

Title

Frequent users of emergency departments and patient flow in Alberta and Ontario, Canada: an administrative data study

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Data Sharing

The data were provided by the Canadian Institute for Health Information (CIHI, Ottawa, Canada) and recipients of data are not permitted to share data with other parties. Requests can be made for the same data from CIHI and inquiries can be made at <https://www.cihi.ca/en/make-a-data-request>.

ABSTRACT

Background

Frequent users to emergency departments (EDs) are a diverse group of patients with high numbers of ED presentations. This study compares patient flow characteristics of adult high system users (HSUs) and control groups in Alberta and Ontario, Canada.

Methods

Annual cohorts of HSUs were created for Alberta and Ontario by identifying patients who made up the top 10% of ED users (by count of ED presentations) in the National Ambulatory Care Reporting System during April 2011 to March 2016. Random samples of patients not in the HSU groups were selected in each province as controls (4:1 ratio). Presentation (e.g., acuity measured by the Canadian Triage and Acuity Scale [CTAS]) and ED times (e.g., time to physician initial assessment [PIA], length of stay) data were extracted and described. The length of stay for 2015/2016 data was decomposed into stages and Cox models compared time between stages.

Results

There were 20,343,230 and 18,222,969 ED presentations made by 7,032,655 and 1,923,462 individuals in the control and HSU groups, respectively. The Ontario groups had higher acuity than the Alberta groups: about 20% in the Ontario groups were from emergent (CTAS 2) level whereas Alberta had 11-15%. Time to PIA was similar across provinces and groups (medians of 60min to 67min). Lengths of stay were longest for Ontario HSUs (median=3h) and shortest for Alberta HSUs (median=2.2h). HSUs had shorter times to PIA (hazard ratio [HR]=1.02; 95% confidence interval [CI] 1.02, 1.03), longer times from PIA to decision (HR=0.84; 95%CI 0.84, 0.84), and longer times from decision to leaving the ED (HR=0.91; 95%CI 0.91, 0.91).

Conclusion

Ontario HSUs had higher acuity and longer ED lengths of stay than the other groups. In both provinces, HSU had shorter times to PIA and longer times after assessment.

Key Words Emergency department; frequent health service users; patient flow

INTRODUCTION

Frequent users of emergency departments (EDs) are a small number of patients who are responsible for a large proportion of ED presentations¹ and are believed to be one of the main contributors to ED crowding.² A systematic review of adult frequent ED users in the United States (US) indicates that frequent ED users are disproportionately sicker and were more likely to be from younger age groups, have public insurance, and be female.³ For EDs outside the US, frequent ED users were more likely to be younger and have chronic illnesses compared to non-frequent ED users.⁴ Significant associations have also been reported between frequent ED users and asthma,⁵ psychological distress,^{6,7} and substance use.^{8,9} Other studies have suggested that a misunderstanding of medical necessity and access issues (e.g., ease, timing, geography) are reasons that frequent users present to EDs.¹⁰ In terms of outcomes, higher mortality, hospital admissions, and outpatient visits have been reported for frequent ED users compared to non-frequent users.¹¹

Previous studies generally focus on one ED or EDs within one administrative jurisdiction. We focus on cohorts created from two provinces in Canada, Alberta and Ontario. Despite the key role of the ED in health care delivery, research and surveillance opportunities in this setting, while occasionally employed, are clearly underutilized, especially in Canada. There is a paucity of research on ED presentations in Canada, especially for ambulatory care sensitive conditions, and on frequent ED users. The primary objectives of this study were to describe and compare measures of patient flow through the ED, physician initial assessment (PIA) and length of stay ED (LOS), between high system users (HSUs) of EDs and control groups in Alberta and Ontario at different acuity levels.

METHODS

Study Design

This retrospective cohort study used population-based health administrative databases from the provinces of Alberta and Ontario, Canada during April 1, 2011, to March 31, 2016. The University of Alberta Health Research Ethics Board approved this study (Pro00078363). The funding organization had no input in the conduct and reporting of the study.

Study Setting and Population

Provinces in Canada have uniform single-payer health systems that are administrated by individual provinces to provide medically necessary health care. The western Canadian province of Alberta has >4 million residence and the central Canadian province of Ontario has >14 million residents.

The study population consists of individuals aged ≥ 18 years at the end of the fiscal year in the HSU or control groups who presented to EDs during the study period. A dynamic cohort of the most frequent users was created for each province and fiscal year by identifying the top 10% of patients with respect to the number of ED presentations.¹² These patients form the HSU group. Control groups were also created for each province and fiscal year by selecting a random sample of patients not in the HSU group using a sampling ratio of 4:1.¹² The number of presentations was based on unscheduled presentations, however, our extract has included both scheduled and unscheduled presentations as there may be variability in coding and relatively few (< 1%) ED presentations were classified as scheduled.

The Dynamic Cohort of Complex, High System Users¹² based on acute care cost, highest length of stay, most frequent hospitalizations, and most frequent ED presentations has been created as

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collaboration between the Canadian Institutes of Health Research and the Canadian Institute for Health Information (CIHI). Alberta and Ontario are the only two provinces in Canada that report on all ED presentations to the National Ambulatory Care Reporting System (NACRS)¹³ and CIHI used this database to extract and link the data needed for our study.

Study Protocol

The NACRS database provides data on characteristics of ED presentations including dates and times, triage level, diagnoses, and disposition status. The demographic data include age in years at date of ED presentation, sex, and the forward sortation area (first three characters of the postal code) of residence to provide a proxy for urban and rural location of residence. The full postal code was used by CIHI to obtain “as the crow flies” distances from patients’ home to hospital visited (kilometres [km]). For Ontario, the demographic data include access to primary health care (e.g., family physician, other, none). The date/time variables included the date/time of registration, triage, physician initial assessment, disposition decision, and patient leaving the ED. The start of the presentation (registration) defined fiscal year, month of year, weekday/weekend, and time of shift (daytime 08:00-15:59, evening 16:00-23:59, night 00:00-07:59). Mode of arrival included type of ambulances and no ambulance arrival. Triage level represents the urgency of ED care required by the individual and is based on the Canadian Emergency Department Triage and Acuity Scale (CTAS).^{14 15} The triage codes are: resuscitation (1), emergency (2), urgent (3), semi-urgent (4), and non-urgent (5). Diagnoses are provided as International Classification of Diseases (ICD-10-CA)¹⁶ codes with up to 10 codes recorded. Patients are given one of 15 disposition codes according to the way in which they are released from ED and we have grouped these as discharges (1,15), admissions (6, 7), transfers (8, 9, 12, 13, 14), deaths (10, 11), left without being seen (LWBS; 2, 3), and left against medical advice (LAMA; 4, 5).

