ED visit in which the individual had both ED and pre-ED baseline serum creatinine measurements.

Kidney Function

AKI was defined as a relative increase in serum creatinine by ≥50%, or an absolute increase of ≥0.3 mg/dl from the pre-ED baseline. Patients were identified and staged according to AKI severity as outlined in the 2012 Kidney Disease: Improving Global Outcomes guidelines (Supplemental Table 8) (19). Urine output was not available in our data sources. Pre-ED baseline serum creatinine measurements were chosen no earlier than 7 days before the ED visit to avoid potentially unstable baseline values. Baseline kidney function was reported as the eGFR (in ml/min per 1.73 m^2), derived from the CKD Epidemiology Collaboration equation (20). We stratified baseline kidney function into five CKD groups (21): CKD stage 1, 2, or normal kidney function (eGFR≥60 ml/min per 1.73 m^2); stage 3a (eGFR of 45 to <60 ml/min per 1.73 m^2); stage 3b (eGFR of 30 to <45 ml/min per 1.73 m^2); stage 4 (eGFR of 15 to <30 ml/min per 1.73 m^2); and stage 5 (eGFR<15 ml/min per 1.73 m^2 when not on dialysis).

Outcomes

In the descriptive analysis, the outcomes assessed were all-cause mortality, receipt of hospital-based acute dialysis, hospitalization, at least one outpatient physician visit (family physician, internist, nephrologist, or urologist), at least one outpatient serum creatinine or urine protein test, and total health care costs, all within 30 days of ED discharge (outcome codes defined in Supplemental Table 6). Health care costs were reported in Canadian dollars and adjusted for inflation to 2013. In the two subpopulation analyses, the primary outcome was all-cause mortality and the secondary outcome was hospital-based acute dialysis, all within 30 days of ED discharge.

Statistical Analyses

We compared patients discharged home from the ED with AKI to two separate propensity score-matched referent ED

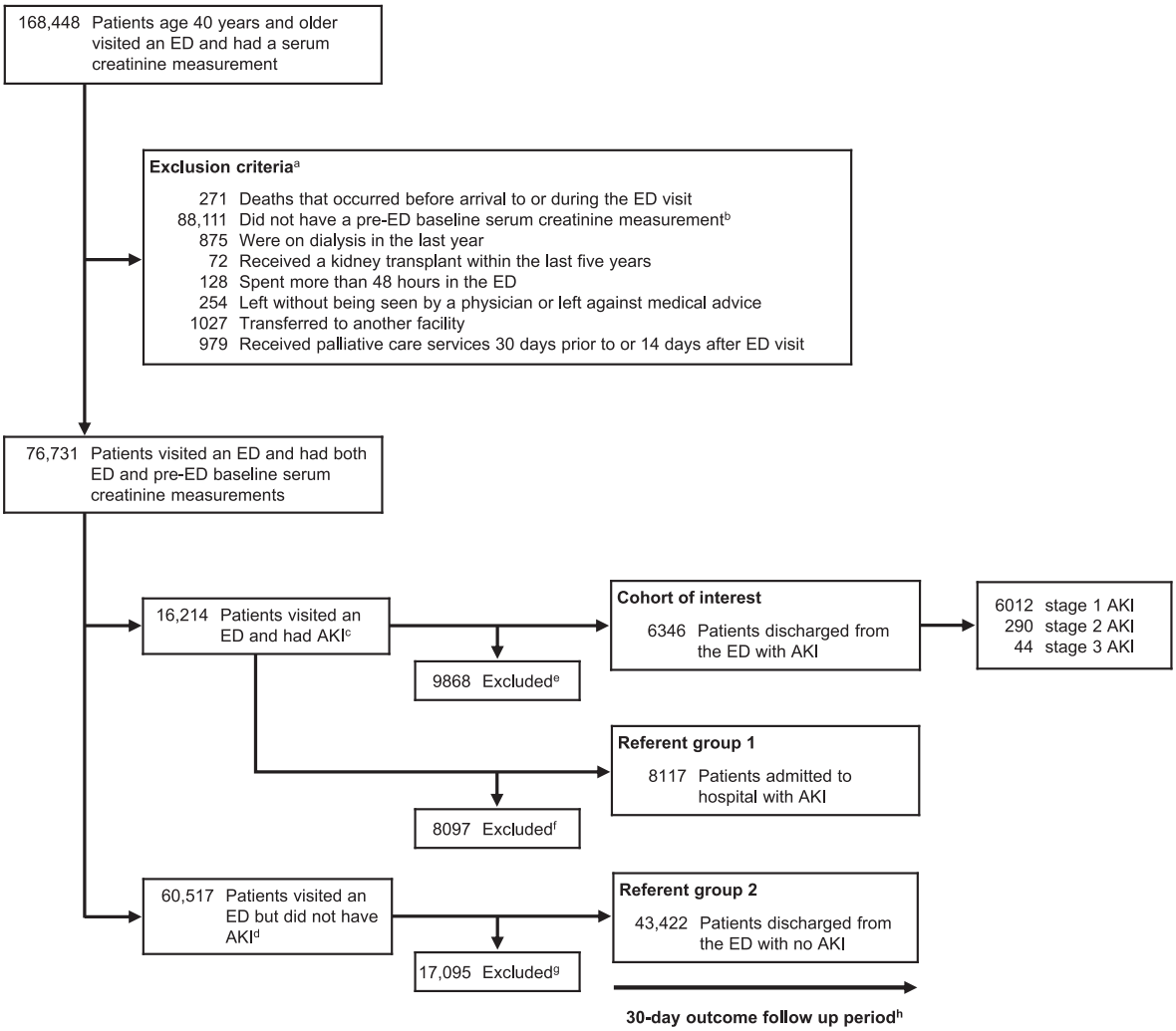

Figure 1. | Study flow diagram. [a]Patients were excluded in order as listed. [b]We selected the most recent pre-ED baseline serum creatinine measurement. [c]If an individual had more than one ED visit with AKI, as defined by ED and pre-ED serum creatinine measurements, we selected the first ED visit with AKI. [d]If an individual had more than one ED visit with a serum creatinine measurement, we selected the first ED visit. This group does not include patients with a subsequent ED visit with AKI (*n*=9549); these patients were preferentially classified as having AKI. [e]Excluded: improvement in AKI severity (discharged *n*=447, admitted *n*=1248); admitted to hospital (*n*=8117); assigned an ED diagnosis of AKI (International Classification of Diseases, Tenth Revision, code N17) (*n*=56). [f]Excluded: patients with an improvement in AKI severity (*n*=1695); discharged home from ED (*n*=6402). [g]Excluded: patients admitted to hospital from the ED with no AKI. [h]Follow-up was complete during the 30-day period. ED, emergency department.

groups: (*1*) patients hospitalized with AKI (AKI subpopulation) and (*2*) patients discharged home with no AKI (discharge subpopulation) (Supplemental Figure 1).

In the AKI subpopulation, we matched each patient from our discharged home cohort to one patient admitted to hospital from the ED with AKI on the logit of the propensity score and AKI stage. In the discharged subpopulation, we matched each patient to one patient discharged from the ED with no AKI on the logit of the propensity score and baseline CKD stage. We derived the propensity scores from logistic regression models and included 92 and 91 baseline variables for the AKI and discharged subpopulations, respectively (Supplemental Table 7). We included Ontario Drug Benefit eligibility in the propensity score to account for individuals who did not have provincial drug coverage. We used greedy, nearest neighbor matching (without replacement) with a specified caliper width ±0.2 times the SD of the logit of the propensity score (22).

Serum sodium and potassium values were missing in <10% of patients. We performed single imputation using the median value (23). Income quintile and rural residency status were missing in <2% of patients. We imputed the middle quintile for income and "no" for rural residency status.

Baseline characteristics included demographic information, comorbidities, prior health care utilization, medications dispensed, laboratory results, and ED characteristics. We compared characteristics using standardized differences to assess balance after propensity score matching because this metric is less sensitive to large sample sizes (24,25). A standardized difference of ≥10% was considered

Table 1. Baseline characteristics of patients discharged home from the emergency department (ED) with AKI

Characteristic	Patients Discharged Home from the ED with AKI, *n* (%)[a]			
	All Patients	AKI Stage[b]		
		1	2	3
Cohort size	6346	6012	290	44
Age, yr, mean (SD)	69 (13)	69 (13)	68 (14)	65 (13)[‡§]
40 to <65	2326 (37)	2189 (36)	112 (39)	25 (57)[‡§]
65 to <80	2475 (39)	2351 (39)	114 (39)	10 (23)[‡§]
≥80	1545 (24)	1472 (25)	64 (22)	9 (21)
Women	2948 (47)	2745 (46)	177 (61)[†]	26 (59)[‡]
Year of cohort entry (index date)				
2003–2005	1593 (25)	1497 (25)	87 (30)[†]	9 (21)[‡§]
2006–2008	2903 (46)	2769 (46)	116 (40)[†]	18 (41)[‡]
2009–2011	1850 (29)	1746 (29)	87 (30)	17 (39)[‡§]
Rural residence	969 (15)	912 (15)	51 (18)	6 (14)[§]
Comorbid conditions[c]				
Hypertension	4783 (75)	4525 (75)	222 (77)	36 (82)[‡§]
Diabetes	2405 (38)	2292 (38)	100 (35)	13 (30)[‡§]
Heart failure	Not reported	1325 (22)	48 (17)[†]	≤5 (≤11)[‡§]
Coronary artery disease[d]	2160 (34)	2069 (34)	78 (27)[†]	13 (30)[‡]
Chronic liver disease	Not reported	399 (7)	24 (8)	≤5 (≤11)[§]
Nephrolithiasis	Not reported	162 (3)	11(4)	≤5 (≤11)[‡§]
Aggregated diagnosis group point score[e]				
0–5	1756 (28)	1669 (28)	79 (27)	9 (21)[‡§]
≥6	4589 (72)	4343 (72)	211 (73)	35 (80)[‡§]
Medication utilization[f]				
Ontario Drug Benefit eligible patients	4605 (73)	4367 (73)	213 (73)	25 (57)[‡§]
Medication class[g]				
Angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers	2750/4605 (60)	2614/4367 (60)	122/213 (57)	14/25 (56)
Antibiotics	2041/4605 (44)	1931/4367 (44)	97/213 (46)	13/25 (52)[‡§]
Antipsychotic medications	Not reported	284/4367 (7)	18/213 (9)	≤5/25 (≤20)
Nonpotassium-sparing diuretics	2609/4605 (57)	2465/4367 (56)	128/213 (60)	16/25 (64)[‡]
Potassium-sparing diuretics	Not reported	511/4367 (12)	34/213 (16)[†]	≤5/25 (≤20)[‡§]
Nonsteroidal anti-inflammatory drugs[h]	892/4605 (19)	849/4367 (19)	34/213 (16)	9/25 (36)[‡§]
No. of unique drug names, median (interquartile range)	5 (0–10)	5 (0–10)	5 (0–10)	0 (0–7)
Pre-ED baseline kidney function[i]				
Baseline serum creatinine in mg/dl, mean (SD)	1.1 (0.6)	1.2 (0.6)	0.9 (0.3)[†]	1.1 (1.0)[§]
No. of d taken before ED visit, mean (SD)	133 (102)	132 (102)	140 (105)	152 (116)[‡§]
No. with serum creatinine ≤0.6 mg/dl	Not reported	215 (4)	44 (15)[†]	≤5 (≤11)[‡§]

Table 1. (Continued)

Characteristic	Patients Discharged Home from the ED with AKI, *n* (%)[a]			
	All Patients	AKI Stage[b]		
		1	2	3
Baseline eGFR, ml/min per 1.73 m^2				
≥60	3919 (62)	3654 (61)	230 (80)[†]	35 (80)[‡]
45 to <60	Not reported	1029 (17)	34 (12)[†]	≤5 (≤11)[‡§]
30 to <45	Not reported	833 (14)	19 (7)[†]	≤5 (≤11)[‡]
<30	Not reported	496 (8)	7 (2)[†]	≤5 (≤11)[§]
Albumin-to-creatinine ratio, mg/g	1689 (27)	1602 (27)	77 (27)	10 (23)
<30	Not reported	959 (16)	49 (17)	≤5 (≤11)[‡§]
30 to <300	Not reported	262 (4)	13 (5)	≤5 (≤11)
≥300	Not reported	381 (6)	15 (5)	≤5 (≤11)
ED visit laboratory values				
Serum potassium in mEq/L, mean (SD)	4.2 (0.6)	4.2 (0.6)	4.1 (0.8)[†]	4.2 (0.8)[§]
Serum sodium in mEq/L, mean (SD)	137 (5)	137 (5)	136 (5)[†]	134 (5)[‡§]
Serum creatinine in mg/dl				
Mean (SD)	1.7 (0.8)	1.6 (0.7)	2.0 (0.8)[†]	3.8 (2.1)[‡§]
Median (interquartile range)	1.5 (1.2–1.8)	1.4 (1.2–1.8)	1.8 (1.4–2.3)	3.4 (2.3–4.8)
Absolute change in serum creatinine in mg/dl				
Mean (SD)	0.5 (0.4)	0.5 (0.2)	1.1 (0.5)[†]	2.7 (1.4)[‡§]
Median (interquartile range)	0.4 (0.4–0.6)	0.4 (0.4–0.5)	1.0 (0.8–1.3)	2.5 (1.6–3.7)
Percent change in serum creatinine, %				
Mean (SD)	52 (34)	48 (18)	129 (26)[†]	294 (128)[‡§]
Median (interquartile range)	45 (35–60)	44 (34–57)	121 (108–144)	265 (224–359)
Previous health care utilization[j]				
ED visit in the previous 30 d	1114 (18)	1062 (18)	45 (16)	7 (16)
Hospitalization in the previous 30 d	481 (8)	451 (8)	24 (8)	6 (14)[‡§]
Family physician visit	6251 (99)	5924 (99)	283 (98)	44 (71)[‡§]
General internist visit	1470 (23)	1385 (23)	76 (26)	9 (21)[§]
Nephrology visit	Not reported	270 (5)	14 (5)	≤5 (≤11)
Urology visit	1132 (18)	1084 (18)	40 (14)[†]	8 (18)[§]
Imaging and investigations				
Computed tomography with contrast	Not reported	175 (3)	7 (2)	≤5 (≤11)
Coronary angiogram or revascularization	Not reported	138 (2)	6 (2)	≤5 (≤11)[‡§]
ED patient acuity and wait times				
Canadian triage acuity scale[k]				
1 and 2	1321 (21)	1271 (21)	43 (15)[†]	7 (16)[‡]
3	3797 (60)	3579 (60)	193 (67)[†]	25 (57)[§]
4 and 5	1228 (19)	1162 (19)	54 (19)	12 (27)[‡§]

Table 1. (Continued)

Characteristic	Patients Discharged Home from the ED with AKI, *n* (%)[a]			
	All Patients	AKI Stage[b]		
		1	2	3
Time (in hr) waiting for physician assessment, mean (SD)				
Canadian triage acuity scale 1 and 2	0.6 (0.8)	0.6 (0.8)	0.5 (0.6)[†]	0.3 (0.5)[‡§]
Canadian triage acuity scale 3	1.3 (1.3)	1.3 (1.3)	1.5 (1.3)	1.6 (1.1)[‡§]
Canadian triage acuity scale 4 and 5	1.6 (1.4)	1.6 (1.4)	1.7 (1.4)	1.4 (1.2)[‡§]

A standardized difference of ≥10% was found between the following two AKI subgroup comparisons: [†]stage 1 versus stage 2; [‡]stage 1 versus stage 3; and [§]stage 2 versus stage 3. To convert serum creatinine from traditional units (milligram per deciliter) to SI units (micromole), multiply by 88.42.

