Emergency department use by persons with HIV in Ontario: a population-based study

Short title: Emergency department use by persons with HIV

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Text count: 2986 **Abstract Word Count:** 249

Background

Emergency department utilization may reflect poor access to primary care. However, there are few contemporary studies describing emergency department use among persons with HIV. Our objectives were to compare rates and causes of emergency department utilization between adults living with and without HIV.

Methods

We conducted a population-based study of Ontario residents living with and without HIV between April 1, 2011 and May 31, 2012. We frequency matched adults with HIV to four HIV-negative individuals on age, sex and census division, and compared rates of emergency department utilization using random effects multivariable negative binomial regression. We classified visits as low-urgency or high-urgency, and also examined visits for ambulatory care sensitive conditions. Hospitalization following an emergency department visit was a secondary outcome.

Results

We studied 14,534 persons with HIV and 58,136 HIV-negative individuals. Rates of emergency department utilization were higher for persons with HIV (67.3 versus 31.2 visits per 100 person-years; adjusted rate ratio 1.58, 95% confidence interval 1.51 to 1.65). Similar results were observed for low-urgency visits. With the exception of hypertension, visit rates for ambulatory care sensitive conditions were higher for persons with HIV. Persons with HIV were also more likely to be hospitalized following an emergency department visit (adjusted odds ratio 1.55; 95% confidence interval 1.43 to 1.69).

Conclusion

Compared with HIV-negative individuals, persons with HIV have higher rates of emergency department utilization, including potentially avoidable visits. Optimizing timely access to appropriate community-based care may prevent a significant proportion of emergency department utilization in this population.

INTRODUCTION

Emergency department utilization, particularly for non-urgent conditions, is a frequently used indicator of access to primary care.[1] Understanding patterns of emergency department utilization is therefore necessary for optimizing resource allocation and identifying possible gaps in outpatient care. Yet, in contrast to studies examining inpatient and outpatient healthcare use,[2-6] comparatively few contemporary studies exist examining emergency department utilization among persons with HIV.[7-11] Studies conducted in the years preceding the introduction of combination antiretroviral therapy demonstrated that persons with HIV had rates of emergency department visits that were three- to four-fold higher than those of the general population.[12,13] Although subsequent studies found persistently heightened rates of emergency department utilization following the introduction of combination antiretroviral therapy, inferences were limited by samples that were small and not population-based in nature.[7,9,10] A recent analysis of the United States National Hospital Ambulatory Medical Survey demonstrated that rates of emergency department room visits in persons with HIV continue to exceed those of non-infected persons (633 vs 438 visits per 1000 persons), although by a smaller magnitude than during the preceding decade.[14]

Analagous population-based studies characterizing emergency department utilization among persons with HIV in a Canadian setting are lacking. These data are important for several reasons. First, findings generated in the United States are of limited generalizability to the Canadian context because Canadians have access to universally insured and publicly-financed health care; consequently, emergency room use should not be influenced by health insurance status. In addition, persons with HIV are disproportionately disadvantaged by socioeconomic and structural factors that are associated with poor access to primary care.[15] In this context, high rates

of emergency room use for conditions that could be potentially managed in ambulatory settings could be emblematic of poor access to primary care and highlight gaps in the community-based management of these patients. Accordingly, we compared rates and causes of emergency department utilization between adults living with and without HIV in Ontario, Canada. We examined risk of admission following emergency room visits as a secondary outcome. In light of previously published research, we speculated that persons with HIV would have higher rates of emergency department utilization, including potentially avoidable visits, than HIV-negative individuals.

METHODS

Setting

We conducted a population-based study comparing rates of emergency room visits between adults aged 18 years and older who were living with and without HIV infection in Ontario, Canada, between April 1, 2011 and March 31, 2012. This study was approved by the Research Ethics Board of Sunnybrook Health Sciences Centre, Toronto, Ontario.

Data Sources

We used Ontario's administrative health databases, which were held securely in linkable files without any direct personal identifiers, and analyzed at the Institute for Clinical Evaluative Sciences. We identified adults living with HIV using the Ontario HIV Database, an administrative data registry of Ontario residents with diagnosed HIV infection which was generated using a validated case-finding algorithm.[16] The definition of three physician claims

with an International Classification of Diseases, Ninth Revision code for HIV infection (042, 043, 044) within a three year period has a sensitivity and specificity of 96.2% (95% confidence intervals [CI] 95.2% to 97.9%) and 99.6% (95% CI 99.1% to 99.8%), respectively, for identifying persons living with HIV.[16] We obtained hospitalization and emergency department data from the Canadian Institute for Health Information's Discharge Abstract Database and National Ambulatory Care Reporting System (NACRS), respectively. The NACRS database contains detailed clinical information regarding all emergency room visits in Ontario. Recorded data elements include patient demographic variables, service dates and up to 10 diagnostic codes [International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)], one of which must be designated as the 'main problem', or the most clinically significant reason for the patient's visit to the emergency room. We used the Ontario Health Insurance Plan database to identify claims for physician services, and used validated disease registries to define the presence of diabetes, hypertension, chronic obstructive pulmonary disease, congestive heart failure and asthma.[17-21] We obtained basic demographic and date of death data from the Registered Persons Database, a registry of all Ontario residents eligible for health insurance.

Study population

We used the Registered Persons Database to identify all adults in Ontario aged 18 years and over who were alive and eligible for health insurance as of the index date of the study, April 1, 2011. From within this cohort, we identified individuals who had been diagnosed with HIV using the Ontario HIV Database. To create a control group that was similar with respect to characteristics that might influence emergency department utilization, we frequency matched a random sample

of HIV-negative residents on age, sex and census division in Ontario to persons with HIV in a ratio of 4:1.