Key Outcome Measures

Study outcomes were PIA and LOS calculated for HSU and control groups in each province. Time to physician initial assessment was calculated as the difference between physician initial assessment and the start of the ED presentation. The ED length of stay (LOS) is also provided and depends on disposition: it is calculated as the time from the start of ED presentation until the time of the disposition decision for discharged patients or time the patient left the ED for admitted patients.¹⁷

Data Analysis

Data cleaning included combining overlapping ED presentations for a patient into a single presentation and considering durations >12 hours for time to physician initial assessment and >7 days for time to disposition decision, time to patient leaving the ED, and ED LOS as missing (presumed inaccurate). Numerical summaries (i.e., means, medians, standard deviations [SDs], IQR represented as [25th percentile, 75th percentile]) and counts (percentages) describe patient demographics and ED presentation characteristics. Data are summarized by province and by HSU cohort status. To obtain 95% confidence intervals (CIs) for key outcomes, the cluster bootstrap with 500 samples was used to adjust for the correlated data from the same individual. Further, Cox models with province, group, and CTAS level as predictors were obtained for times to transition along the key stages within the overall ED visit for the 2015/2016 data (Appendix Figure 1) similar to Liu et al.¹⁸ These models only include patients with non-missing times and assume the ED visits are independent for computational feasibility. Hazard ratios (HRs) and associated 95% confidence intervals (CIs) are provided. All analyses were conducted in R (Vienna, Austria; Version 3.5.1).¹⁹

RESULTS

During the entire study period, there were 20,343,230 and 18,222,969 ED presentations made by 7,032,655 and 1,923,462 individuals in the control and HSU groups, respectively. As the definition of HSU was based on fiscal year, different patients may have comprised the HSU and control groups over fiscal year. Table 1 provides the basic demographic summaries and the number of ED presentations by group and fiscal year.

Table 1. Basic demographics and ED presentations by province, group, and fiscal year.

Fiscal Year	Characteristic	Alberta		Ontario	
		Control	HSU	Control	HSU
2011/2012	Number of patients	390,247	97,736	1,743,552	436,438
	Female (%)	294,575 (51.8)	368,229 (54.4)	1,167,536 (53.2)	1,108,572 (54.9)
	Male (%)	274,551 (48.2)	308,330 (45.6)	1,028,548 (46.8)	909,660 (45.1)
	Age at ED presentation				
	Mean (SD)	45.4 (19.3)	48.0 (20.2)	48.7 (19.9)	50.6 (21.0)
	Median (Q1, Q3)	43.0 (29.0, 58.0)	46.0 (30.0, 63.0)	48.0 (32.0, 63.0)	49.0 (32.0, 68.0)
	Number of ED presentations	569,126	676,559	2,196,106	2,018,238
	ED presentations per patient				
	Mean (SD)	1.5 (0.7)	6.9 (6.8)	1.3 (0.5)	4.6 (3.7)
	Median (Q1, Q3)	1.0 (1.0, 2.0)	5.0 (4.0, 7.0)	1.0 (1.0, 2.0)	4.0 (3.0, 5.0)
2012/2013	Number of patients	404,055	101,419	1,790,443	448,316
	Female (%)	299,402 (51.7)	379,561 (54.6)	1,182,717 (52.9)	1,138,327 (55.0)
	Male (%)	280,075 (48.3)	315,128 (45.4)	1,050,996 (47.1)	929,524 (45.0)
	Age at ED presentation				
	Mean (SD)	45.4 (19.1)	48.1 (20.2)	48.9 (19.8)	51.1 (21.2)
	Median (Q1, Q3)	43.0 (29.0, 58.0)	46.0 (30.0, 63.0)	48.0 (32.0, 63.0)	50.0 (32.0, 68.0)
	Number of ED presentations	579,477	694,689	2,233,736	2,067,866
	ED presentations per patient				
	Mean (SD)	1.4 (0.7)	6.8 (6.8)	1.2 (0.5)	4.6 (3.8)
	Median (Q1, Q3)	1.0 (1.0, 2.0)	5.0 (4.0, 7.0)	1.0 (1.0, 1.0)	4.0 (3.0, 5.0)
2013/2014	Number of patients	406,584	102,268	1,794,311	453,011
	Female (%)	295,315 (51.2)	377,763 (54.4)	1,175,974 (52.8)	1,154,708 (55.1)
	Male (%)	281,447 (48.8)	316,690 (45.6)	1,050,875 (47.2)	939,564 (44.9)
	Age at ED presentation				
	Mean (SD)	45.5 (18.9)	48.0 (20.2)	49.0 (19.7)	51.2 (21.2)
	Median (Q1, Q3)	43.0 (30.0, 58.0)	46.0 (30.0, 63.0)	48.0 (32.0, 63.0)	50.0 (32.0, 68.0)
	Number of ED presentations	576,765	694,457	2,226,878	2,094,329
	ED presentations per patient				

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	Mean (SD)	1.4 (0.7)	6.8 (6.5)	1.2 (0.4)	4.6 (3.9)
	Median (Q1, Q3)	1.0 (1.0, 2.0)	5.0 (4.0, 7.0)	1.0 (1.0, 1.0)	4.0 (3.0, 5.0)
2014/2015	Number of patients	411,570	103,594	1,750,579	467,402
	Female (%)	296,255 (51.3)	376,531 (54.0)	1,139,718 (52.6)	1,193,239 (55.2)
	Male (%)	281,673 (48.7)	321,089 (46.0)	1,025,303 (47.4)	969,462 (44.8)
	Age at ED presentation				
	Mean (SD)	45.8 (19.0)	48.3 (20.3)	49.3 (19.7)	51.7 (21.4)
	Median (Q1, Q3)	43.0 (30.0, 59.0)	47.0 (31.0, 64.0)	49.0 (32.0, 64.0)	51.0 (33.0, 69.0)
	Number of ED presentations	577,930	697,620	2,165,039	2,162,728
	ED presentations per patient				
	Mean (SD)	1.4 (0.7)	6.7 (6.6)	1.2 (0.4)	4.6 (3.9)
	Median (Q1, Q3)	1.0 (1.0, 2.0)	5.0 (4.0, 7.0)	1.0 (1.0, 1.0)	4.0 (3.0, 5.0)
2015/2016	Number of patients	401,923	101,250	1,714,037	478,424
	Female (%)	287,525 (51.3)	371,621 (54.1)	1,110,576 (52.5)	1,218,732 (54.8)
	Male (%)	273,228 (48.7)	315,196 (45.9)	1,003,345 (47.5)	1,003,386 (45.2)
	Age at ED presentation				
	Mean (SD)	46.1 (18.9)	48.8 (20.3)	49.5 (19.6)	51.8 (21.3)
	Median (Q1, Q3)	43.0 (30.0, 59.0)	47.0 (31.0, 64.0)	49.0 (33.0, 64.0)	51.0 (33.0, 69.0)
	Number of ED presentations	560,755	686,817	2,113,961	2,222,173
	ED presentations per patient				
	Mean (SD)	1.4 (0.6)	6.8 (7.0)	1.2 (0.4)	4.6 (4.1)
	Median (Q1, Q3)	1.0 (1.0, 2.0)	5.0 (4.0, 7.0)	1.0 (1.0, 1.0)	4.0 (3.0, 5.0)