[a]Reported as *n* (%) unless otherwise noted. To comply with privacy regulations for minimizing the chance of patient reidentification, numbers of patients were suppressed in five or fewer patients. The total number of patients was not reported if there were other calculations that could result in the reidentification of five or fewer patients.

[b]Stage 1, evidence of a relative increase in serum creatinine value of ≥50% to <100% or ≥0.3 mg/dl from baseline; stage 2, evidence of a relative increase in serum creatinine value of ≥100% to <200% from baseline; and stage 3, evidence of a relative increase in serum creatinine value of >200% from baseline or an absolute increase in serum creatinine value to ≥4 mg/dl or the initiation of dialysis.

[c]Look-back window for comorbidities was 5 years unless otherwise noted.

[d]Does not include angina.

[e]The Aggregated Diagnosis Groups point score, derived from the John Hopkins Adjusted Clinical Groups system, is a weighted measure of health care utilization as a proxy measure for comorbidity and accounts for the duration of condition, severity of condition, diagnostic certainty, etiology of the condition, and specialty care involvement. The higher Aggregated Diagnosis Groups score, the greater the comorbidity. Individuals with an Aggregated Diagnosis Groups score of 0–2 reflect low health care costs with no prior hospitalizations; 3–5 reflects high health care costs but no prior hospitalizations; and a score of ≥6 reflects high health care costs and at least one prior hospitalization.

[f]Look-back window for medication utilization was 120 days.

[g]Percentages reported are on the basis of the number of Ontario Drug Benefit eligible patients (those aged ≥65 years).

[h]Does not include acetylsalicylic acid.

[i]Pre-ED visit look-back window was 7–365 days.

[j]Look-back window for health care utilization was 365 days unless otherwise noted.

[k]Patients with a Canadian Triage Acuity Scale score of 1 or 2 need to be seen immediately 98% of the time or within 15 minutes 95% of the time, respectively. Patients with a Canadian Triage Acuity Scale score of 3 need to be seen within 30 minutes 90% of the time or 60 minutes 85% of the time, respectively. Patients with a Canadian Triage Acuity Scale score of 4 or 5 need to be seen within 120 minutes 80% of the time.

Table 2. Thirty-day outcomes of patients discharged home from the emergency department (ED) with AKI

Outcome	Patients Discharged Home from the ED with AKI, *n* (%)[a]			
	All Patients (*n*=6346)	AKI Stage[b]		
		1 (*n*=6012)	2 (*n*=290)	3 (*n*=44)
All-cause mortality	149 (2)	127 (2)	15 (5)	7 (16)
Receipt of hospital-based acute dialysis	22 (0.3)	Not reported	≤5 (≤2)	≤5 (≤11)
At least one hospitalization	1032 (16)	956 (16)	62 (21)	14 (32)
At least one outpatient				
Physician clinic visit[c]	4287 (68)	4062 (68)	197 (68)	28 (64)
Serum creatinine test	1446 (23)	1339 (22)	89 (31)	18 (41)
Urine test for protein[d]	Not reported	713 (12)	41 (14)	≤5 (≤11)
Total health care costs, $[e]				
Mean (SD)	3522 (7079)	3499 (7135)	3856 (6065)	4429 (5454)
Median (interquartile range)	1172 (661–3020)	1164 (657–2955)	1342 (749–4372)	1748 (699–6478)

[a]Reported as *n* (%) unless otherwise noted. To comply with privacy regulations for minimizing the chance of patient reidentification, numbers of patients were suppressed in five or fewer patients. The total number of patients was not reported if there were other calculations that could result in the reidentification of five or fewer patients.
[b]AKI stage 1, evidence of a relative increase in serum creatinine value of ≥50% to <100% or ≥0.3 mg/dl from baseline; stage 2, evidence of a relative increase in serum creatinine value of ≥100% to <200% from baseline; and stage 3, evidence of a relative increase in serum creatinine value of >200% from baseline or an absolute increase in serum creatinine value to ≥4 mg/dl or the initiation of dialysis.
[c]Seen by any one of the following physicians as outpatient: family medicine, internal medicine, nephrology, or urology.
[d]Urine protein tests included any one of dipstick, protein, or albumin-to-creatinine ratio.
[e]Reported in Canadian dollars, adjusted for inflation to 2013.

clinically meaningful (26). After matching, we used modified Poisson regression to express risk in relative terms, account for matched data, and test for interaction (27,28). We defined statistical significance as a two-sided *P* value of <0.05.

Results

Characteristics of Patients Discharged Home from the ED with AKI

Cohort selection is presented in Figure 1. There were 6346 patients discharged home from the ED with AKI included in the cohort, of which 6012 (95%) had stage 1, 290 (5%) had stage 2, and 44 (0.7%) had stage 3 AKI. Selected characteristics of this cohort are shown in Table 1 (additional characteristics in Supplemental Table 9). The mean age was 69 years and 47% were women. The most common preexisting comorbidities were hypertension (75%), diabetes (38%), and coronary artery disease (34%). Baseline medication information was available for 73% of patients. Commonly prescribed medications in the 120 days before the ED visit were angiotensin-converting enzyme inhibitors or angiotensin receptor blockers (60%), antibiotics (44%), nonpotassium-sparing diuretics (57%), and nonsteroidal anti-inflammatory drugs (19%). CKD, defined by a baseline eGFR of <60 ml/min per 1.73 m^2, was present in 38% of patients. Compared with patients with stage 1 AKI, patients with stage 2 or 3 AKI were more likely to be women, reside in long-term care, or a have lower baseline serum creatinine value; they were less likely to have coronary artery disease, heart failure, CKD, or be prescribed β-blockers, calcium channel blockers, lithium, oral hypoglycemic agents, or insulin. The three most frequent main diagnoses assigned by ED physicians were throat or chest pain (9%), abdominal or pelvic pain (7%), and renal colic (5%) (Supplemental Table 10).

Outcomes

During the 30 days after an ED discharge with AKI, 149 (2%) patients died, 22 (0.3%) received hospital-based acute dialysis, and 1032 (16%) required hospitalization (Table 2). There were 4287 (68%) patients who were seen at least once by a physician as an outpatient. Outpatient serum creatinine testing occurred at least once in 1446 (23%) patients. Outpatient urine protein testing occurred in at least 11% of patients. When assessing patients by AKI severity, 127 (2%) with stage 1, 15 (5%) with stage 2, and seven (16%) with stage 3 AKI died within 30 days of ED discharge. Compared with patients with stage 1 AKI, the likelihood of hospitalization and total health care costs were higher in patients with stage 2 or 3 AKI.

AKI Subpopulation

Among patients who had AKI upon presentation to the ED, we matched 4379 patients discharged home to 4379 patients whose ED visit resulted in hospitalization (Table 3). There were 4091 (93%) patients with stage 1, 244 (6%) with stage 2, and 44 (1%) with stage 3 AKI. Groups were balanced for 91 out of 92 characteristics (Supplemental Table 11). The primary outcome of 30-day all-cause mortality is presented in Table 3. Compared with

Table 3. Thirty-day risk of all-cause mortality and other adverse outcomes in the AKI subpopulation

Outcome	Events, n/N (%)		Relative Risk[a] (95% Confidence Interval)	P Value
	Patients in the ED with AKI			
	Discharged Home	Admitted to Hospital		
All-cause mortality	130/4379 (3)	522/4379 (12)	0.3 (0.2 to 0.3)	<0.001
AKI severity				
Stage 1	108/4091 (3)	477/4091 (12)	0.2 (0.2 to 0.3)	<0.001[b]
Stage 2	15/244 (6)	38/244 (16)	0.4 (0.2 to 0.7)	
Stage 3	7/44 (16)	7/44 (16)	1.0 (0.4 to 2.6)	
Receipt of hospital-based acute dialysis	19/4379 (0.4)	33/4379 (0.8)	0.6 (0.3 to 1.0)	0.06

[a]Patients admitted to hospital from the ED with AKI served as the referent group.
[b]P value for interaction.

patients admitted to hospital with AKI, fewer patients discharged home with AKI died (130 [3%] versus 522 [12%]; relative risk, 0.3; 95% confidence interval, 0.2 to 0.3; $P<0.001$). The difference was attenuated in a subgroup of patients with increased AKI severity (P value for interaction <0.001). Fewer patients discharged home with AKI received hospital-based acute dialysis within 30 days of an ED visit, although this difference was not statistically significant (19 [0.4%] versus 33 [0.8%]; relative risk, 0.6; 95% confidence interval, 0.3 to 1.0; $P=0.06$).

Discharge Subpopulation

We matched 6188 patients discharged home from the ED with AKI to 6188 patients discharged home with no AKI (Table 4). The groups were balanced on 89 out of 91 characteristics (Supplemental Table 12). The primary outcome of 30-day all-cause mortality is presented in Table 4. Compared with patients discharged with no AKI, patients discharged with AKI had a higher risk of death (136 [2%] versus 87 [1%]; relative risk, 1.6; 95% confidence interval, 1.2 to 2.0; $P=0.001$). The association between AKI and mortality was not modified by CKD stage (P value for interaction <0.6). More patients discharged with AKI received hospital-based acute dialysis within 30 days of ED discharge (19 [0.3%] versus seven [0.1%]; relative risk, 2.7; 95% confidence interval, 1.2 to 6.0; $P=0.01$).

Discussion

In this population-based cohort study of adults discharged home from the ED with AKI, 149 (2%) died within 30 days and this proportion increased with AKI severity. Compared with patients who were hospitalized with AKI, patients discharged from the ED with AKI had lower risk of death and subsequent dialysis. Although these two groups had comparable characteristics, the divergence in outcomes highlights the accuracy of ED clinicians in discerning subtle clinical differences in patients with AKI. Sicker patients destined for worse outcomes were appropriately hospitalized. Nonetheless, the adverse outcomes of AKI after an ED discharge are clearly highlighted when such patients were compared with a similar cohort of ED patients without AKI. An ED discharge with AKI was associated with a 1.6-fold increase in mortality and an increased need for hospital-based acute dialysis within 30 days of discharge. Among the groups studied, an ED discharge with AKI represents an intermediate risk population.

The results of our study provide important insights into the characteristics and outcomes of patients discharged home from the ED with AKI. In our literature review, we found two observational studies of patients with community-acquired AKI managed by primary care or ED physicians (29,30). However, neither study performed a separate and comprehensive analysis of ED discharges with AKI.

We found comparable 30-day mortality in a matched subgroup of patients with stage 3 AKI in the AKI subpopulation. Patients discharged home with severe AKI appear to be at risk of poor outcomes. This may reflect progression of an underlying illness because 32% of patients were admitted to hospital within 30 days of the ED visit. However, the use of administrative data cannot account for important factors such as hemodynamic stability and the ED physician's determination of safety and appropriateness for discharge home. Further details would require a detailed chart review, best collected in a prospective fashion.

The 30-day mortality risk in patients discharged home from the ED with AKI is not insignificant when compared with other ED patient groups. For example, fewer patients die within 30 and 90 days of an ED discharge with chest pain (0.2%) and a transient ischemic attack (2%), respectively (31,32). Without conducting a formal analysis and accounting for differences in study methodology, the higher risk is likely because our cohort has a greater burden of comorbidity. Conversely, other studies showed that more patients die within 30 days of ED discharge with heart failure (4%) or unstable angina (5%) (33,34). The lower risk is likely because a proportion of AKI in our cohort may be caused by mild, reversible hemodynamic changes and thus confer better short-term

Table 4. Thirty-day risk of all-cause mortality and other adverse outcomes in the discharge subpopulation

Variable	Events, n/N (%)		Relative Risk[a] (95% Confidence Interval)	P Value
	Patients Discharged from the ED			
	AKI	No AKI		
All-cause mortality	136/6188 (2)	87/6188 (1)	1.6 (1.2 to 2.0)	0.001
Pre-ED CKD stage, eGFR in ml/min per 1.73 m2[b]				
≥60	67/3904 (2)	47/3904 (1)	1.4 (1.0 to 2.1)	0.57[c]
45 to <60	34/1054 (3)	16/1054 (2)	2.1 (1.2 to 3.8)	
30 to <45	16/803 (2)	13/803 (2)	1.2 (0.6 to 2.6)	
<30[d]	19/427 (4)	11/427 (3)	1.7 (0.8 to 3.6)	
Receipt of hospital-based acute dialysis	19/6188 (0.3)	7/6188 (0.1)	2.7 (1.2 to 6.0)	0.01

ED, emergency department.
[a]Patients discharged home from the ED with no AKI served as the referent group.
[b]Derived from pre-ED serum creatinine measurements 7–365 days before the ED visit and is reported in ml/min per 1.73 m^2.
[c]P value for interaction.
[d]Patients with an eGFR of 15 to <30 ml/min per 1.73 m^2 and those with <15 ml/min per 1.73 m^2 (not on dialysis) were combined because of a low number of events.

outcomes. We also found that most patients had mild AKI and that mortality was far more common than the need for dialysis. Mortality does not appear to be caused by kidney failure—it is more likely that AKI is a marker of severe illness.

The need for hospitalization within 30 days of an ED discharge with AKI occurred in 1032 (16%) patients, similar to the 30-day readmission rates (15%–20%) among AKI survivors discharged after hospitalization (35,36). We also found a discrepancy between the proportion of patients who received outpatient physician follow-up (68%) and those who had repeat serum creatinine measurements (23%). This raises questions of whether AKI was the main reason for the outpatient visit, physicians recognized the presence of AKI, and if appropriate measures were taken to avoid hospitalization.

Our results suggest there is an opportunity to explore health system strategies to improve the identification and management of patients discharged home from the ED with AKI. Several rapid access clinics for patients discharged from the ED with chest pain, heart failure, or a transient ischemic attack have been shown to improve patient outcomes (37–39). AKI survivors discharged after hospitalization appear to benefit from follow-up clinics (40). A similar model could be adapted for patients discharged home from the ED with AKI, supported by an automated surveillance system to aid in the identification of AKI.