The vast majority of ED presentations in each group and province did not involve an ambulance in 2015/2016 (79.9% to 88.1%, Table 2). However, more HSU visits arrived by ambulance than control visits. The Ontario HSU group had the most use of ground ambulance (20.1%) and the Alberta control group had the lowest use (11.8%, Table 2). Across provinces and groups, similar proportions were seen for type of day (weekday/weekend) and shift. The Ontario groups had higher acuity than the Alberta groups: 20.6% and 19.8% in the Ontario HSU and control groups, respectively, were from emergent level (CTAS 2) while 11.3% and 14.5% in the Alberta HSU and control groups, respectively. Triage levels over time (Appendix Figure 2) show that the Ontario groups had similar acuity and the Alberta groups have more variability over time.

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Table 2. Emergency department presentation characteristics by province and group for 2015/2016.

Characteristic	Alberta		Ontario	
	Control (n= 560,755)	HSU (n= 686,817)	Control (n= 2,113,961)	HSU (n= 2,222,173)
Admit via ambulance				
No ambulance arrival (e.g., walk in) (%)	494,292 (88.1)	588,648 (85.7)	1,803,287 (85.3)	1,774,770 (79.9)
Ground ambulance (%)	65,952 (11.8)	97,268 (14.2)	309,852 (14.7)	445,702 (20.1)
Air ambulance (%)	346 (0.1)	437 (0.1)	235 (0.0)	404 (0.0)
Any combination of ground, air or water ambulance (%)	165 (0.0)	464 (0.1)	587 (0.0)	1,297 (0.1)
Day				
Weekday (%)	401,925 (71.7)	505,314 (73.6)	1,523,089 (72.0)	1,628,069 (73.3)
Weekend (%)	158,830 (28.3)	181,503 (26.4)	590,872 (28.0)	594,104 (26.7)
Shift				
00:00-07:59 (%)	69,287 (12.4)	88,230 (12.8)	274,707 (13.0)	307,453 (13.8)
08:00-15:59 (%)	285,340 (50.9)	351,680 (51.2)	1,074,124 (50.8)	1,117,009 (50.3)
16:00-23:59 (%)	206,128 (36.8)	246,907 (35.9)	765,130 (36.2)	797,711 (35.9)
Triage level				
1 - Resuscitation (%)	3,184 (0.6)	3,093 (0.5)	19,235 (0.9)	20,660 (0.9)
2 - Emergent (%)	81,079 (14.5)	77,517 (11.3)	417,725 (19.8)	457,096 (20.6)
3 - Urgent (%)	214,526 (38.3)	220,567 (32.1)	967,426 (45.8)	1,011,687 (45.5)
4 - Less-urgent (Semi-urgent) (%)	205,098 (36.6)	238,190 (34.7)	639,120 (30.2)	593,952 (26.7)
5 - Non-urgent (%)	45,912 (8.2)	116,028 (16.9)	60,550 (2.9)	113,907 (5.1)
Missing / Unavailable (%)	10,956 (2.0)	31,422 (4.6)	9,905 (0.5)	24,871 (1.1)
Time to physician initial assessment (TPIA) (minutes)				
Mean (SD)	88.7 (74.5)	83.6 (77.0)	87.5 (73.5)	84.4 (74.2)
Median (Q1, Q3)	67.0 (35.0, 121.0)	60.0 (30.0, 112.0)	67.0 (35.0, 119.0)	63.0 (32.0, 115.0)
Missing / N.A. (%)	113,512 (20.2)	264,046 (38.4)	156,479 (7.4)	243,843 (11.0)
Time to disposition decision (hours)				
Mean (SD)	3.5 (3.3)	3.4 (3.7)	3.5 (3.0)	3.8 (3.6)
Median (Q1, Q3)	2.6 (1.4, 4.5)	2.2 (1.1, 4.3)	2.7 (1.5, 4.5)	2.9 (1.5, 5.0)
Missing / N.A. (%)	13,520 (2.4)	34,972 (5.1)	14,402 (0.7)	36,961 (1.7)
Disposition				
Discharged (%)	478,332 (85.3)	575,360 (83.8)	1,826,261 (86.4)	1,789,388 (80.5)
Admitted (%)	51,136 (9.1)	65,087 (9.5)	197,128 (9.3)	291,669 (13.1)
Transferred (%)	10,445 (1.9)	16,438 (2.4)	24,262 (1.1)	44,444 (2.0)
Left without being seen (LWBS) (%)	14,604 (2.6)	19,542 (2.8)	49,749 (2.4)	71,189 (3.2)
Left against medical advice (LAMA) (%)	5,685 (1.0)	10,179 (1.5)	13,955 (0.7)	24,364 (1.1)
Death (%)	553 (0.1)	211 (0.0)	2,606 (0.1)	1,119 (0.1)
Length of stay (hours)				
Mean (SD)	4.1 (5.8)	4.0 (6.2)	4.2 (5.5)	4.9 (6.7)
Median (Q1, Q3)	2.6 (1.4, 4.7)	2.2 (1.1, 4.5)	2.8 (1.6, 4.7)	3.0 (1.6, 5.4)

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Missing (%)	13,395 (2.4)	34,784 (5.1)	6,922 (0.3)	17,195 (0.8)
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When the main diagnosis code was examined by ICD chapter, “XIX - Injury, poisoning and certain other consequences of external causes (S00-T98)” and “XVIII - Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified (R00-R99)” were the most frequent diagnoses across provinces and groups (Appendix Table 1). For Alberta, the top three chapters were factors influencing health (22.6% XXI), abnormal findings not elsewhere classified (15.9% XVIII), and injury and poisoning (12.8% XIX) for the HSU group and injury and poisoning (26.7% XIX), abnormal findings not elsewhere classified (18.2% XVIII), and respiratory diseases (8.4% X) for the control group. For Ontario, abnormal findings not elsewhere classified (21.3% XVIII), injury and poisoning (14.4% XIX), and factors influencing health (9.4% XXI) were the top three chapters for the HSU group and the top three chapters for the control group were injury and poisoning (27.2% XIX), abnormal findings not elsewhere classified (20.1% XVIII), and musculoskeletal diseases (8.0% XIII).

The vast majority of presentations ended in discharge (Alberta: 85.3% control, 83.8% HSU; Ontario: 86.4% control, 80.5% HSU; Table 2). The Ontario HSU group had higher admissions (13.1%) than the control group, and the Alberta groups. The Ontario HSU group also had the most LWBS (3.2%) whereas the Alberta HSU group had the most LAMA (1.5%) compared to the other groups. The HSU groups had higher LWBS and LAMA than their provincial control groups. There were relatively few deaths in any of the groups.

ED Presentation Durations across Years

Time to physician initial assessment was similar across provinces and groups (medians of 60min to 67min, Table 2). When examined by time and triage level (Figure 1), the median times were fairly

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stable over time and CTAS levels 2 to 5 had more similar median times in Ontario than compared to Alberta.

There were lower times to disposition decision and overall LOS in the Alberta groups compared to the Ontario groups in 2015/2016. The Ontario control group had median times to disposition decision and LOS about 10min shorter than the HSU group. Conversely, the Alberta control group had median times to disposition decision about 25min longer than the HSU group. In both provinces, the HSU groups had longer LOS compared with the control groups when the triage level was resuscitation or emergent (Figure 2). The median LOS has remained stable over time in Ontario; however, in Alberta the median LOS for presentations with resuscitations has increased over time in both the HSU and control groups.

When LOS was further examined by disposition (Appendix Table 2), the median LOS for presentations ending in discharge was 2.5h for the Ontario control group, 2.6h for the Ontario HSU group, 2.4h for the Alberta control group, and 1.9h for the Alberta HSU group in 2015/2016. When triage level was considered in Appendix Figure 3, the median LOS's for resuscitation and emergent presentations were longer compared with Ontario. Within Alberta, the HSU group had longer median LOS than the control group for those levels. For admissions/transfers in 2015/2016, the median LOS was 9.3h for the Ontario control and HSU groups, 8.2h for the Alberta control group, and 7.3h for the Alberta HSU group. Overall, Alberta times were shorter than Ontario times. The HSU group had lower times than the control for Alberta but not Ontario. Appendix Figure 4 shows that the median LOS differs by province and triage level. The median LOS's in Alberta generally increased over time.

ED Flow for 2015/2016

Our further examination of the effect of province and group on transitions among key stages of the ED visit involved 549,799 and 655,395 visits in the control and HSU Alberta groups, respectively, and 2,104,056 and 2,197,302 visits in the control and HSU Ontario groups, respectively. For the visits that flowed through the stages and completed care, patients in Alberta EDs took longer than those in Ontario when adjusted by group and triage level (Table 3). Patients in the HSU group had shorter times between start and PIA (HR=1.02; 95% CI 1.02, 1.03) but had longer times to disposition decision and to end of the ED visit than the control group (Decision: HR=0.84; 95% CI 0.84, 0.84; End: HR=0.91; 95% CI 0.91, 0.91). For patients who did not complete care, Albertans had shorter times to LWBS and LAMA than Ontarians. Notably, the HSU group also had shorter times in these stages than the control group (LWBS: HR=1.42 95% CI 1.40, 1.43; LAMA: 1.63, 95% CI 1.59, 1.67)

Table 3. Hazard ratios (HRs) and associated 95% confidence intervals (CIs) for flow between stages for visits that ended with care completed and those that ended before care completed (LWBS=left without being seen, LAMA=left against medical advice) for fiscal year 2015/2016.

Visits where ED Care was Completed			
	Start-Physician HR (95% CI)	Physician-Decision HR (95% CI)	Decision-End HR (95% CI)
Province (reference=Ontario)	0.96 (0.96, 0.97)*	0.81 (0.81, 0.81)*	0.98 (0.98, 0.99)*
Group (reference=Control)	1.02 (1.02, 1.03)*	0.84 (0.84, 0.84)*	0.91 (0.91, 0.91)*
Triage level (reference=5-Non-urgent)			
1 - Resuscitation	4.73 (4.68, 4.78)*	0.20 (0.19, 0.20)*	0.32 (0.32, 0.33)*
2 - Emergent	0.93 (0.92, 0.93)*	0.20 (0.20, 0.20)*	0.50 (0.50, 0.50)*
3 - Urgent	0.74 (0.73, 0.74)*	0.29 (0.29, 0.30)*	0.71 (0.71, 0.71)*
4 - Less-urgent (Semi-urgent)	0.88 (0.88, 0.89)*	0.70 (0.70, 0.71)*	0.96 (0.95, 0.96)*
Visits where Patient Left before Completion of Care			
	Start-LWBS HR (95% CI)	Physician-LAMA HR (95% CI)	
Province (reference=Ontario)	1.06 (1.05, 1.07)*	1.06 (1.03, 1.09)*	
Group (reference=Control)	1.42 (1.40, 1.43)*	1.63 (1.59, 1.67)*	
Triage level (reference=5-Non-urgent)			
1 - Resuscitation	0.11 (0.08, 0.14)*	0.40 (0.35, 0.46)*	
2 - Emergent	0.20 (0.20, 0.21)*	0.54 (0.49, 0.58)*	

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3 - Urgent	0.35 (0.35, 0.36)*	0.65 (0.60, 0.70)*	
4 - Less-urgent (Semi-urgent)	0.58 (0.57, 0.59)*	0.83 (0.77, 0.91)*	

DISCUSSION

We examined over 38 million ED presentations in Alberta and Ontario made by the top 10% of the most frequent users and a sample of controls for each year (2011/2012 to 2015/2016) from a population-based database. The study described characteristics of the ED presentations and focused on key patient flow measures of time to PIA and LOS in the ED. To our knowledge, we are the first to compare HSUs and provinces on patient flow measures in the ED. EDs in Ontario and British Columbia were compared on flow measures for adults and children, but did not consider frequent users of EDs.²⁰ Other studies have examined a single ED or jurisdiction to describe^{21 22} or compare²³⁻²⁵ frequent users to other groups.