Our study has limitations. First, we could not capture patients who had baseline pre-ED serum creatinine measurements in other outpatient laboratories or hospitals. Second, use of administrative data limited our ability to ascertain information regarding AKI awareness by ED physicians. For many patients, we suspect that AKI was in fact recognized, appropriately managed, and deemed safe for discharge home. Third, we excluded patients with an improvement in AKI severity in order to exclude those recognized and treated. These individuals may differ systematically from those who did not have an improvement in AKI severity. Fourth, hospitalization may not have been preventable because of underlying illness. Alternatively, these patients could have been appropriately hospitalized after a visit to a rural ED, where patients were strategically discharged and instructed to seek further care at a tertiary care center. Such patients would be considered an ED discharge. There were also limitations in our two subpopulation analyses. First, as with all observational studies, our results are subject to confounding because propensity score matching will only ensure balance on measured characteristics. The ED main diagnosis was not included in our propensity score models because the diagnosis is often preliminary and there is significant disagreement with main diagnoses assigned at later stages of patient care (41–43). Second, referent subpopulations are only generalizable to ED discharges with AKI included in the match. We could not match 1967 (31%) patients in the AKI subpopulation and 228 (4%) patients in the discharged subpopulation. Third, medication information was only available for a subset of patients eligible for provincial drug coverage. We minimized the effect of missing medication information by balancing the comorbidities for which these medications are indicated.

In summary, patients discharged home from the ED with AKI are at significant risk of 30-day mortality and hospitalization. Compared with hospital admission with AKI and an ED discharge with no AKI, an ED discharge with AKI is at intermediate risk for adverse outcomes. Research into risk factors for adverse outcomes, further characterization of ED and outpatient care, and testing health system strategies to identify and mitigate gaps in care is warranted.

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Disclosures

None.

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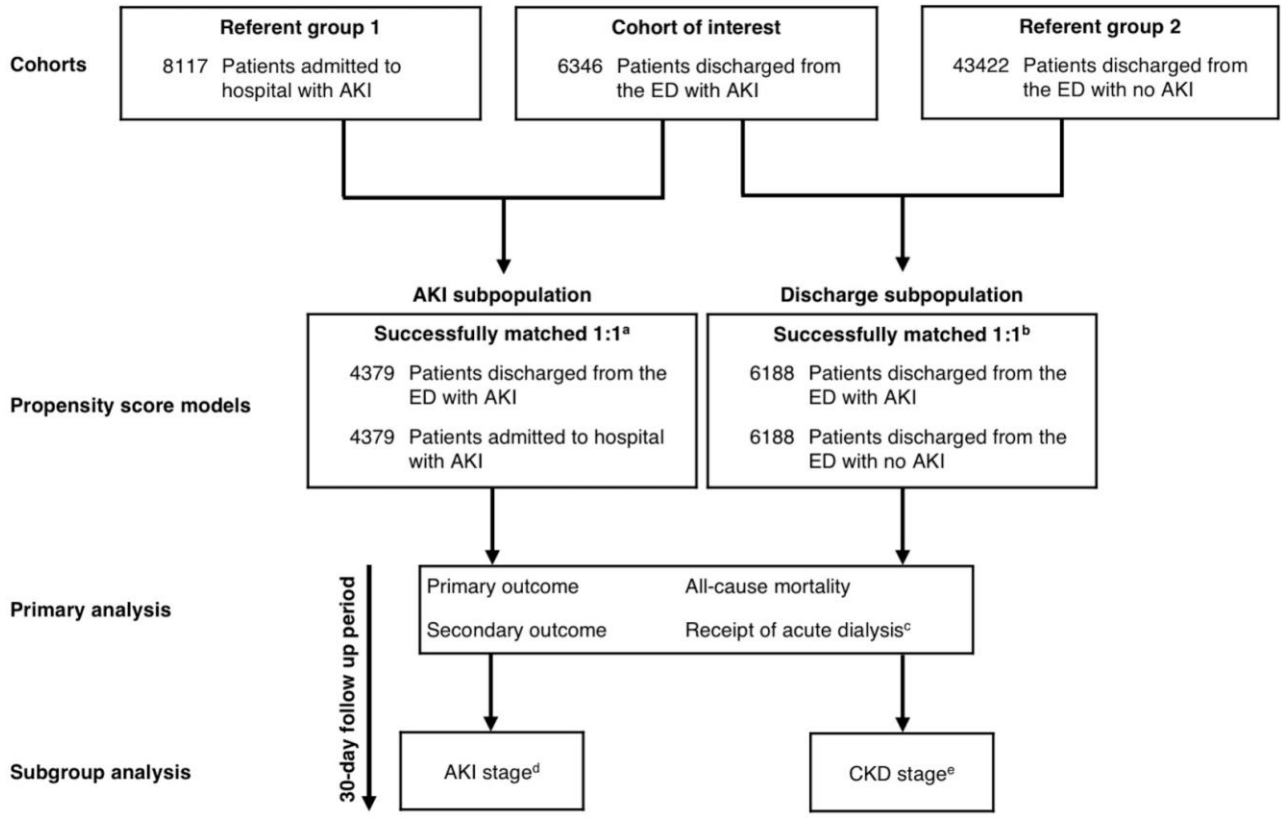
Figure 1. Development of propensity score matched subpopulations



Abbreviations: AKI, acute kidney injury; CKD, chronic kidney disease; ED, emergency department; eGFR, estimated glomerular filtration rate.

[a] Matched 1:1 for ED disposition (discharge home versus admission to hospital) and AKI stage. The propensity score was derived from 92 characteristics (Supplemental Table 7).
[b] Matched 1:1 for the presence of AKI and CKD stage. The propensity score was derived from 91 characteristics (Supplemental Table 7).
[c]Patientswere admitted to hospital for acute dialysis.
[d] AKI staging according to 2012 Kidney Diseases: Improving Global Outcomes clinical practice guidelines (Supplemental Table 8).[1]
[e] CKD staging according to 2012Kidney Diseases: Improving Global Outcomes clinical practice guidelines (in ml/min/1.73m^2): eGFR≥60 (no CKD or CKD stage 1 or 2); 45≤eGFR<60 (CKD stage 3a), 30≤eGFR<45 (CKD stage 3b); 15≤eGFR<30 (CKD stage 4); and eGFR<15, but not on dialysis (CKD stage 5).[2]

Table 1. STrengthening the Reporting of OBservational studies in Epidemiology checklist of items for reporting[3]

Section	Item no.	Recommendation	Reported[a]
Title and abstract	1a	Indicate the study's design with a commonly used term in the title or the abstract	1
	1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6,7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-9
Data sources and measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-9
Bias	9	Describe any efforts to address potential sources of bias	8,9
Study size	10	Explain how the study size was arrived at	6-9
Quantitative Variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8,9
Statistical methods	12a	Describe all statistical methods, including those used to control for confounding	8,9
	12b	Describe any methods used to examine subgroups and interactions	8,9
	12c	Explain how missing data were addressed	8,9
	12d	If applicable, explain how loss to follow-up was addressed	8,9
	12e	Describe any sensitivity analyses[b]	N/A
Results			
Participants	13a	Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9-12,26

	13b	Give reasons for non-participation at each stage	9,10,25
	13c	Consider use of a flow diagram	Figure 1
Descriptive data	14a	Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	9-12, 26-29
	14b	Indicate number of participants with missing data for each variable of interest	9,10
	14c	Summarise follow-up time (e.g., average and total amount)	8,25, Figure 1
Outcome data	15	Report numbers of outcome events or summary measures over time	10-12, 30-32
Main results	16	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-12, 26-32 Supplemental Table 7
		Report category boundaries when continuous variables were categorized	26-32
		If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	11,12,31,32
Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses[b]	11,12,31,32
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	14,15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-15
Generalizability	21	Discuss the generalizability (external validity) of the study results	12,15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15-17

[a]Location of STrengthening the Reporting of OBservational studies in Epidemiologychecklist items refer to the page numbers in the final manuscript submission.
[b]All analyses reported in study. No other sensitivity analyses were done.

Table 2. List of databases held at the Institute for Clinical Evaluative Sciences

Data Source	Description	Study Purpose
Assistive Device Program	The Assistive Device Program database is operated by the Ministry of Health and Long-Term Care. It contains information on consumer-centered support to Ontario residents with long-term disabilities such as personalized assistive devices.	Estimation of health care costs
Client Agency Program Enrolment	The Client Agency Program Enrolment database accounts for the services provided by multi-disciplinary family health teams comprised of family physicians, nurses, and other allied healthcare professionals.	Estimation of health care costs
Continuing Care Reporting System	The Continuing Care Reporting Systemfor chronic care database contains clinical and demographic information on residents receiving facility-based continuing care services, including hospital-based continuing care (complex continuing care, extended/chronic care) and residential care providing 24-hour nursing services (nursing home, home for the aged).	Estimation of health care costs
Cerner	Electronic health record database (Cerner, Missouri, USA) shared by 13 hospitals in Southwestern Ontario and contains both outpatient and inpatient laboratory test results for adults 40 years and older.	Cohort creation, stratification, description, exposure, and outcome
Canadian Institute for Health Information Discharge Abstract Database and National Ambulatory Care Reporting System	The Canadian Institute for Health Information Discharge Abstract Database and National Ambulatory Care Reporting System collect diagnostic and procedural variables for inpatient stays and ED visits, respectively. Diagnostic and inpatient procedural coding use the 10th version of the Canadian Modified International Classification of Disease system 10th Revision (after 2002).	Cohort creation, stratification, description, exposure, and outcome Estimation of health care costs
Dynacare (formerly known as Gamma-Dynacare Medical Laboratories)	Database that contains all outpatient laboratory test results from all Dynacare laboratory locations across Ontario since 2002. Dynacare is one of the three largest laboratory providers in Ontario and contains records on over 59 million tests each year.	Cohort creation, stratification, description, exposure, and outcome
Home Care Database	The Home Care Database, derived from either the Ontario Association of Community Care Access Centres or the Ministry of Health, contains information on individuals requiring any home care service provided by the province's Community Care Access Centres.	Estimation of health care costs
Institute for Clinical Evaluative Sciences Physician Database	The Institute for Clinical Evaluative Sciences Physician Database contains demographic, specialty, education, and practice information on all practicing physicians in Ontario.	Cohort description, and outcome
National Rehabilitation Reporting System	The National Rehabilitation Reporting System database collects, processes and analyzes adult inpatient rehabilitation services at the hospital, regional, and provincial/territorial levels.	Estimation of health care costs
Ontario Drug Benefits	The Ontario Drug Benefits database includes a wide range of outpatient prescription medications available to all Ontario citizens over the age of 65 and in specific circumstances for citizens under the age of 65. The error rate in the	Medication prescriptions Estimation of health care

	Ontario Drug Benefits database is less than 1%.[4]	costs
Ontario Health Insurance Plan	The Ontario Health Insurance Plan database contains information on Ontario physician billing claims for medical services using fee and diagnosis codes outlined in the Ontario Health Insurance Plan Schedule of Benefits. These codes capture information on outpatient, inpatient, and laboratory services rendered to a patient. The sensitivity of information recorded in the Ontario Health Insurance Plan database is over 90% when diagnosis and procedural codes abstracted from the database are compared to the actual code recorded on the chart by the physician.[5]	Cohort creation, stratification, description, exposure, and outcome Estimation of health care costs
Ontario Mental Health Reporting System	The Ontario Mental Health Reporting System database collects data on patients in adult designated inpatient mental health beds, which includes beds in General, Provincial Psychiatric, and Specialty Psychiatric facilities.	Estimation of health care costs
Registered Persons Database	The Registered Persons Database captures demographic (sex, date of birth, postal code) and vital status information on all Ontario residents. Relative to the Canadian Institute for Health Information Discharge Abstract Database in-hospital death flag, the Registered Persons Database has a sensitivity of 94% and a positive predictive value of 100%.[6]	Cohort creation and outcome analyses

Table 3. Coding definitions for co-morbid conditions

Variable	Database	Code Set	Code
Abdominal aortic aneurysm repair	Canadian Institute for Health Information Discharge Abstract Database	Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	5024, 5034
		Canadian Classification of Health Interventions	1KA76
	Ontario Health Insurance Plan	Fee code	R802, R816, R817, R783, R784, R785, R814
Atrial fibrillation or flutter	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	4273
		International Classification of Diseases 10th Revision	I48
Major cancer[a]	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	150, 154, 155, 157, 162, 174, 175, 185, 203, 204, 205, 206, 207, 208, 2303, 2304, 2307, 2330, 2312, 2334
		International Classification of Diseases 10th Revision	971, 980, 982, 984, 985, 986, 987, 988, 989, 990, 991, 993, C15, C18, C19, C20, C22, C25, C34, C50, C56, C61, C82, C83, C85, C91, C92, C93, C94, C95, D00, D010, D011, D012, D022, D075, D05
	Ontario Health Insurance Plan	Diagnosis	203, 204, 205, 206, 207, 208, 150, 154, 155, 157, 162, 174, 175, 183, 185
Chronic liver disease	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	4561, 4562, 070, 5722, 5723, 5724, 5728, 573, 7824, V026, 571, 2750, 2751, 7891, 7895
		International Classification of Diseases 10th Revision	B16, B17, B18, B19, I85, R17, R18, R160, R162, B942, Z225, E831, E830, K70, K713, K714, K715, K717, K721, K729, K73, K74, K753, K754, K758, K759, K76, K77
	Ontario Health Insurance Plan	Diagnosis	571, 573, 070
		Fee code	Z551, Z554
Chronic obstructive pulmonary disease	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	491, 492, 496
		International Classification of Diseases 10th Revision	J41, J43, J44
Coronary artery disease (excluding angina)	Canadian Institute for Health Information Discharge Abstract Database	Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	4801, 4802, 4803, 4804, 4805, 481, 482, 483
		Canadian Classification of Health Interventions	1IJ50, 1IJ76

		International Classification of Diseases 9th Revision	412, 410, 411
		International Classification of Diseases 10th Revision	I21, I22, Z955, T822
	Ontario Health Insurance Plan	Diagnosis	410, 412
		Fee code	R741, R742, R743, G298, E646, E651, E652, E654, E655, Z434, Z448
Dementia	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	2900, 2901, 2903, 2904, 2908, 2909, 2948, 2949, 3310, 3311, 3312, 2941, 797
		International Classification of Diseases 10th Revision	F065, F066, F068, F069, F09, F00, F01, F02, F03, F051, G30, G31, R54
	Ontario Health Insurance Plan	Diagnosis	290, 331, 797
Diabetes[b]	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	250
		International Classification of Diseases 10th Revision	E10, E11, E13, E14
	Ontario Health Insurance Plan	Diagnosis	250
		Fee code	Q040, K029, K030, K045, K046
Heart failure	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	425, 5184, 428, 514
		International Classification of Diseases 10th Revision	I500, I501, I509, I255, J81
		Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	4961, 4962, 4963, 4964
		Canadian Classification of Health Interventions	1HP53, 1HP55, 1HZ53GRFR, 1HZ53LAFR, 1HZ53SYFR
	Ontario Health Insurance Plan	Diagnosis	428
		Fee code	R701, R702, Z429
Hypertension[b]	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	401, 402, 403, 404, 405
		International Classification of Diseases 10th Revision	I10, I11, I12, I13, I15
	Ontario Health Insurance Plan	Diagnosis	401, 402, 403
Nephrolithiasis	Canadian Institute for Health Information	International Classification of Diseases 9th Revision	5920, 5921, 5929, 5940, 5941, 5942, 5948, 5949, 27411

	Discharge Abstract Database	International Classification of Diseases 10th Revision	N200, N201, N202, N209, N210, N211, N218, N219, N220, N228
Osteoarthritis	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	715
		International Classification of Diseases 10th Revision	M15, M16, M17, M18, M19, M47
Parkinson's disease	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	332
		International Classification of Diseases 10th Revision	G20, F023
Peripheral vascular disease	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	4402, 4408, 4409, 5571, 4439, 444
		International Classification of Diseases 10th Revision	I700, I702, I708, I709, I731, I738, I739, K551
		Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	5125, 5129, 5014, 5016, 5018, 5028, 5038, 5126, 5159
		Canadian Classification of Health Interventions	1KA76, 1KA50, 1KE76, 1KG50, 1KG57, 1KG76MI, 1KG87, 1IA87LA, 1IB87LA, 1IC87LA, 1ID87LA, 1KA87LA, 1KE57
	Ontario Health Insurance Plan	Fee code	R787, R780, R797, R804, R809, R875, R815, R936, R783, R784, R785, E626, R814, R786, R937, R860, R861, R855, R856, R933, R934, R791, E672, R794, R813, R867, E649
Rheumatoid arthritis	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	714
		International Classification of Diseases 10th Revision	M05, M06
	Ontario Health Insurance Plan	Diagnosis	714
Cerebrovascular disease (stroke or transient ischemic attack)	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	430, 431, 432, 4340, 4341, 4349, 435, 436, 3623
		International Classification of Diseases 10th Revision	I62, I630, I631, I632, I633, I634, I635, I638, I639, I64, H341, I600, I601, I602, I603, I604, I605, I606, I607, I609, I61, G450, G451, G452, G453, G458, G459, H340

[a]List of major cancers include lung/bronchi, colon/rectum, breast, pancreas, prostate, leukemia, non-Hodgkin lymphoma, liver, ovarian, and esophagealcancers.
[b]Medications were not considered as not all patients have medication information available.