Over all years and all acuity groups, median PIA remained relatively stable. When examined by acuity group, CTAS levels 2 to 5 had more similar median times in Ontario than compared to Alberta. In 2015/2016, HSUs had shorter times to PIA than controls and Ontarians had longer times to PIA than Albertans, when adjusted by CTAS.

Over all years and all acuity groups, LOS remained relatively stable with Ontario groups having longer median LOS than Alberta groups, and the Alberta HSUs having the shortest LOS. In one suburban ED in Alberta in 2010/2011, 22,333 ED presentations were compared for non-frequent users (1-4 visits), frequent users (≥ 5 presentations), and extreme frequent users (≥ 8 presentations) and the frequent users groups had longer mean LOS than the non-frequent user group.²³ The mean LOSs were 5.5, 8.0, and 7.9 hours for the non-frequent, frequent, and extreme frequent user groups, respectively. These mean

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LOSs were longer than the control and HSU groups in our study. A study of 75,141 patients with 98,908 presentations to one ED and one minor injury unit in a city in the United Kingdom in 2003 showed that discharged frequent users had a mean LOS that was 40 min longer than discharged non-frequent users.²⁵ In our study, discharged HSUs in Alberta had about the same mean LOS as discharged controls whereas discharged HSUs in Ontario had a mean LOS about 12 min longer than discharged controls. A study in an urban ED in Ottawa, Ontario showed that 261 highly frequent ED users (patients in the 99th percentile during 2014) with 3,164 presentations had a median LOS of 5.2 hours (Q1, Q3 3.1, 8.7)²¹ and a study in a Singapore ED showed that 243 frequent users (≥ 4 presentations in 2015) with 1,705 presentations had a median LOS of 2.9 hours (Q1, Q3 1.7, 5)²² but neither study compare this measure to non-frequent users. These highly frequent ED users had longer median LOS than either of the HSU groups in our study and Ontario HSUs had about the same median as the Singapore frequent users. When examined by acuity group, our HSUs in the highest acuity groups had longer LOSs than controls. In 2015/2016, HSUs had longer times from assessment to decision and decision to end when adjusted by CTAS. In addition, Albertans longer times from assessment to decision and decision to end, when adjusted by CTAS.

HSU groups also had more ED presentations that were LWBS or LAMA compared to control groups. Other studies have shown that frequent ED users are more likely to have presentations that end in LWBS or LAMA.^{24,26} In 2015/2016, HSUs had shorter times to LWBS and LAMA when adjusted by CTAS. Albertans had shorter times to LWBS and LAMA than Ontarians.

Strengths and Limitations

The strengths of our study include large sample sizes from population-based data sources in two geographically large areas of Canada. The NACRS database requires mandatory reporting in Alberta

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and Ontario and CIHI implements data quality controls and reports on data quality. Medical record nosologists use ICD diagnostic codes to code the charts. Our study also has several limitations. First, the data were obtained from paper-based sources and there may be some errors in the coding and the documented times. Second, our results may not be generalizable to other areas of Canada or other jurisdictions with different health care systems. Third, the cohorts defined by CIHI were based on unscheduled ED presentations. There are a few control patients in our study who may have had more presentations than the patients in the HSU group. With the large data size, this difference is negligible.

CONCLUSION

Ontario HSUs had higher acuity and longer lengths of stay than the other groups. In both provinces, HSUs had shorter times to PIA and longer times after that assessment. Further study is need to safely determine how the number of ED presentations and the duration of presentations can be reduced for HSUs.

ACKNOWLEDGMENTS

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COMPETING INTERESTS

The authors report no conflicts of interest.

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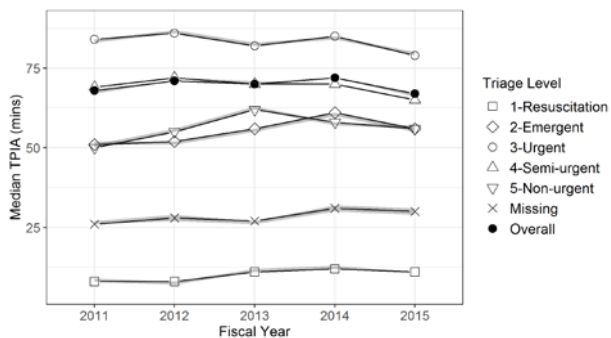
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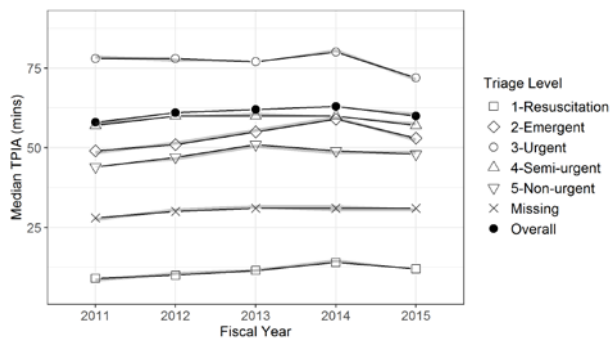
FIGURES

Figure 1. Median time to physician initial assessment by triage level, province, group, and fiscal year.