Table 4. Diagnostic codes for health care utilization characteristics

Variable	Database	Code Set	Code
Family physician visit	Ontario Health Insurance Plan	Fee code	A001, A003, A004, A005, A006, A007, A008, A900, A901, A905, A911, A912, A967, K131, K132, K140, K141, K142, K143, K144, W003, W008, W121
	Institute for Clinical Evaluative Sciences Physician Database	Main specialty	GP/FP
Internal medicine physician visit	Ontario Health Insurance Plan	Fee code	A135, C135
	Institute for Clinical Evaluative Sciences Physician Database	Main specialty	INTERNAL MEDICINE
Nephrologist visit	Ontario Health Insurance Plan	Fee code	A135, A161, A163, A164, A165, A166, A168, C101, C138, G860, G323, G333, E083, C132, C135, C137, C139, H540, G325, G326, G860, G865, G866, G330, G331, G332, G861, G864
	Institute for Clinical Evaluative Sciences Physician Database	Main specialty	NEPHROLOGY
Urology visit	Ontario Health Insurance Plan	Fee code	A355, A356, A353, A354, C355, C356, C353, C354 Z606, Z628, Z632, Z633, Z634, S655, S654
	Institute for Clinical Evaluative Sciences Physician Database	Main specialty	UROLOGY
Coronary angiogram or revascularization	Canadian Institute for Health Information Discharge Abstract Database	Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	4892, 4893, 4894, 4895, 4896, 4897, 4898, 481, 482, 483, 480
		Canadian Classification of Health Interventions	3IP10, 3IS10, 1IJ50, 1IJ26, 1IJ27, 1IJ57, 1IJ76, 1IJ57GQ, 1IJ54GQAZ
	Ontario Health Insurance Plan	Fee code	G297, G509, R741, R742, R743, E651, E652, E654, E646, G298, Z434, G262
Computed tomography scan with contrast	Canadian Institute for Health Information Discharge Abstract Database	Canadian Classification of Health Interventions	3AF20WC, 3AN20WC, 3CA20WC, 3DR20WC, 3EA20WC, 3EL20WC, 3ER20WC, 3EY20WC, 3FX20WC, 3FY20WC, 3GE20WC, 3GT20WC, 3GY20WC, 3ID20WC, 3IP20WC, 3JE20WC, 3JX20WC, 3JY20WC, 3KE20WC, 3KG20WC, 3KT20WC, 3NM20WC, 3OT20WC, 3PC20WC, 3PZ20WC, 3QT20WC, 3SC20WC, 3SF20WC, 3TZ20WC, 3VZ20WC, 3WZ20WC, 3YM20WC, 3ZZ20WC, 3FY20VZ, 3FY20VC
Echocardiogram	Canadian Institute for	Canadian Classification of	0282

	Health Information Discharge Abstract Database	Diagnostic, Therapeutic and Surgical Procedures	
		Canadian Classification of Health Interventions	3IP30
	Ontario Health Insurance Plan	Fee code[a]	G560, G561, G562, G566, G567, G568, G570, G571, G572, G574, G575, G576, G577, G578, G581
Cardiac stress test	Canadian Institute for Health Information Discharge Abstract Database	Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	0341, 0342, 0343, 0344, 0605
		Canadian Classification of Health Interventions	2HZ08, 3IP70
	Ontario Health Insurance Plan	Fee code	G315, G174, G111, G112, G319, G582, G583, G584, J607, J608, J807, J808, J809, J866, J609, J666
Abdominal ultrasound	Ontario Health Insurance Plan	Fee code	J128, J135, J428, J435
Kidney stone interventions	Ontario Health Insurance Plan	Fee code	Z630, Z628, E760, E761, Z624, Z627

[a] G560, G561, G562, G566, G567, G568, G576 are no longer in the Ontario Health Insurance Plan fee schedule as of 2014/11

Table 5. Diagnostic codes for exclusion criteria

Variable	Database	Code Set	Code
Dialysis	Canadian Institute for Health Information Discharge Abstract Database	International Classification of Diseases 9th Revision	V451, V560, V568, 99673
		International Classification of Diseases 10th Revision	T824, Y602, Y612, Y622, Y841, Z49, Z992
		Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	5127, 5142, 5143, 5195, 6698
		Canadian Classification of Health Interventions	1PZ21, 1OT53DATS, 1OT53HATS, 1OT53LATS, 1SY55LAFT, 7SC59QD, 1KY76, 1KG76MZXXA, 1KG76MZXXN, 1JM76NC, 1JM76NCXXN
	Ontario Health Insurance Plan	Fee code	R850, G324, G336, G327, G862, G865, G099, R825, R826, R827, R833, R840, R841, R843, R848, R851, R946, R943, R944, R945, R941, R942, Z450, Z451, Z452, G864, R852, R853, R854, R885, G333, H540, H740, R849, G323, G325, G326, G860, G863, G866, G330, G331, G332, G861, G082, G083, G085, G090, G091, G092, G093, G094, G095, G096, G294, G295
Kidney transplant	Canadian Institute for Health Information Discharge Abstract Database	Canadian Classification of Health Interventions	1PC85
	Ontario Health Insurance Plan	Fee code	S435, S434
Palliative care	Canadian Institute for Health Information Discharge Abstract Database	Patient service	58
	Ontario Health Insurance Plan	Fee code	C945, C882, C982, W872, W972, B966, B998, B997, G511, W882, W982, K023 (inpatient or LTC use only)
Acute kidney injury	Canadian Institute for Health Information Discharge Abstract Database and National Ambulatory Care Reporting System	International Classification of Diseases 10th Revision	N17

Table 6. Diagnostic codes for outcome variables

Variable	Database	Code Set	Code
Mortality	Registered Persons Database	Vital status	Vital status field
Hospital-based acute dialysis	Ontario Health Insurance Plan	Fee code	R849, G323, G866, G330, G331, G093, G095, G294, G2955 associated with hospital admission
Health care cost	Assistive Device Program, Client Agency Program Enrolment, Continuing Care Reporting System, Canadian Institute for Health Information Discharge Abstract Database and National Ambulatory Care Reporting System, Home Care Database, National Rehabilitation Reporting System, Ontario Drug Benefits, Ontario Health Insurance Plan, Ontario Mental Health Reporting System		Institute for Clinical Evaluative Sciences costing macro[7]
Outpatient physician visit by any one of: family physician, general internist, nephrologist, urologist	Ontario Health Insurance Plan	Fee code	GP/FP: A001, A003, A004, A005, A006, A007, A008, A900, A901, A905, A911, A912, A967, K131, K132, K140, K141, K142, K143, K144, W003, W008, W121 Internal Medicine: A135, C135 Nephrology: A135, A161, A163, A164, A165, A166, A168, C101, C138, G860, G323, G333, E083, C132, C135, C137, C139, H540, G325, G326, G860, G865, G866, G330, G331, G332, G861, G864 Urology: A355, A356, A353, A354, C355, C356, C353, C354 Z606, Z628, Z632, Z633, Z634, S655, S654
	Institute for Clinical Evaluative Sciences Physician Database	Main specialty	GP/FP, INTERNAL MEDICINE, NEPHROLOGY, UROLOGY
Serum creatinine tests	Dynacare		067A
	Cerner		Test done=”A”
	Ontario Health Insurance Plan	Fee code	L067
Urine protein tests (dipstick, albumin-to-creatinine ratio, protein-to-creatinine ratio)	Dynacare		05DR, 05DU, P/CR, P/CM, 208Y, 208Z, 253
	Ontario Health Insurance Plan	Fee code	L253, L254, L255, L633, L634, L641, G009, G010

Table 7. Characteristics used to derive propensity scores

Category	Variable
Demographics	Age, sex
Income	Income quintile
Index date	Year of cohort entry
Residence status	Location, long-term care status
Pharmacy	Forward sortation area
Co-morbid conditions	Abdominal aortic aneurysm repair, atrial fibrillation/flutter, major cancer, chronic liver disease, chronic obstructive pulmonary disease, coronary artery disease, dementia, diabetes, heart failure, hypertension, nephrolithiasis, osteoarthritis, Parkinson's disease, peripheral vascular disease, rheumatoid arthritis, stroke/transient ischemic attack
Co-morbidity indices	Charlson co-morbidity index, aggregated diagnosis group point score
Laboratory characteristics	Baseline serum creatinine[a], number of days baseline serum creatinine was measured prior to ED index date[a], proportion with baseline serum creatinine ≤0.3mg/dL, serum creatinine at ED visit (each AKI stage)[a], albumin-to-creatinine ratio, serum potassium[a], serum sodium[a], AKI stage[b], eGFR category
Health care utilization	Prior hospitalizations, prior ED visits, Family physician encounter, Internal Medicine visit, Nephrologist visit, Urologist visit, coronary angiogram or revascularization, computed tomographywith contrast, echocardiogram, cardiac stress test, abdominal ultrasound, intervention for kidney stones
Medication class[b]	Ontario Drug Benefiteligibility, number of unique drug identification numbers, number of unique drug names angiotensin-converting enzyme inhibitor or angiotensin receptor blocker, antibacterial, anticoagulant, antidepressant (selective serotonin reuptake inhibitor or serotonin-norepinephrine reuptake inhibitor), antineoplastic, antiplatelet, antipsychotic medication, beta-adrenergic antagonist, calcium channel blocker, corticosteroid, xanthine oxidase inhibitor or uricosuric agent, anti-retroviral medication, immunosuppressive medication, lithium, non-potassium sparing diuretic, non-steroidal anti-inflammatory drug[c], oral hypoglycemic agent or insulin, potassium-sparing diuretic, prostatic hyperplasia medication, proton pump inhibitor, statin
ED and hospital Characteristics	Hospital institution[d], ED registrations in last 12 hours[a], hospital admissions in last 24 hours[a], hospital discharges in last 24 hours[a], proportion of ED registrations admitted to hospital, ED length of stay, time waiting for physician assessment, Canadian Triage Acuity Scale, time of day (weekday and weekend), season of the year, ED physician specialty training.

Abbreviations: AKI, acute kidney injury; ED, emergency department; eGFR, estimated glomerular filtration rate.

We considered a total of 93 variables to derive propensity scores for the AKI and dischargesubpopulations. In the AKI subpopulation (comparing patients discharged home from the ED with AKI versus patients admitted to hospital with AKI), a total 92 variables were used to derive the propensity score. The ED length of stay variable was not included because admitted patients may remain in the ED until an inpatient bed is available, inflating the ED length of stay (defined as time of registration to time patient physically left the ED). In the discharge subpopulation (comparing patients discharged home from the ED with AKI versus patients discharged home from the EDwith no AKI), a total of 91 variables were used to derive the propensity score. ED visit serum creatinine and AKI stage were not included in the model.To convert serum creatinine from traditional units (mg/dL) to SI units (µmol/L), multiply by 88.42.

[a] Continuous variables in the propensity score model.

[b] Medications available for Ontario Drug Benefiteligible patients.

[c] Excludes acetylsalicylic acid.

[d]Thirteen hospital institutions in Southwestern Ontario share the same electronic health record (Cerner, Missouri, USA).

Table 8. Definition and staging of acute kidney injury

Stage	Serum creatinine
1	1.5-1.9 times pre-ED baseline OR ≥0.3mg/dL absolute increase
2	2.0-2.9 times pre-ED baseline
3	3.0 times pre-ED baseline OR an increase in serum creatinine to >4 mg/dL OR the initiation of renal replacement therapy

Abbreviations: AKI, acute kidney injury; ED, emergency department.

To convert serum creatinine from traditional units (mg/dL) to SI units (µmol/L), multiply by 88.42.

Definition and staging of AKIwas adapted from the 2012Kidney Diseases: Improving Global Outcomesclinical practice guidelines.[1] Urine output was not available in our data sources and therefore was not included in our definition of AKI.

Serum creatinine measured 7 to 365 days before the ED visit served as the baseline (pre-ED baseline). Pre-ED baseline serum creatinine measurements were chosen no earlier than seven days before the ED visit to avoid potentially unstable baseline values.

Kidney Diseases: Improving Global Outcomesclinical practice guidelines defined the AKI as a relative increase of 1.5-1.9 times within 7 days from baseline or an absolute increase in serum creatinine of 0.3 mg/dL or more within 48 hours from baseline.