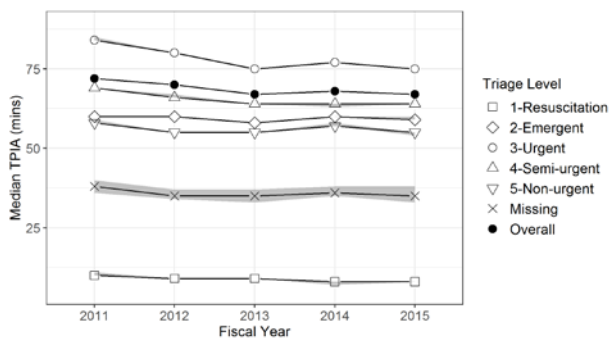
(a) Alberta, control group



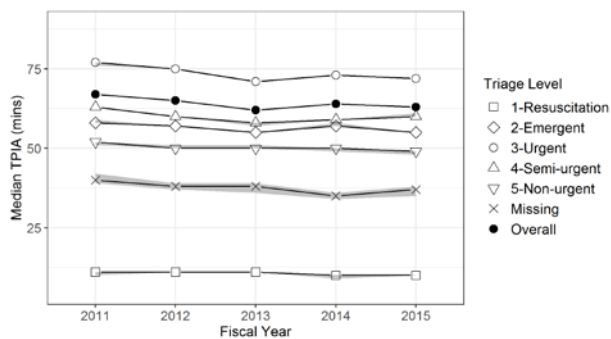
(b) Alberta, HSU group



(c) Ontario, control group



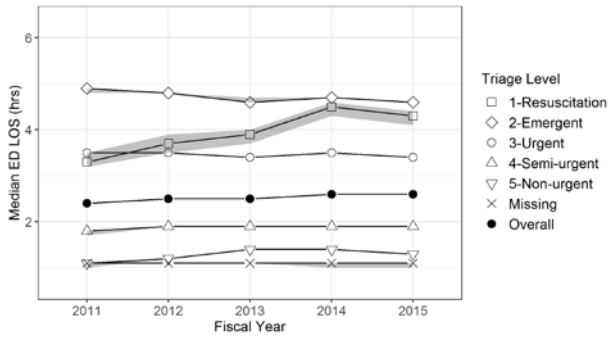
(d) Ontario, HSU group



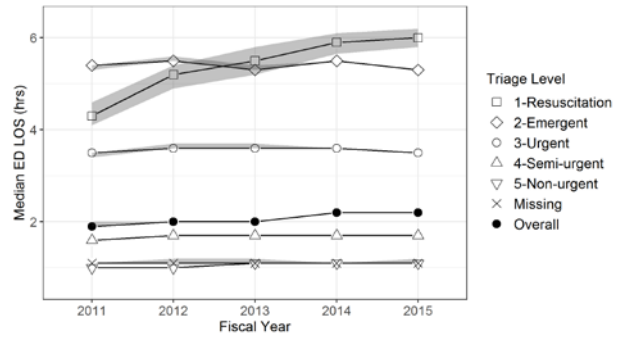
Frequent users of EDs and patient flow in Alberta and Ontario, Canada

Figure 2. Median ED length of stay by triage level, province, group, and fiscal year.

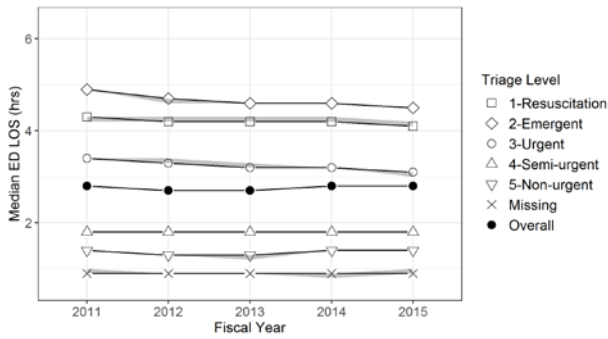
(a) Alberta, control group



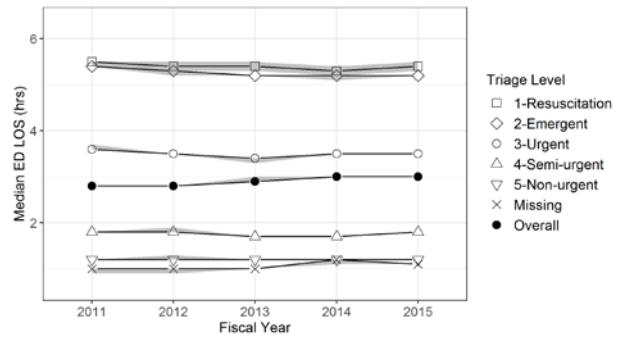
(b) Alberta, HSU group



(c) Ontario, control group



(d) Ontario, HSU group



APPENDIX

Appendix Table 1. ICD chapter of main diagnosis by province and group for 2015/2016.

	Alberta		Ontario	
	Control (n= 560,755)	HSU (n= 686,817)	Control (n= 2,113,961)	HSU (n= 2,222,173)
I - Certain infectious and parasitic diseases (A00-B99) (%)	18,331 (3.3)	16,960 (2.5)	70,904 (3.4)	64,765 (2.9)
II - Neoplasms (C00-D48) (%)	3,015 (0.5)	4,089 (0.6)	9,023 (0.4)	16,264 (0.7)
III - Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D89) (%)	1,685 (0.3)	3,559 (0.5)	7,579 (0.4)	15,025 (0.7)
IV - Endocrine, nutritional and metabolic diseases (E00-E90) (%)	5,570 (1.0)	11,207 (1.6)	17,144 (0.8)	34,147 (1.5)
V - Mental and behavioural disorders (F00-F99) (%)	17,192 (3.1)	40,104 (5.8)	58,822 (2.8)	139,739 (6.3)
VI - Diseases of the nervous system (G00-G99) (%)	9,794 (1.7)	14,305 (2.1)	33,869 (1.6)	42,163 (1.9)
VII - Diseases of the eye and adnexa (H00-H59) (%)	8,887 (1.6)	4,591 (0.7)	43,915 (2.1)	23,744 (1.1)
VIII - Diseases of the ear and mastoid process (H60-H95) (%)	9,427 (1.7)	6,673 (1.0)	38,742 (1.8)	25,874 (1.2)
IX - Diseases of the circulatory system (I00-I99) (%)	21,121 (3.8)	23,282 (3.4)	86,866 (4.1)	103,487 (4.7)
X - Diseases of the respiratory system (J00-J99) (%)	47,162 (8.4)	49,922 (7.3)	162,921 (7.7)	178,605 (8.0)
XI - Diseases of the digestive system (K00-K93) (%)	33,858 (6.0)	39,754 (5.8)	125,988 (6.0)	143,370 (6.5)
XII - Diseases of the skin and subcutaneous tissue (L00-L99) (%)	20,281 (3.6)	29,047 (4.2)	71,834 (3.4)	98,675 (4.4)
XIII - Diseases of the musculoskeletal system and connective tissue (M00-M99) (%)	40,572 (7.2)	39,592 (5.8)	168,648 (8.0)	154,993 (7.0)
XIV - Diseases of the genitourinary system (N00-N99) (%)	31,227 (5.6)	36,161 (5.3)	118,193 (5.6)	139,978 (6.3)
XV - Pregnancy, childbirth and the puerperium (O00-O99) (%)	12,262 (2.2)	15,098 (2.2)	30,358 (1.4)	36,841 (1.7)
XVI - Certain conditions originating in the perinatal period (P00-P96) (%)	* (0.0)	12 (0.0)	27 (0.0)	24 (0.0)
XVII - Congenital malformations, deformations, and chromosomal abnormalities (Q00-Q99) (%)	124 (0.0)	168 (0.0)	462 (0.0)	513 (0.0)
XVIII - Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified (R00-R99) (%)	102,083 (18.2)	109,045 (15.9)	425,016 (20.1)	473,582 (21.3)
XIX - Injury, poisoning and certain other consequences of external causes (S00-T98) (%)	149,613 (26.7)	87,913 (12.8)	575,323 (27.2)	320,552 (14.4)
XX - External causes of morbidity and mortality (V01-Y98)	0 (0)	0 (0)	0 (0)	0 (0)
XXI - Factors influencing health status and contact with health services (Z01-Z99) (%)	28,468 (5.1)	155,230 (22.6)	67,890 (3.2)	208,632 (9.4)
XXII - Morphology of Neoplasms (8000/0-9989/1)	0 (0)	0 (0)	0 (0)	0 (0)
XXIII - Provisional codes for research and temporary assignment (U00-U99) (%)	* (0.0)	0 (0.0)	* (0.0)	* (0.0)
Missing (%)	77 (0.0)	105 (0.0)	435 (0.0)	1,199 (0.1)