Table9. Additional baseline characteristics of patients discharged home from the emergency department with acute kidney injury

	Patients discharged from the ED with AKI, n (%)[a]			
	All patients	AKI stage		
		1	2	3
Cohort size	6346	6012	290	44
Demographics				
Neighbourhood income quintile				
1	1401 (22)	1314 (22)	78 (27)[†]	9 (21)[§]
2	1353 (21)	1290 (22)	54 (19)	9 (21)
3	1307 (21)	1238 (21)	62 (21)	7 (16)[‡§]
4	1046 (17)	996 (17)	42 (15)	8 (18)[§]
5	1140 (18)	1079 (18)	50 (17)	11 (25)[‡§]
Not reported[b]	99 (2)			
Pharmacyforward sortation area[c]	5214 (82)	4945 (82)	233 (80)	36 (82)
Co-morbid conditions[d]				
Abdominal aortic aneurysm repair	49 (0.8)	37	≤5 (≤2)	≤5 (≤11)[‡]
Atrial fibrillation or flutter	not reported	627 (10)	23 (8)	≤5 (≤11)[‡]
Major cancer[e]	1056 (17)	994 (17)	53 (18)	9 (21)[‡]
Chronic obstructive pulmonary disease	not reported	369 (6)	22 (8)	≤5 (≤11)[‡§]
Dementia	not reported	591 (10)	39 (13)[†]	≤5 (≤11)[‡§]
Osteoarthritis	not reported	431 (7)	26 (9)	≤5 (≤11)[‡§]
Parkinson's disease	not reported	32 (0.5)	≤5 (≤2)	≤5 (≤11)[‡§]
Peripheral vascular disease	not reported	178 (3)	≤5 (≤2)	≤5 (≤11)
Rheumatoid arthritis	not reported	429 (7)	22 (8)	≤5 (≤11)
Cerebrovascular disease	not reported	243 (4)	14 (5)	≤5 (≤11)[‡§]
Charlson co-morbidity index[f]				
0	4181 (66)	3962 (66)	188 (65)	31 (71)[§]
1	not reported	661 (11)	33 (11)	≤5 (≤11)
2	not reported	606 (10)	35 (12)	≤5 (≤11)[‡§]
≥3	824 (13)	783 (13)	34 (12)	7 (16)[§]
Medication utilization[g]				
Ontario Drug Benefiteligible patients	4605 (73)	4367 (73)	213 (74)	25 (57)

Patients in long-term care[h]	not reported	171 (4)	13 (6)[†]	≤5 (≤11)[‡]
Medication class[i]				
Anticoagulant	not reported	689 (16)	32 (15)	≤5 (≤11)
Antidepressant (selective serotonin reuptake inhibitor or serotonin-norepinephrine reuptake inhibitor)	774 (17)	728 (17)	40 (19)	6 (24)[‡§]
Antineoplastic (chemotherapy)	not reported	108 (2)	≤5 (≤2)	≤5 (≤11)[‡§]
Antiplatelet	not reported	714 (16)	31 (15)	≤5 (≤11)[‡§]
Beta-adrenergic antagonist	1781 (39)	1705 (39)	66 (31)[†]	10 (40)[§]
Calcium channel blocker	not reported	1499 (34)	64 (30)	≤5 (≤11)[‡§]
Corticosteroid	1188 (26)	1119 (26)	63 (30)	6 (24)[§]
Xanthine oxidase inhibitor or uricosuric agent	not reported	302 (7)	≤5 (≤2)[†]	≤5 (≤11)[‡§]
Anti-retroviral medication	not reported	7 (0.2)	≤5 (≤2)	≤5 (≤11)
Immunosuppressive medication	not reported	166 (4)	13 (6)[†]	≤5 (≤11)
Lithium	not reported	30 (0.7)	≤5 (≤2)[†]	≤5 (≤11)[‡]
Oral hypoglycemic agents or insulin	1403 (31)	1346 (31)	52 (24)[†]	5 (20)[‡§]
Prostatic hyperplasia medication (alpha-1-adrenoceptor antagonist or 5-alpha reductase inhibitor)	not reported	279 (6)	13 (6)	≤5 (≤11)
Proton pump inhibitor	1651 (36)	1571 (36)	68 (32)	12 (48)[‡§]
Statin	2174 (47)	2072 (47)	93 (44)	9 (36)[‡§]
Number of unique drug names, mean (standard deviation)	6 (6)	6 (6)	6 (6)	3 (5)[‡§]
Number of unique drug identification numbers				
Mean (standard deviation)	6 (6)	6 (6)	6 (7)	4 (6)[‡§]
Median (interquartile range)	5 (0-10)	5 (0-10)	5 (0-10)	0 (0-7)
Pre-ED baseline kidney function[j]				
Baseline serum creatinine in mg/dL, median (interquartile range)	1.0 (0.8-1.3)	1.0 (0.8-1.3)	0.8 (0.6-1.0)	0.8 (0.6-1.0)
Days measurement taken prior to ED visit, median (interquartile range)	106 (44-207)	106 (44-206)	126 (45-215)	115 (46-256)
CKD risk category[k]				
Low risk	not reported	678 (11)	41 (14)	≤5 (≤11)
Moderate risk	not reported	293 (5)	15 (5)	≤5 (≤11)[‡§]
High risk	not reported	366 (6)	16 (6)	≤5 (≤11)
Very high risk	not reported	654 (11)	12 (4)[†]	≤5 (≤11)[§]
ED visit laboratory characteristics				
Serum potassium measured	5854 (92)	5552 (92)	264 (91)	38 (86)
Median (interquartile range)	4.1 (3.8-4.5)	4.1 (3.8-4.5)	4.1 (3.6-4.5)	4.2 (3.6-4.8)
Serum sodium measured	5854 (92)	5552 (92)	264 (91)	38 (86)

Median (interquartile range)	138 (135-140)	138 (135-140)	137 (134-139)	134 (131-139)
Previous health care utilization[l]				
Number of ED visits in the previous 30 days				
0	5232 (82)	4950 (82)	245 (85)	37 (84)
1	not reported	293 (5)	9	≤5 (≤11)
2	not reported	229 (4)	10	≤5 (≤11)[‡§]
≥3	not reported	540 (9)	26	≤5 (≤11)[‡§]
Number of ED visits in the previous 31 to 365 days				
0	3836 (60)	3628 (60)	176 (61)	32 (73)[‡§]
1	not reported	1126 (19)	52 (18)	≤5 (≤11)[‡§]
2	not reported	572 (10)	26	≤5 (≤11)
≥3	not reported	686 (11)	36	≤5 (≤11)[‡§]
Number of hospitalizations in the previous 30 days				
0	5865 (92)	5561 (93)	266 (92)	38 (86)[‡§]
1	not reported	250 (4)	13	≤5 (≤11)[‡§]
2	not reported	120 (2)	≥6 (≥2)	≤5 (≤11)[‡§]
≥3	not reported	81 (1)	≤5 (≤2)	≤5 (≤11)[‡§]
Number of hospitalizations in the previous 31 to 365 days				
0	4894 (77)	4646 (77)	212 (73)	36 (82)[‡§]
1	not reported	895 (15)	53 (18)	≤5 (≤11)[‡§]
2	not reported	295 (5)	14 (5)	≤5 (≤11)[‡§]
≥3	not reported	176 (3)	11 (4)	≤5 (≤11)
Family physician visits				
0	not reported	88 (2)	7 (2)	≤5 (≤11)[‡§]
1-2	not reported	339 (6)	15 (5)	≤5 (≤11)
3-4	not reported	590 (10)	24 (8)	≤5 (≤11)
5-6	862 (13.6)	813 (14)	42 (15)	7 (16)
7-8	735 (11.6)	689 (12)	40 (14)	6 (14)
9-10	not reported	659 (11)	27 (9)	≤5 (≤11)
≥11	2990 (47.1)	2834 (47)	135 (47)	21 (48)[‡§]
Abdominal ultrasound[m]	1530 (24.1)	1456 (24)	59 (20)	15 (34)[‡§]
Echocardiogram	not reported	1097 (18)	34 (12)[†]	≤5 (≤11)[‡§]
Cardiac stress test	not reported	931 (16)	34 (12)[†]	≤5 (≤11)[‡§]
Intervention for kidney stones[n]	not reported	73 (1)	≤5 (≤2)	≤5 (≤11)

ED and hospital characteristics				
Institution[o]				
1	1754 (286)	1665 (28)	78 (26.9)	11 (25.0)
2	1482 (23)	1400 (23)	70 (24.1)	12 (27.3)
3	not reported	608 (10)	36	≤5 (≤11.4)[‡§]
4	not reported	435 (7)	26	≤5 (≤11.4)
5	not reported	145 (2)	≤5 (≤1.7)	≤5 (≤11.4)[‡]
6	not reported	42 (0.7)	≤5 (≤1.7)	≤5 (≤11.4)[‡§]
7	not reported	569 (10)	35 (12.1)	≤5 (≤11.4)
8	not reported	241 (4)	7 (2.4)	≤5 (≤11.4)
9	not reported	338 (6)	10 (3.4)[†]	≤5 (≤11.4)[§]
10	not reported	366 (6)	10 (3.4)[†]	≤5 (≤11.4)
11	not reported	148 (3)	≤5 (≤1.7)	≤5 (≤11.4)[‡§]
12	not reported	32 (0.5)	≤5 (≤1.7)	≤5 (≤11.4)[‡§]
13	not reported	23 (0.4)	≤5 (≤1.7)	≤5 (≤11.4)
ED and hospital activity				
Standardized number of registrations in the last 12h[p]				
Mean (standard deviation)	1.1 (0.3)	1.1 (0.3)	1.1 (0.3)	1.1 (0.3)[‡§]
Median (interquartile range)	1.1 (0.9-1.3)	1.1 (0.9-1.3)	1.1 (0.9-1.3)	1.0 (0.8-1.3)
Standardized number of hospital admissions in the last 24h[q]				
Mean (standard deviation)	1.1 (0.3)	1.1 (0.3)	1.1 (0.3)	1.1 (0.3)[‡]
Median (interquartile range)	1.1 (0.8-1.3)	1.1 (0.8-1.3)	1.1 (0.8-1.3)	1.2 (0.9-1.3)
Standardized number of hospital discharges in the last 24[r]				
Mean (standard deviation)	1.1 (0.4)	1.1 (0.3)	1.1 (0.4)	1.1 (0.4)[‡§]
Median (interquartile range)	1.1 (0.8-1.2)	1.1 (0.8-1.2)	1.1 (0.8-1.2)	1.3 (0.9-1.4)
Proportion of ED registrations resulting in hospitalization[s]	47%	47%	49%	48%
ED seasonal and time characteristics				
Weekday (Monday-Friday)				
0700 to <1700	2463 (53)	2311 (54)	125 (60)[†]	27 (71)[‡§]
1700 to <2400	1624 (35)	1553 (35)	62 (30)[†]	9 (24)[‡§]
0000 to <0700	not reported	540 (12)	23 (11)	≤5 (≤11)[‡§]
Weekend (Saturday-Sunday)				
0700 to <1700	not reported	817 (51)	37 (46)	≤5 (≤11)
1700 to <2400	not reported	572 (36)	29 (36)	≤5 (≤11)[‡§]
0000 to <0700	not reported	219 (14)	14 (18)[†]	≤5 (≤11)[‡§]
Season[t]				
Fall	1502 (24)	1418 (24)	71 (25)	13 (30)[‡§]
Winter	1446 (23)	1358 (23)	77 (27)	11 (25)

Spring	1635 (26)	1563 (26)	63 (22)[†]	9 (21)[‡]
Summer	1763 (28)	1673 (28)	79 (27)	11 (25)
ED physician training				
Emergency Medicine	4642 (73)	4403 (73)	210 (72)	29 (66)[‡§]
Family Medicine	1338 (21)	1264 (21)	62 (21)	≥10 (≥24)[‡§]
Other	not reported	345 (6)	18 (6)	≤5 (≤11)
ED patient acuity and wait times				
90% percentile ED length of stay, in hours				
Canadian Triage Acuity Scale1 and 2[u]	9	9	10	7
Canadian Triage Acuity Scale3	9	9	8	10
Canadian Triage Acuity Scale4 and 5	8	8	9	8

Abbreviations: AKI, acute kidney injury; CKD, chronic kidney disease; ED, emergency department.

A standardized difference of 10% or greater was found between the following two AKI subgroup comparisons: [†] stage 1 versus stage 2; [‡] stage 1 versus stage 3; and [§] stage 2 versus stage 3.To convert serum creatinine from traditional units (mg/dL) to SI units (µmol), multiply by 88.42.

[a] Reported as n(%) unless otherwise noted. To comply with privacy regulations for minimizing the chance of patient re-identification, numbers of patients were suppressed in the case of five or fewer patients. The total number of patients was not reported if there were other calculations that result in the re-identification of five or fewer patients.
[b]Missing income quintile imputed as 3.
[c]Pharmacy forward sortation area refers to a region in Ontario represented by the first three letters of the postal code. This variable describes the number and proportion of individuals who live in the same region as the pharmacy that provided them with prescription medications.
[d]Look-back window for co-morbidities was five years unless otherwise noted.
[e] Major cancers include the following tissues/organs: lung/bronchi, colon/rectum, breast, pancreas, prostate, leukemia, non-Hodgkin lymphoma, liver, ovaries, and esophagus.
[f]Look-back window for Charlson co-morbidity index was two years.
[g] Look-back window for medication utilization was 120 days.
[h]Patients in long-term care can only be identified from the Ontario Drug Benefits database.
[i] Percentages reported are based on the number of Ontario Drug Benefitseligible patients.
[j] Pre-ED visit look-back window: 7 to 365 days.
[k] Risk categories derived from the 2012Kidney Diseases: Improving Global Outcomes clinical practice guidelines for CKD. Urine dipstick and urine protein values were converted to an estimate albumin-to-creatinine ratio.[2]
[l] Look-back window for health care utilization was 365 days unless otherwise noted.
[m] Not specific for the assessment of the kidneys.
[n]Urological procedures included extracorporeal shockwave lithotripsy, percutaneous nephrolithotomy, or ureteroscopic lithotripsy with stone removal.
[o]For privacy considerations, numbers of patients by AKI stage were not identified by individual hospital institution.
[p]Standardized to the mean number of registrations that occurred in the last 12-hour period over the last 14 days.
[q] Standardized to the mean number of hospital admissions that occurred in the last 24-hour period over the last 14 days.
[r] Standardized to the mean number of hospital discharges that occurred in the last 24-hour period over the last 14 days.
[s] Proportion of registrations resulting in hospitalization standardized to each ED/hospital institution's number of registrations occurring in the last 24 hours.
[t] Fall: September 21 to December 20; Winter: December 21 to March 20; Spring: March 21 to June 20; Summer: June 21 to September 20.

[u]Patients with a Canadian Triage Acuity Scaleof 1 or 2 need to be seen immediately 98% of the time or within 15 minutes 95% of the time, respectively. Patients with a Canadian Triage Acuity Scaleof 3 or 4 need to be seen within 30 minutes 90% of the time or 60 minutes 85% of the time, respectively. Patients with a Canadian Triage Acuity Scaleof 5 need to be seen within 120 minutes 80% of the time.

Table 10. Most common main diagnoses assigned by physicians to patients discharged home from the emergency department with acute kidney injury

Rank	ED main diagnosis[a]		Frequency
	Code[b]	Description	
1	R07	Pain in throat and chest	515
2	R10	Abdominal and pelvic pain	447
3	N23	Unspecified renal colic	309
4	R55	Other disorders of urinary system	248
5	N39	Syncope and collapse	219
6	J18	Pneumonia, organism unspecified	175
7	R53	Malaise and fatigue	159
8	E86	Other non-infective gastroenteritis and colitis	150
9	I50	Volume depletion	128
10	I48	Atrial fibrillation and flutter	123
11	R06	Abnormalities of breathing	116
12	R42	Dizziness and giddiness	116
13	K52	Calculus of kidney and ureter	111
14	I20	Heart failure	110
15	R11	Nausea and vomiting	98
16	N20	Angina pectoris	89
17	R00	Cellulitis	88
18	R33	Diarrhea and gastroenteritis of presumed infectious origin	77
19	G45	Other chronic obstructive pulmonary disease	77
20	J44	Abnormalities of heart beat	76

Abbreviations: ED, emergency department.
[a] Assigned by ED physicians after assessment of the patient.
[b] Diagnostic codes derived from the International Classification of Diseases 10th Revision.

Table 11. Baselinecharacteristics of the acute kidney injury subpopulation before andafter propensity score matching

Statistic	Patients with AKI in the ED					
	Before matching, n (%)[a]		Standardized difference (%)	Successfully matched 1:1, n (%)[a]		Standardized difference (%)
	Discharged home	Admitted to hospital		Discharged home	Admitted to hospital	
Cohort size	6346	8117		4379	4379	
Demographics						
Age						
Mean (standard deviation)	69 (13)	73 (13)	32	71 (13)	71 (13)	2
Median (interquartile range)	70 (58-79)	75 (64-83)		73 (62-81)	74 (62-81)	
40 to <50	683 (11)	445 (6)	19	305 (7)	307 (7)	0
50 to <65	1643 (26)	1610 (20)	15	962 (22)	991 (23)	1
65 to <70	731 (12)	812 (10)	5	509 (12)	439 (10)	5
70 to <75	827 (13)	1026 (13)	1	615 (14)	548 (13)	4
75 to <80	917 (15)	1340 (17)	6	695 (16)	694 (16)	0
80 to <85	809 (13)	1390 (17)	12	656 (15)	717 (16)	4
85 to <90	514 (8)	979 (12)	13	439 (10)	439 (10)	0
≥90	222 (4)	515 (6)	13	198 (5)	244 (6)	5
Sex, female	2948 (47)	3737 (46)	1	2037 (47)	2037 (47)	0
Year of cohort entry (index date)						
2003	344 (5)	434 (5)	0	242 (6)	250 (6)	1
2004	481 (8)	673 (8)	3	371 (9)	362 (8)	1
2005	768 (12)	892 (11)	3	501 (12)	505 (12)	0
2006	842 (13)	1005 (12)	3	555 (137)	597 (14)	3
2007	1059 (17)	1082 (13)	10	673 (15)	667 (15)	1
2008	1002 (16)	1102 (13)	6	653 (15)	647 (15)	0
2009	657 (10)	964 (12)	5	474 (11)	471 (11)	0
2010	620 (10)	1052 (13)	10	471 (11)	472 (11)	0
2011	573 (9)	913 (11)	7	439 (10)	408 (9)	2
Rural residence	969 (15)	1302 (16)	2	685 (16)	652 (15)	2
Neighbourhood income quintile						
1	1401 (22)	1892 (23)	3	971 (22)	989 (23)	1
2	1353 (21)	1748 (21)	1	942 (22)	932 (21)	0
3	1307 (21)	1608 (20)	2	978 (22)	957 (22)	1

4	1046 (17)	1342 (17)	0	731 (17)	732 (17)	0
5	1140 (18)	1391 (17)	2	757 (17)	769 (18)	1
Pharmacy forward sortation area[b]	5214 (82)	6513 (80)	5	3562 (81)	3573 (82)	1
Co-morbid conditions[c]						
Abdominal aortic aneurysm repair	49 (0.8)	78 (1)	2	38 (0.9)	38 (0.9)	0
Atrial fibrillation or flutter	not reported	1133 (14)	11	539 (12)	547 (13)	1
Chronic liver disease	not reported	722 (9)	8	327 (8)	325 (7)	0
Chronic obstructive pulmonary disease	not reported	907 (11)	18	352 (8)	364 (8)	1
Coronary artery disease[d]	2160 (34)	3124 (39)	9	1614 (37)	1636 (37)	1
Dementia	not reported	1204 (15)	15	531 (12)	540 (12)	1
Diabetes	2405 (38)	3496 (43)	11	1728 (40)	1703 (39)	1
Heart failure	not reported	2591 (32)	23	1168 (27)	1170 (27)	0
Hypertension	4783 (75)	6454 (80)	10	3475 (79)	3475 (79)	0
Major cancer[e]	1056 (17)	1735 (21)	12	829 (19)	843 (19)	1
Nephrolithiasis	not reported	191 (2)	2	117 (3)	110 (3)	1
Osteoarthritis	not reported	631 (8)	2	344 (8)	330 (8)	2
Parkinson's disease	not reported	82 (1)	6	32 (0.7)	32 (0.7)	0
Peripheral vascular disease	not reported	371 (5)	9	154 (4)	156 (4)	1
Rheumatoid arthritis	not reported	604 (7)	1	317 (7)	309 (7)	0
Cerebrovascular disease	not reported	396 (5)	4	221 (5)	208 (5)	1
Charlson co-morbidity index[f]						
0	4181 (66)	4338 (53)	26	2676 (61)	2574 (59)	5
1	not reported	1017 (13)	5	515 (12)	541 (12)	2
2	not reported	1110 (14)	11	489 (11)	575 (13)	6
≥3	824 (13)	1652 (20)	20	699 (16)	689 (16)	1
Aggregated Diagnosis Groupspoint score[g]						
0-2	not reported	375 (5)	3	194 (4)	219 (5)	3
3-5	1417 (22)	1517 (19)	9	927 (21)	891 (20)	2
≥6	4589 (72)	6225 (77)	10	3255 (74)	3265 (75)	1
Medication utilization[h]						
Ontario Drug Benefiteligible patients	4605 (73)	6748 (83)	26	3459 (79)	3477 (79)	1
Patients in long-term care[i]	not reported	458 (6)	13	172 (4)	188 (4)	2

Medication class[j]						
Angiotensin-converting enzyme inhibitor or angiotensin receptor II blocker	2750 (60)	4026 (60)	0	2065 (60)	2074 (60)	0
Antibiotic	2041 (44)	3214 (48)	7	1567 (45)	1569 (45)	0
Anticoagulant	not reported	1253 (19)	8	594 (17)	609 (18)	1
Antidepressant (selective serotonin reuptake inhibitor or serotonin-norepinephrine reuptake inhibitor)	774 (17)	1151 (17)	1	566 (16)	563 (16)	0
Antineoplastic (chemotherapy)	not reported	150 (2)	2	83 (2)	82 (2)	0
Antiplatelet	not reported	1028 (15)	3	557 (16)	558 (16)	0
Antipsychotic medication	not reported	497 (7)	3	226 (7)	228 (7)	0
Beta-adrenergic antagonist	1781 (39)	2712 (40)	3	1385 (40)	1381 (40)	1
Calcium channel blocker	not reported	2357 (35)	2	1193 (35)	1196 (34)	0
Corticosteroid	1188 (26)	1904 (28)	5	935 (27)	943 (27)	0
Xanthine oxidase inhibitor or uricosuric agent	not reported	576 (9)	7	245 (7)	262 (8)	2
Anti-retroviral medication	not reported	12 (0.2)	0	6 (0.2)	≤5 (≤0.1)	6
Immunosuppressive medication	not reported	291 (4)	2	144 (4)	127 (4)	3
Lithium	not reported	45 (0.7)	0	23 (0.7)	21 (0.6)	1
Non-potassium sparing diuretic	2609 (57)	4213 (62)	12	2034 (59)	2071 (60)	2
Non-steroidal anti-inflammatory drug	892 (19)	1245 (18)	3	660 (19)	657 (19)	0
Oral hypoglycemic agent or insulin	1403 (31)	2069 (31)	0	1039 (30)	1016 (29)	2
Potassium-sparing diuretic	not reported	1013 (15)	9	445 (13)	481 (14)	3
Prostatic hyperplasia medication	not reported	439 (7)	0	217 (6)	211 (6)	1
Proton pump inhibitor	1651 (36)	2563 (38)	4	1260 (36)	1289 (37)	1
Statin	2174 (47)	2932 (43)	8	1584 (46)	1563 (45)	2
Number of unique drug identification numbers						
Mean (standard deviation)	6 (6)	8 (7)	27	7 (6)	7 (6)	2
Median (interquartile range)	5(0-10)	7 (0-11)		6 (0-11)	6 (0-11)	
Number of unique drug names						
Mean (standard deviation)	6 (6)	7 (6)	27	6 (6)	6 (6)	1
Median (interquartile range)	5 (0-10)	6 (0-10)		6 (0-10)	6 (0-10)	
Pre-ED baseline kidney function[l]						
Baseline serum creatinine in mg/dL						

Mean (standard deviation)	1.1 (0.6)	1.3 (0.8)	23	1.2 (0.6)	1.2 (0.7)	2
Median (interquartile range)	1.0 (0.8-1.3)	1.1 (0.9-1.5)		1.0 (0.8-1.3)	1.0 (0.8-1.4)	
Days serum creatinine measurement taken prior to ED visit						
Mean (standard deviation)	133 (102)	121 (99)	12	127 (101)	128 (101)	1
Median (interquartile range)	106 (44-207)	90 (38-188)		98 (41-197)	100 (40-203)	
Proportion with pre-ED serum creatinine ≤0.3mg/dL	not reported	277 (3)	4	164 (4)	165 (4)	1
Baseline eGFR in ml/min/1.73m^2						
≥60	3919 (61.8)	3907 (48)	28	2435 (56)	2386 (55)	2
45 to <60	not reported	1610 (20)	8	815 (19)	834 (19)	1
30 to <45	not reported	1470 (18)	13	695 (16)	685 (16)	1
15 to <30	not reported	924 (11)	16	362 (8)	396 (9)	2
<15, but not on dialysis	not reported	206 (3)	9	72 (2)	78 (2)	2
Albumin-to-creatinine ratio in mg/g						
<30	not reported	1014 (13)	10	633 (15)	567 (13)	5
30 to <300	not reported	363 (5)	1	186 (4)	208 (5)	2
≥300	not reported	417 (5)	5	259 (6)	244 (6)	1
No measurement	4657 (73.4)	6323 (78)	11	3301 (75)	3360 (77)	3
CKD risk category[m]						
Low risk	not reported	558 (7)	16	422 (10)	352 (8)	6
Moderate risk	not reported	382 (5)	1	201 (5)	208 (5)	0
High risk	not reported	394 (5)	5	248 (6)	236 (5)	1
Very high risk	not reported	1358 (17)	18	551 (13)	586 (13)	2
ED visit laboratory characteristics						
Serum creatinine in mg/dL						
Mean (standard deviation)	1.7 (0.8)	2.4 (1.8)	54	1.8 (0.8)	1.8 (0.8)	3
Median (interquartile range)	1.5 (1.2-1.8)	1.8 (1.4-2.6)		1.5 (1.3-2.0)	1.6 (1.3-2.0)	
Serum potassium in mEq/L						
Mean (standard deviation)	4.2 (0.6)	4.4 (0.9)	32	4.2 (0.6)	4.3 (0.8)	7
Median (interquartile range)	4.1 (3.8-4.5)	4.3 (3.8-4.9)		4.1 (3.8-4.5)	4.1 (3.7-4.7)	
Serum sodium in mEq/L						
Mean (standard deviation)	137 (5)	136 (7)	25	137 (5)	136 (6)	22
Median (interquartile range)	138 (135-140)	136 (133-139)		138 (135-140)	137 (134-139)	
AKI severity						
Stage 1	6012 (95)	6407 (79)	48	4091 (93)	4091 (93)	0

Stage 2	290 (5)	1007 (12)	28	244 (6)	244 (6)	0
Stage 3	44 (0.7)	703 (9)	39	44 (1)	44 (1)	0
Previous health care utilization[n]						
Number of ED visits in the previous 30 days						
0	5232 (82)	6479 (80)	7	3561 (81)	3539 (81)	1
1	not reported	451 (6)	3	218 (5)	242 (6)	2
2	not reported	373 (5)	4	187 (4)	180 (4)	1
≥3	not reported	814 (10)	4	413 (9)	418 (10)	0
Number of ED visits in the previous 31 to 365 days						
0	3836 (60)	4865 (60)	1	2635 (60)	2636 (60)	0
1	not reported	1543 (19)	1	809 (19)	834 (19)	1
2	not reported	785 (10)	1	444 (10)	407 (9)	3
≥3	not reported	924 (11)	0	491 (11)	502 (12)	1
Number of hospitalizations in the previous 30 days						
0	5865 (92)	6987 (86)	21	3960 (90)	3925 (90)	3
1	not reported	534 (7)	11	222 (5)	269 (6)	4
2	not reported	341 (4)	13	113 (3)	119 (2)	1
≥3	not reported	255 (3)	12	84 (2)	66 (2)	3
Number of hospitalizations in the previous 31 to 365 days						
0	4894 (77)	5730 (71)	15	3277 (75)	3134 (72)	7
1	not reported	1472 (18)	8	705 (16)	804 (19)	6
2	not reported	581 (7)	10	246 (6)	296 (7)	5
≥3	not reported	334 (4)	6	151 (3)	145 (3)	1
Family physician visits						
0	not reported	152 (2)	3	60 (1)	85 (2)	4
1-2	not reported	393 (5)	4	212 (5)	241 (6)	3
3-4	not reported	694 (9)	4	374 (9)	406 (9)	3
5-6	862 (14)	852 (11)	10	558 (13)	487 (11)	5
7-8	735 (12)	915 (11)	1	483 (11)	498 (11)	1
9-10	not reported	804 (10)	3	480 (11)	444 (10)	3
≥11	2990 (47)	4307 (53)	12	2212 (51)	2218 (51)	0

General internist visits						
0	4876 (77)	5631 (69)	17	3236 (74)	3208 (73)	1
1	1148 (18)	1837 (23)	11	863 (20)	920 (21)	3
2	252 (4)	509 (6)	10	219 (5)	206 (5)	1
≥3	70 (1)	140 (2)	5	61 (1)	45 (1)	4
Nephrology visits						
0	6060 (96)	7621 (94)	7	4153 (95)	4175 (95)	2
1	183 (3)	253 (3)	1	137 (3)	108 (3)	4
2	32 (0.5)	52 (0.6)	2	26 (0.6)	18 (0.4)	3
≥3	71 (1)	191 (2)	9	63 (1)	78 (2)	3
Urology visits						
0	5214 (82)	6727 (83)	2	3588 (82)	3650 (83)	4
1	361 (6)	437 (5)	1	245 (6)	227 (5)	2
2	305 (5)	334 (4)	3	206 (5)	169 (4)	4
≥3	466 (7)	619 (8)	1	340 (8)	333 (8)	1
Imaging and investigations						
Abdominal ultrasound[o]	1530 (24)	2210 (27)	7	883 (20)	886 (20)	0
Cardiac stress test	not reported	1056 (13)	7	50 (1)	50 (1)	0
Computed tomography with contrast	not reported	407 (5)	11	157 (4)	158 (4)	0
Coronary angiogram or revascularization	not reported	157 (2)	3	1080 (25)	1083 (25)	0
Echocardiogram	not reported	1820 (22)	11	91 (2)	102 (2)	1
Intervention for kidney stones[p]	not reported	96 (1)	0	619 (14)	627 (14)	1
ED and hospital characteristics						
Institution[q]						
1	1754 (28)	2565 (32)	9	1336 (31)	1317 (30)	1
2	1482 (23)	2051 (25)	4	1060 (24)	1089 (25)	2
3	not reported	806 (10)	1	464 (11)	472 (11)	1
4	not reported	74 (0.9)	33	61 (1)	62 (1)	0
5	not reported	150 (2)	5	94 (2)	107 (2)	2
6	not reported	70 (0.9)	2	36 (0.8)	31 (0.7)	1
7	not reported	833 (10)	2	466 (11)	447 (10)	1
8	not reported	332 (4)	1	180 (4)	186 (4)	1
9	not reported	369 (5)	5	246 (6)	242 (6)	0