HSU = high system users; ICD = International Classification of Diseases; * = suppressed because of small numbers

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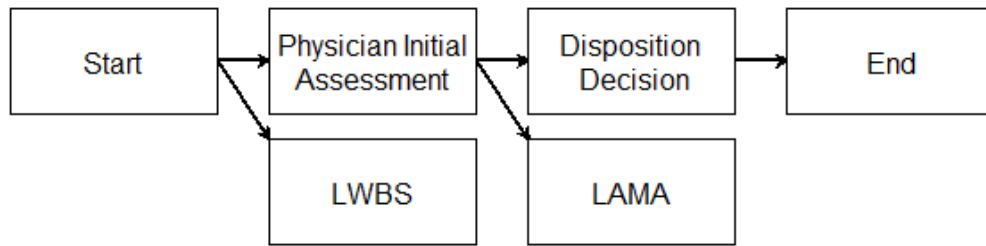
Appendix Table 2. Length of stay (LOS) in the ED for patient subgroups by province and group for 2015/2016.

		Alberta		Ontario	
		Control	HSU	Control	HSU
All Patients		(n=560,755)	(n=686,817)	(n=2,113,961)	(n=2,222,173)
	Mean (SD)	4.1 (5.8)	4.0 (6.2)	4.2 (5.5)	4.9 (6.7)
	Median (Q1, Q3)	2.6 (1.4, 4.7)	2.2 (1.1, 4.5)	2.8 (1.6, 4.7)	3.0 (1.6, 5.4)
	Missing (%)	13,395 (2.4)	34,784 (5.1)	6,922 (0.3)	17,195 (0.8)
Discharged		(n=478,332)	(n=575,360)	(n=1,826,261)	(n=1,789,388)
	Mean (SD)	3.1 (2.8)	3.0 (3.3)	3.2 (2.6)	3.4 (3.2)
	Median (Q1, Q3)	2.4 (1.3, 4.0)	1.9 (1.0, 3.8)	2.5 (1.5, 4.1)	2.6 (1.4, 4.4)
	Missing (%)	12,187 (2.5)	31,652 (5.5)	5,134 (0.3)	13,631 (0.8)
Admitted/Transferred		(n=61,581)	(n=81,525)	(n=221,390)	(n=336,113)
	Mean (SD)	12.3 (12.9)	11.5 (13.0)	13.2 (11.8)	13.5 (12.4)
	Median (Q1, Q3)	8.2 (4.5, 15.3)	7.3 (3.7, 14.4)	9.3 (5.4, 17.8)	9.3 (5.2, 18.4)
	Missing (%)	182 (0.3)	485 (0.6)	128 (0.1)	467 (0.1)

HSU = high system users; SD = standard deviation; Q1 = 25th percentile; Q3 = 75th percentile

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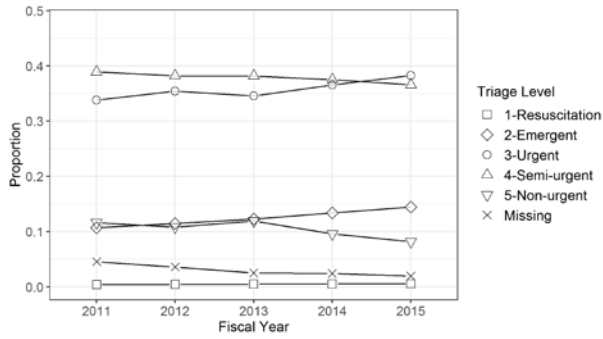
Appendix Figure 1. Flow through the ED (LWBS=left without being seen, LAMA=left against medical advice).



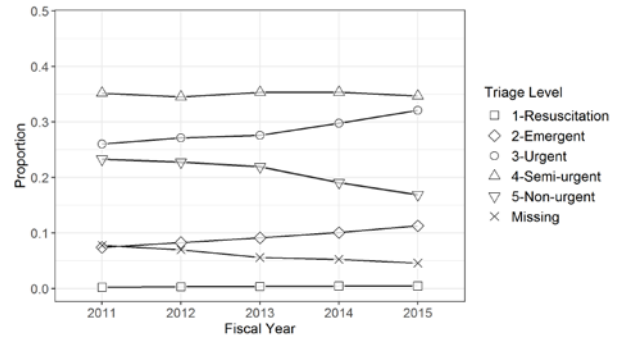
Frequent users of EDs and patient flow in Alberta and Ontario, Canada

Appendix Figure 2. Triage levels by province, group, and fiscal year.