10	not reported	657 (8)	8	308 (7)	295 (7)	1
11	not reported	139 (2)	5	88 (2)	90 (2)	0
12	not reported	39 (0.5)	1	22 (0.5)	23 (0.5)	0
13	not reported	32 (0.4)	0	18 (0.4)	18 (0.4)	0
ED and hospital activity						
Standardized number of registrations in the last 12h[r]						
Mean (standard deviation)	1.1 (0.3)	1.1 (0.3)	14	1.1 (0.3)	1.1 (0.3)	0
Median (interquartile range)	1.1 (0.9-1.3)	1.1 (0.7-1.3)		1.1 (0.9-1.3)	1.1 (0.9-1.3)	
Standardized number of hospital admissions in the last 24h[s]						
Mean (standard deviation)	1.1 (0.3)	1.1 (0.3)	3	1.1 (0.3)	1.1 (0.3)	0
Median (interquartile range)	1.1 (0.8-1.3)	1.1 (0.8-1.3)		1.1 (0.8-1.3)	1.1 (0.8-1.3)	
Standardized number of hospital inpatient discharges in the last 24[t]						
Mean (standard deviation)	1.1 (0.4)	1.1 (0.4)	3	1.1 (0.3)	1.1 (0.4)	3
Median (interquartile range)	1.1 (0.8-1.2)	1.1 (0.8-1.3)		1.1 (0.8-1.3)	1.1 (0.8-1.3)	
Proportion of ED registrations resulting in hospitalization[u]	47%	51%	8	50%	49%	0
ED seasonal and time characteristics						
Weekday (Monday-Friday)						
0700 to <1700	2463 (53)	3412 (57)	9	1709 (54)	1779 (56)	5
1700 to <2400	1624 (35)	1783 (30)	11	1092 (34)	999 (31)	6
0000 to <0700	not reported	750 (13)	2	394 (12)	404 (13)	1
Weekend (Saturday-Sunday)						
0700 to <1700	not reported	1126 (52)	2	589 (50)	602 (50)	1
1700 to <2400	not reported	712 (33)	6	405 (34)	424 (35)	3
0000 to <0700	not reported	334 (15)	4	190 (16)	171 (14)	5
Season[v]						
Fall	1502 (24)	2141 (26)	6	1067 (24)	1105 (25)	2
Winter	1446 (23)	1925 (24)	2	1033 (24)	1013 (23)	1
Spring	1635 (26)	1959 (24)	4	1108 (25)	1086 (25)	1
Summer	1763 (28)	2092 (26)	5	1171 (27)	1175 (27)	0
ED physician training						
Emergency Medicine	4642 (73)	5781 (71)	4	3140 (73)	3152 (72)	1

Family Medicine	1338 (21)	1602 (20)	4	945 (22)	936 (21)	1
Other	not reported	734 (9)	12	294 (7)	291 (7)	0
ED patient acuity and wait times						
Canadian Triage Acuity Scale[w]						
1 and 2	1321 (21)	3142 (39)	40	1192 (27)	1185 (27)	0
3	3797 (60)	4257 (52)	15	2620 (60)	2626 (60)	0
4 and 5	1228 (19)	718 (9)	31	567 (13)	568 (13)	0
Time (in hours) waiting for physician assessment, mean (standard deviation)						
Canadian Triage Acuity Scale1 and 2	0.6 (0.8)	0.46 (0.8)	16	0.6 (0.8)	0.5 (0.6)	7
Canadian Triage Acuity Scale3	1.3 (1.3)	1.2 (1.2)	12	1.3 (1.1)	1.2 (1.2)	3
Canadian Triage Acuity Scale4 and 5	1.6 (1.4)	1.7 (1.7)	2	1.4 (1.3)	1.6 (1.6)	9

Abbreviations: AKI, acute kidney injury; CKD, chronic kidney disease; ED, emergency department; eGFR, estimated glomerular filtration rate.

To convert serum creatinine from traditional units (mg/dL) to SI units (µmol/L), multiply by 88.42.

[a]Reported as n (%) unless otherwise noted. To comply with privacy regulations for minimizing the chance of patient re-identification, numbers of patients were suppressed in the case of five or fewer patients. The total number of patients was not reported if there were other calculations that could result in the re-identification of five or fewer patients.
[b]Pharmacy forward sortation area refers to a region in Ontario represented by the first three letters of the postal code. This variable describes the number and proportion of individuals who live in the same region as the pharmacy that provided them with prescription medications.
[c] Look-back window for co-morbidities was five years unless otherwise noted.
[d] Does not include angina.
[e] Major cancers include the following tissues/organs: lung/bronchi, colon/rectum, breast, pancreas, prostate, leukemia, non-Hodgkin lymphoma, liver, ovaries, and esophagus.
[f] Look-back window for Charlson co-morbidity Index was two years.
[g]The Aggregated Diagnosis Groupspoint score, derived from the John Hopkins Adjusted Clinical Groups system, score is a weighted measure of health care utilization as a proxy measure for co-morbidity and accounts for the duration of condition, severity of condition, diagnostic certainty, etiology of the condition, and specialty care involvement. The higher Aggregated Diagnosis Groups score, the greater the co-morbidity. Individuals with an Aggregated Diagnosis Groups score of 0 to 2 reflect low health care costs with no prior hospitalizations; 3 to 5, high health care costs but no prior hospitalizations; 6 or more, high health care costs and at least one prior hospitalization.
[h] Look-back window for medication utilization was 120 days.
[i]Patients in long-term care can only be identified from the Ontario Drug Benefits database.
[j] Percentages reported are based on the number of Ontario Drug Benefitseligible patients.
[k] Does not include acetylsalicylic acid.
[l] Pre-ED visit look-back window: 7 to 365 days.
[m] Risk categories derived from the 2012Kidney Diseases: Improving Global Outcomes clinical practice guidelines for CKD. Urine dipstick and urine protein values were converted to an estimate albumin-to-creatinine ratio.[2]
[n] Look-back window for health care utilization was 365 days unless otherwise noted.

[o] Not specific for the assessment of kidneys.
[p] Urological procedures included extracorporeal shockwave lithotripsy, percutaneous nephrolithotomy, or ureteroscopic lithotripsy with stone removal.
[q]For privacy considerations, numbers of patients with AKI by ED disposition were not identified by individual hospital institution.
[r]Standardized to the mean number of registrations that occurred in the last 12-hour period over the last 14 days.
[s] Standardized to the mean number of hospital admissions that occurred in the last 24-hour period over the last 14 days.
[t] Standardized to the mean number of hospital discharges that occurred in the last 24-hour period over the last 14 days.
[u] Proportion of registrations resulting in hospitalization standardized to each ED/hospital institution's number of registrations occurring in the last 24 hours.
[v] Fall: September 21 to December 20; Winter: December 21 to March 20; Spring: March 21 to June 20; Summer: June 21 to September 20.
[w]Patients with a Canadian Triage Acuity Scaleof 1 or 2 need to be seen immediately 98% of the time or within 15 minutes 95% of the time, respectively. Patients with a Canadian Triage Acuity Scaleof 3 or 4 need to be seen within 30 minutes 90% of the time or 60 minutes 85% of the time, respectively. Patients with a Canadian Triage Acuity Scaleof 5 need to be seen within 120 minutes 80% of the time.

Table 12. Baselinecharacteristics of the discharge subpopulationbefore and after propensity score matching

Statistic	Patients discharged home from the ED					
	Before matching, n (%)[a]		Standardized difference	Successfully matched 1:1, n (%)[a]		Standardized difference
	AKI	No AKI		AKI	No AKI	
Cohort size	6346	43422		6188	6188	
Demographics						
Age						
Mean (standard deviation)	69 (13)	63 (14)	42	68 (13)	69 (14)	2
Median (interquartile range)	70 (58-79)	62 (51-74)		70 (58-79)	71 (58-80)	
40 to <50	683 (11)	9017 (21)	28	676 (11)	737 (12)	3
50 to <65	1643 (26)	15019 (35)	19	1633 (26)	1453 (24)	7
65 to <70	731 (12)	4565 (11)	3	715 (12)	745 (12)	1
70 to <75	827 (13)	4294 (10)	10	804 (13)	794 (13)	1
75 to <80	917 (15)	4202 (10)	15	882 (14)	890 (14)	0
80 to <85	809 (13)	3633 (8)	14	776 (13)	854 (14)	4
85 to <90	514 (8)	1928 (4)	15	498 (8)	487 (8)	0
≥90	222 (4)	764 (2)	11	204 (3)	228 (4)	2
Sex, female	2948 (47)	24532 (57)	20	2900 (47)	2940 (48)	1
Year of cohort entry (index date)						
2003	344 (5)	1722 (4)	7	334 (5)	343 (6)	0
2004	481 (8)	2886 (7)	4	474 (8)	442 (7)	2
2005	768 (12)	4003 (9)	9	751 (12)	773 (13)	1
2006	842 (13)	5217 (12)	4	819 (13)	841 (14)	1
2007	1059 (17)	5947 (14)	8	1022 (17)	996 (16)	1
2008	1002 (16)	5892 (14)	6	970 (16)	1002 (16)	1
2009	657 (10)	6226 (14)	12	651 (11)	615 (10)	2
2010	620 (10)	5902 (14)	12	609 (10)	606 (10)	0
2011	573 (9)	5627 (13)	13	558 (9)	570 (9)	1
Rural residence	969 (15)	6299 (15)	2	940 (15)	957 (16)	1
Neighbourhood income quintile						
1	1401 (22)	8814 (20)	4	1372 (22)	1416 (23)	2
2	1353 (21)	9012 (21)	1	1306 (21)	1323 (21)	1

3	1307 (21)	8757 (20)	1	1372 (22)	1330 (22)	2
4	1046 (17)	7896 (18)	5	1023 (17)	999 (16)	1
5	1140 (18)	8520 (20)	4	1115 (18)	1120 (18)	0
Pharmacy forward sortation area[b]	5214 (82)	34871 (80)	5	5089 (82)	5059 (82)	1
Co-morbid conditions[c]						
Abdominal aortic aneurysm repair	49 (0.8)	162 (0.4)	5	47 (0.8)	55 (0.9)	0
Atrial fibrillation or flutter	not reported	1759 (4)	24	606 (10)	581 (9)	1
Chronic liver disease	not reported	2203 (5)	7	412 (7)	392 (6)	2
Chronic obstructive pulmonary disease	not reported	1140 (3)	18	359 (6)	337 (5)	2
Coronary artery disease[d]	2160 (34)	8678 (20)	32	2062 (33)	2049 (33)	0
Dementia	not reported	2428 (6)	17	607 (10)	614 (10)	0
Diabetes	2405 (38)	10678 (25)	29	2294 (37)	2308 (37)	0
Heart failure	not reported	3460 (8)	39	1280 (21)	1226 (20)	2
Hypertension	4783 (75)	25725 (59)	35	4630 (75)	4668 (75)	1
Major cancer[e]	1056 (17)	5918 (14)	8	1026 (17)	1016 (16)	1
Nephrolithiasis	not reported	666 (2)	8	169 (3)	170 (3)	0
Osteoarthritis	not reported	2580 (6)	5	444 (7)	434 (7)	1
Parkinson's disease	not reported	114 (0.3)	3	32 (0.5)	38 (0.6)	1
Peripheral vascular disease	not reported	1759 (4)	24	174 (3)	163 (3)	1
Rheumatoid arthritis	not reported	2595 (6)	5	445 (7)	437 (7)	0
Cerebrovascular disease	not reported	706 (2)	15	234 (4)	230 (4)	1
Charlson co-morbidity index[f]						
0	4181 (66)	35911 (83)	39	4139 (67)	4246 (69)	4
1	not reported	2900 (7)	15	683 (11)	640 (10)	2
2	not reported	2657 (6)	15	618 (10)	639 (10)	1
≥3	824 (13)	1954 (5)	30	748 (12)	663 (11)	4
Aggregated Diagnosis Groups point score[g]						
0-2	not reported	3704 (9)	13	331 (5)	292 (5)	3
3-5	1417 (22)	13882 (32)	22	1402 (23)	1479 (24)	3
≥6	4589 (72)	25836 (60)	27	4450 (72)	4411 (71)	1
Medication utilization[h]						
Ontario Drug Benefit eligible patients	4605 (73)	22849 (53)	42	4453 (72)	4535 (73)	3

Patients in long-term care[i]	not reported	441 (1)	14	169 (3)	159 (3)	1
Medication class[j]						
Angiotensin-converting enzyme inhibitor or angiotensin receptor II blocker	2750 (60)	10530 (46)	28	2644 (59)	2680 (59)	1
Antibiotic	2041 (44)	8297 (36)	16	1954 (44)	1972 (44)	1
Anticoagulant	not reported	2287 (10)	17	673 (15)	646 (14)	2
Antidepressant (selective serotonin reuptake inhibitor or serotonin-norepinephrine reuptake inhibitor)	774 (17)	3534 (16)	4	738 (17)	767 (17)	1
Antineoplastic (chemotherapy)	not reported	171 (0.7)	0	110 (3)	121 (3)	1
Antiplatelet	not reported	2442 (11)	16	705 (16)	712 (16)	0
Antipsychotic medication	not reported	1335 (6)	3	286 (6)	298 (6.6)	1
Beta-adrenergic antagonist	1781 (39)	6467 (28)	22	1697 (38)	1716 (38)	1
Calcium channel blocker	not reported	5647 (25)	21	1488 (33)	1468 (32)	2
Corticosteroid	1188 (26)	5280 (23)	6	1155 (26)	1172 (26)	0
Xanthine oxidase inhibitor or uricosuric agent	not reported	703 (3)	16	273 (6)	269 (6)	1
Anti-retroviral medication	not reported	40 (0.2)	0	7 (0.2)	8 (0.2)	0
Immunosuppressive medication	not reported	784 (3)	3	175 (4)	184 (4)	1
Lithium	not reported	171 (0.7)	0	30 (0.7)	30 (0.7)	0
Non-potassium sparing diuretic	2609 (57)	8421 (37)	41	2476 (56)	2504 (55)	1
Non-steroidal anti-inflammatory drug	892 (19)	4347 (19)	1	871 (20)	894 (20)	0
Oral hypoglycemic agent or insulin	1403 (31)	4221 (19)	28	1320 (30)	1328 (29)	1
Potassium-sparing diuretic	not reported	1431 (6)	20	512 (12)	505 (11)	1
Prostatic hyperplasia medication	not reported	1078 (5)	7	277 (6)	255 (6)	3
Proton pump inhibitor	1651 (36)	6878 (30)	12	1588 (36)	1548 (34)	3
Statin	2174 (47)	9087 (40)	15	2085 (47)	2075 (46)	2
Number of unique drug identification numbers						
Mean (standard deviation)	6 (6)	3 (5)	54	6 (6)	6 (6)	0
Median (interquartile range)	5(0-10)	3 (0-10)		5 (0-10)	5 (0-10)	
Number of unique drug names						
Mean (standard deviation)	6 (6)	3 (4)	54	5 (5)	5 (5)	0
Median (interquartile range)	5 (0-10)	3 (0-9)		5 (0-9)	5 (0-9)	
Pre-ED baseline kidney function[l]						

Baseline serum creatinine in mg/dL						
Mean (standard deviation)	1.1 (0.6)	0.9 (0.3)	11	1.1 (0.6)	1.1 (0.6)	1
Median (interquartile range)	1.0 (0.8-1.3)	0.9 (0.7-1.0)		1.0 (0.8-1.2)	1.0 (0.8-1.2)	
Days serum creatinine measurement taken prior to ED visit						
Mean (standard deviation)	133 (102)	137 (103)	4	133 (102)	134 (103)	0
Median (interquartile range)	106 (44-207)	114 (46-215)		107 (45-209)	106 (43-210)	
Proportion with pre-ED serum creatinine ≤0.3mg/dL	not reported	1309 (3)	6	263 (4)	264 (4)	0
Baseline eGFR in ml/min/1.73m^2						
≥60	3919 (62)	35924 (83)	48	3904 (63)	3904 (63)	0
45 to <60	not reported	4836 (11)	17	1054 (17)	1054 (17)	0
30 to <45	not reported	2022 (5)	31	803 (13)	803 (13)	0
15 to <30	not reported	570 (1)	28	367 (6)	367 (6)	0
<15, but not on dialysis	not reported	70 (0.2)	13	60 (1)	60 (1)	0
Albumin-to-creatinine ratio in mg/g						
<30	not reported	7404 (17)	3	999 (16)	964 (16)	1
30 to <300	not reported	978 (2)	12	267 (4)	228 (4)	3
≥300	not reported	1828 (4)	9	382 (6)	399 (6)	1
No measurement	4657 (73.4)	33212 (77)	7	999 (16)	964 (16)	1
CKD risk category[m]						
Low risk	not reported	6393 (15)	10	721 (12)	679 (11)	2
Moderate risk	not reported	1436 (3)	8	304 (5)	296 (5)	0
High risk	not reported	1910 (4)	7	377 (6)	391 (6)	1
Very high risk	not reported	988 (2)	34	578 (9)	570 (9)	0
ED visit laboratory characteristics						
Serum creatinine in mg/dL						
Mean (standard deviation)	4.2 (0.6)	4.0 (0.5)	33	4.2 (0.6)	4.0 (0.5)	21
Median (interquartile range)	4.1 (3.8-4.5)	3.9 (3.7-4.2)		4.0 (3.8-4.5)	4.0 (3.7-4.3)	
Serum potassium in mEq/L						
Mean (standard deviation)	137 (5)	138 (4)	20	138 (5)	138 (4)	10[n]
Median (interquartile range)	138 (135-140)	139 (137-141)		138 (136-140)	139 (136-140)	
Serum sodium in mEq/L						
Mean (standard deviation)	6012 (95)			5860 (95)		
Median (interquartile range)	290 (5)			286 (5)		

AKI severity	44 (0.7)			42 (0.7)		
Previous health care utilization[o]						
Number of ED visits in the previous 30 days						
0	5232 (82)	39677 (91)	27	5127 (83)	5352 (87)	10[p]
1	not reported	1445 (3)	7	302 (5)	204 (3)	8
2	not reported	775 (2)	12	227 (4)	135 (2)	9
≥3	not reported	1525 (4)	23	532 (9)	497 (8)	2
Number of ED visits in the previous 31 to 365 days						
0	3836 (60)	29542 (68)	16	3750 (61)	3853 (62)	3
1	not reported	7928 (18)	1	1152 (19)	1154 (19)	0
2	not reported	3138 (7)	8	590 (10)	559 (9)	2
≥3	not reported	2814 (7)	17	696 (11)	622 (10)	4
Number of hospitalizations in the previous 30 days						
0	5865 (92)	41001 (94)	8	5728 (93)	5759 (93)	2
1	not reported	1707 (4)	1	260 (4)	252 (4)	1
2	not reported	449 (1)	8	120 (2)	105 (2)	2
≥3	not reported	265 (0.6)	8	80 (1)	72 (1)	1
Number of hospitalizations in the previous 31 to 365 days						
0	4894 (77)	37494 (86)	24	4813 (78)	4798 (78)	1
1	not reported	4592 (11)	13	906 (15)	986 (16)	4
2	not reported	953 (2)	15	296 (5)	254 (4)	3
≥3	not reported	383 (0.9)	15	173 (3)	150 (2)	3
Family physician visit						
0	not reported	939 (2)	5	93 (2)	90 (2)	0
1-2	not reported	3999 (9)	14	354 (6)	333 (5)	1
3-4	not reported	6646 (15)	17	611 (10)	649 (11)	2
5-6	862 (14)	7422 (17)	10	854 (14)	832 (14)	1
7-8	735 (12)	6165 (14)	8	724 (12)	799 (13)	4
9-10	not reported	4736 (11)	0	680 (11)	683 (11)	0
≥11	2990 (47)	13515 (31)	33	2872 (46)	2802 (45)	2
General internist visit						

0	4876 (77)	36803 (85)	20	4781 (77)	4768 (77)	0
1	1148 (18)	5726 (13)	14	1107 (18)	1152 (19)	2
2	252 (4)	768 (2)	13	235 (4)	216 (4)	2
≥3	70 (1)	125 (0.3)	10	65 (1)	52 (0.8)	3
Nephrology visit						
0	6060 (96)	42861 (99)	19	5928 (96)	5979 (97)	4
1	183 (3)	396 (0.9)	14	169 (3)	131 (2)	4
2	32 (0.5)	52 (0.1)	7	26 (0.4)	22 (0.4)	0
≥3	71 (1)	113 (0.3)	10	65 (1)	56 (0.9)	2
Urology visit						
0	5214 (82)	38337 (88)	17	5085 (82)	5142 (83)	2
1	361 (6)	1801 (4)	7	353 (6)	305 (5)	4
2	305 (5)	1354 (3)	9	297 (5)	280 (5)	1
≥3	466 (7)	1930 (4)	12	453 (7)	461 (7)	0
Imaging and investigations						
Abdominal ultrasound[q]	1530 (24)	8291 (19)	12	1480 (24)	1465 (24)	0
Cardiac stress test	not reported	5584 (13)	7	948 (15)	929 (15)	1
CT with contrast	not reported	636 (2)	10	172 (3)	175 (3)	0
Coronary angiogram or revascularization	not reported	702 (2)	5	144 (2)	135 (2)	1
Echocardiogram	not reported	5204 (12)	17	1077 (17)	1004 (16)	3
Intervention for kidney stones[r]	not reported	270 (0.6)	6	77 (1)	79 (1)	1
ED and hospital characteristics						
Institution[s]						
1	1754 (28)	13190 (30)	6	1724 (28)	1679 (27)	2
2	1482 (23)	11867 (27)	9	1448 (23)	1445 (23)	0
3	not reported	3128 (7)	11	626 (10)	629 (10)	0
4	not reported	2967 (7)	2	456 (7)	469 (8)	1
5	not reported	1108 (3)	1	156 (3)	154 (3)	0
6	not reported	262 (0.6)	1	42 (0.7)	41 (0.7)	0
7	not reported	3143 (7)	9	587 (10)	579 (9)	0
8	not reported	1583 (4)	2	242 (4)	250 (4)	1
9	not reported	1651 (4)	8	337 (5)	327 (5)	0
10	not reported	2883 (7)	3	369 (6)	382 (6)	1

11	not reported	1174 (3)	2	145 (2)	158 (3)	2
12	not reported	271 (0.6)	0	34 (0.5)	48 (0.8)	4
13	not reported	195 (0.4)	0	22 (0.4)	27 (0.4)	0
ED and hospital activity						
Standardized number of registrations in the last 12h[t]						
Mean (standard deviation)	1.1 (0.3)	1.1 (0.3)	14	1.1 (0.3)	1.1 (0.3)	0
Median (interquartile range)	1.1 (0.9-1.3)	1.0 (0.8-1.3)		1.1 (0.9-1.3)	1.1 (0.9-1.3)	
Standardized number of hospital admissions in the last 24h[u]						
Mean (standard deviation)	1.1 (0.3)	1.1 (0.3)	3	1.1 (0.3)	1.1 (0.3)	3
Median (interquartile range)	1.1 (0.8-1.3)	1.1 (0.8-1.2)		1.1 (0.8-1.3)	1.1 (0.8-1.3)	
Standardized number of hospital inpatient discharges in the last 24[v]						
Mean (standard deviation)	1.1 (0.4)	1.1 (0.3)	3	1.1 (0.3)	1.1 (0.4)	0
Median (interquartile range)	1.1 (0.8-1.2)	1.1 (0.8-1.3)		1.1 (0.8-1.2)	1.1 (0.8-1.2)	
Proportion of ED registrations resulting in Hospitalization[w]	47%	49%	4	47%	47%	0
ED seasonal and time characteristics						
Weekday (Monday-Friday)						
0700 to <1700	2463 (53)	18436 (58)	11	2399 (53)	2462 (54)	2
1700 to <2400	1624 (35)	8768 (28)	16	1578 (35)	1513 (33)	4
0000 to <0700	not reported	4471 (14)	6	549 (12)	599 (13)	3
Weekend (Saturday-Sunday)						
0700 to <1700	not reported	6560 (56)	11	842 (51)	852 (53)	4
1700 to <2400	not reported	3318 (28)	16	588 (35)	547 (34)	3
0000 to <0700	not reported	1869 (16)	6	232 (14)	215 (13)	2
Season[x]						
Fall	1502 (24)	11053 (26)	4	1475 (24)	1469 (24)	0
Winter	1446 (23)	9991 (23)	1	1412 (23)	1421 (23)	0
Spring	1635 (26)	11008 (25)	1	1585 (26)	1545 (25)	1
Summer	1763 (28)	11370 (26)	4	1716 (28)	1753 (28)	1
ED physician training						
Emergency Medicine	4642 (73)	33336 (77)	9	4542 (73)	4541 (73)	0
Family Medicine	1338 (21)	7563 (17)	9	1289 (21)	1304 (21)	1

Other	not reported	2523 (6)	0	357 (6)	343 (6)	1
ED patient acuity and wait times						
Canadian Triage Acuity Scale[y]						
1 and 2	1321 (21)	9072 (21)	0	1294 (21)	1290 (21)	0
3	3797 (60)	25241 (58)	4	3693 (60)	3736 (60)	1
4 and 5	1228 (19)	9108 (21)	4	1201 (19)	1162 (19)	2
Time (in hours) waiting for physician assessment, mean (standard deviation)						
Canadian Triage Acuity Scale 1 and 2	0.6 (0.8)	0.6 (0.9)	6	0.60 (0.8)	0.6 (0.8)	1
Canadian Triage Acuity Scale 3	1.3 (1.3)	1.4 (1.3)	5	1.31 (1.3)	1.3 (1.2)	2
Canadian Triage Acuity Scale 4 and 5	1.6 (1.4)	1.8 (1.6)	14	1.57 (1.4)	1.6 (1.4)	4
90% percentile ED length of stay, in hours						
Canadian Triage Acuity Scale 1 and 2	9	8		9	8	
Canadian Triage Acuity Scale 3	8	8		9	8	
Canadian Triage Acuity Scale 4 and 5	8	8		8	8	

Abbreviations: AKI, acute kidney injury; CKD, chronic kidney disease; ED, emergency department; eGFR, estimated glomerular filtration rate.

To convert serum creatinine from traditional units (mg/dL) to SI units (μmol/L), multiply by 88.42.

[a] Reported as n (%) unless otherwise noted. To comply with privacy regulations for minimizing the chance of patient re-identification, numbers of patients were suppressed in the case of five or fewer patients. The total number of patients was not reported if there were other calculations that could result in the re-identification of five or fewer patients.
[b] Pharmacy forward sortation area refers to a region in Ontario represented by the first three letters of the postal code. This variable describes the number and proportion of individuals who live in the same region as the pharmacy that provided them with prescription medications.
[c] Look-back window for co-morbidities was five years unless otherwise noted.
[d] Does not include angina.
[e] Major cancers include the following tissues/organs: lung/bronchi, colon/rectum, breast, pancreas, prostate, leukemia, non-Hodgkin lymphoma, liver, ovaries, and esophagus.
[f] Look-back window for Charlson co-morbidity Index was two years.
[g]The Aggregated Diagnosis Groups point score, derived from the John Hopkins Adjusted Clinical Groups system, score is a weighted measure of health care utilization as a proxy measure for co-morbidity and accounts for the duration of condition, severity of condition, diagnostic certainty, etiology of the condition, and specialty care involvement. The higher Aggregated Diagnosis Groups score, the greater the co-morbidity. Individuals with an Aggregated Diagnosis Groups score of 0 to 2 reflect low health care costs with no prior hospitalizations; 3 to 5, high health care costs but no prior hospitalizations; 6 or more, high health care costs and at least one prior hospitalization.
[h] Look-back window for medication utilization was 120 days.
[i] Patients in long-term care can only be identified from the Ontario Drug Benefits database.
[j] Percentages reported are based on the number of Ontario Drug Benefits eligible patients.
[k] Does not include acetylsalicylic acid.

[l] Pre-ED visit look-back window: 7 to 365 days.
[m] Risk categories derived from the 2012Kidney Diseases: Improving Global Outcomes clinical practice guidelines for CKD. Urine dipstick and urine protein values were converted to an estimate albumin-to-creatinine ratio.[2]
[n]Standardized difference 9.97%.
[o]Look-back window for health care utilization was 365 days unless otherwise noted.
[p]Standardized difference 10.001%.
[q]Not specific for the assessment of kidneys.
[r]Urological procedures included extracorporeal shockwave lithotripsy, percutaneous nephrolithotomy, or ureteroscopic lithotripsy with stone removal.
[s]For privacy considerations, numbers of patients with AKI by ED disposition were not identified by individual hospital institution.
[t]Standardized to the mean number of registrations that occurred in the last 12-hour period over the last 14 days.
[u] Standardized to the mean number of hospital admissions that occurred in the last 24-hour period over the last 14 days.
[v] Standardized to the mean number of hospital discharges that occurred in the last 24-hour period over the last 14 days.
[w] Proportion of registrations resulting in hospitalization standardized to each ED/hospital institution's number of registrations occurring in the last 24 hours.
[x] Fall: September 21 to December 20; Winter: December 21 to March 20; Spring: March 21 to June 20; Summer: June 21 to September 20.
[y]Patients with a Canadian Triage Acuity Scale of 1 or 2 need to be seen immediately 98% of the time or within 15 minutes 95% of the time, respectively. Patients with a Canadian Triage Acuity Scale of 3 or 4 need to be seen within 30 minutes 90% of the time or 60 minutes 85% of the time, respectively. Patients with a Canadian Triage Acuity Scale of 5 need to be seen within 120 minutes 80% of the time.

References for Supplementary Content

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