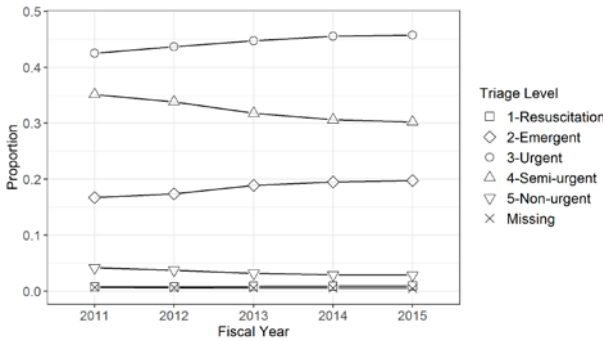
(a) Alberta, control group



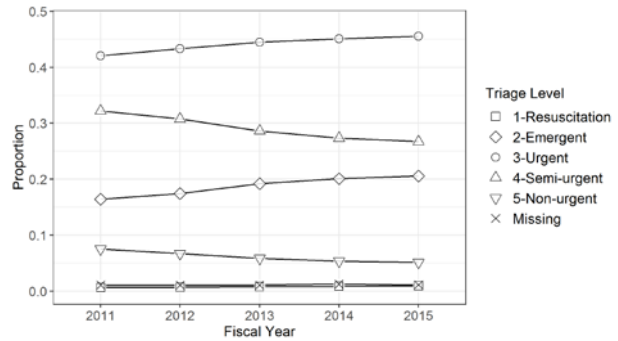
(b) Alberta, HSU group



(c) Ontario, control group



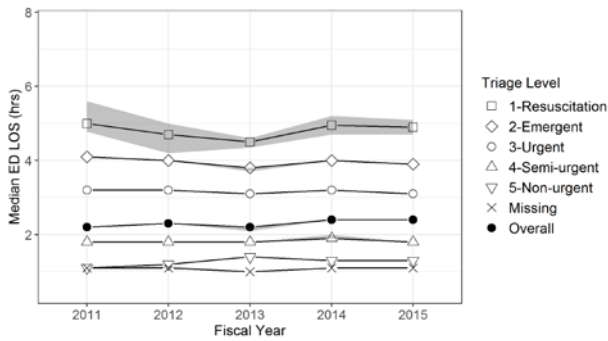
(d) Ontario, HSU group



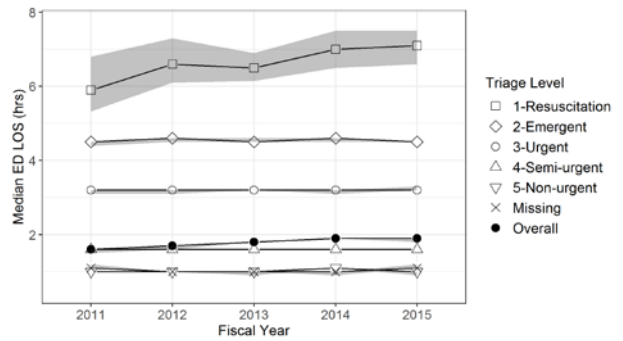
Frequent users of EDs and patient flow in Alberta and Ontario, Canada

Appendix Figure 3. Median ED length of stay for visits ending in discharge by triage level, province, group, and fiscal year.

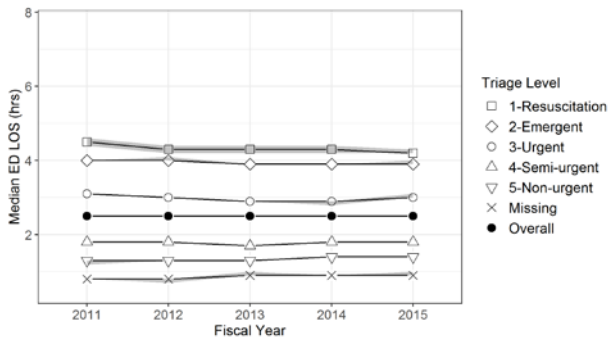
(a) Alberta, control group



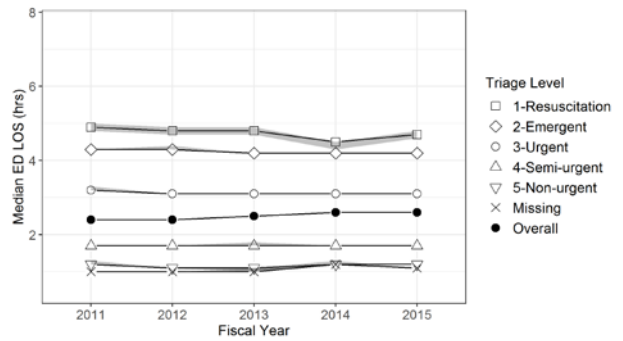
(b) Alberta, HSU group



(c) Ontario, control group



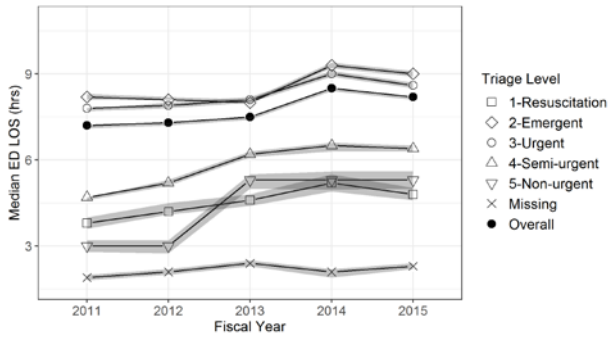
(d) Ontario, HSU group



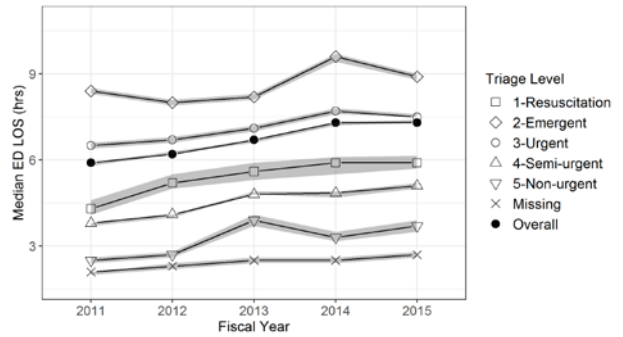
Frequent users of EDs and patient flow in Alberta and Ontario, Canada

Appendix Figure 4. Median ED length of stay for visits ending in admission or transfer by triage level, province, group, and fiscal year.

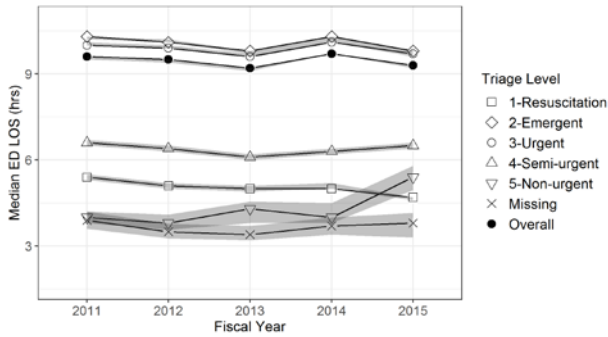
(a) Alberta, control group



(b) Alberta, HSU group



(c) Ontario, control group



(d) Ontario, HSU group