Outcomes

The number of emergency department room visits, person-time at risk and rates of overall emergency room utilization were determined for people living with and without HIV for the study period. We computed emergency department utilization rates as the total number of visits occurring during the study period divided by the total person-years of follow-up in the period. For individuals who died or moved away from Ontario during follow-up, we used an offset to censor their observation at the date of death or migration, respectively, such that these individuals only contributed a fraction of a person-year to the rate calculation. We used the 'main problem' field in each record to determine the diagnosis most responsible for the visit, and aggregated similar diagnoses into organ- or disease-based categories according to ICD-10 codes.

We defined potentially avoidable visits in two ways. First, we used the Canadian Triage and Acuity Scale (CTAS), a standardized measure of the immediacy with which a patient presenting to an emergency department requires care, to categorize emergency room visits as 'low-urgency' or 'high-urgency', as has been done in previous studies.[22,23] Specifically, we considered visits that were triaged as CTAS 4 (less urgent) or 5 (non-urgent) as 'low-urgency', or representing visits for conditions that could have been potentially managed in ambulatory settings. In contrast, we classified visits triaged as CTAS 1 (resuscitation required), 2 (emergent care required) or 3 (urgent care required) as 'high-urgency' and likely non-preventable. Second, we calculated rates of emergency room visits for ambulatory care sensitive conditions, defined as

those conditions for which emergency department use could be potentially avoided with timely and regular access to outpatient care.[24] We classified conditions as being ambulatory care sensitive using definitions from the literature and the Canadian Institute for Health Information.[24-29]

In a separate analysis, we compared the risk of hospital admission following an emergency department room visit between persons with and without HIV. To ensure comparability in the distribution of factors that may predispose to hospitalization following an emergency department visit, we frequency matched each visit resulting in hospitalization among persons with HIV to four such visits among non-HIV-infected individuals on patient age, sex and census division within Ontario.

Statistical Analysis

We computed standardized differences to examine intergroup balance in the distribution of baseline variables. Standardized differences of less than 0.1 indicate good balance between groups for a given covariate.[30]

For the primary analysis, we compared rates of emergency department utilization between persons with and without HIV using random-effects negative binomial regression models to account for the correlation among matched groups. To examine the association between HIV infection and hospital admission following an emergency department room visit, we used generalized estimating equations with a logit link function and exchangeable correlation structure. We adjusted models for variables that could influence emergency department

utilization and risk of subsequent hospitalization, including the number of primary care physician visits during the prior year, urban versus rural residence, socioeconomic status and patient co-morbidity in the year preceding the index date. We determined patient socioeconomic status at the neighborhood level using postal code information and Statistics Canada census data. We used the Johns Hopkins Adjusted Clinical Groups Case-Mix System to adjust for differences in comorbidity burden in the year preceding the index date.[31] This system uses diagnostic information from administrative databases to describe and predict use of health care resources. In this study, we used Aggregated Diagnosis Groups (ADGs), which are clusters of diagnostic codes that are similar in terms of severity and expected persistence. The number of ADGs ranges from 0 to a maximum of 32, with a higher number reflecting a higher level of co-morbidity. We also generated Resource Utilization Bands (RUBs), which are aggregations of age-sex diagnostic groups associated with different levels of expected resource use, ranging from 0 (lowest expected health care use) to 5 (highest expected health care use), to compare patients based on their expected use of health care resources. Because of collinearity between ADGs and RUBs, we adjusted models only for the former. For the hospital admission models, we also adjusted for severity of presenting symptoms according to CTAS score, whether the emergency department was located within an academic teaching hospital and emergency department volume, classified into tertiles as low, medium or high. Because we speculated a priori that patients with HIV would be at heightened risk of admission regardless of visit severity, we examined the interaction between HIV status and CTAS score in a separate model. All analyses were conducted using SAS version 9.3 (SAS institute, Cary, North Carolina, USA).

RESULTS

We identified 14,534 persons with HIV and 58,136 matched HIV-negative individuals. The mean age was 46.4 years (SD ± 11.0 years), and approximately 20% were women (Table 1). Collectively, these individuals contributed 72,043 person-years of follow-up and made 27,637 visits to the emergency department between April 1, 2011 and March 31, 2012, of which 9,670 (35.0%) were attributable to persons with HIV. Compared with HIV-negative individuals, persons with HIV had a greater comorbidity burden as reflected by the number of ADGs and had more physician visits in the year preceding the index date (Table 1). Overall, 4,065 (28.0%; 95% confidence interval, 27.2% to 28.7%) persons with HIV made at least one visit to an emergency department during the study period, compared with 10,252 HIV-negative individuals (17.6%; 95% confidence interval, 17.3% to 17.9%).

Following multivariable adjustment, the rate of emergency department visits was higher in persons with HIV relative to HIV-negative patients (67.3 versus 31.2 visits per 100 person-years; adjusted rate ratio 1.58; 95% confidence interval 1.51 to 1.65) (Table 2). The unadjusted rates of the most common causes of emergency room visits are shown in supplemental Table 1. Compared with HIV-negative individuals, persons with HIV had strikingly higher rates of emergency room visits related to infectious diseases (87.27 versus 21.55 visits per 1000 person-years; rate ratio 4.05, 95% confidence interval 3.74 to 4.38) and mental health illness (62.21 versus 19.73 visits per 1000 person-years; rate ratio 3.15, 95% confidence interval 2.89 to 3.44). The most frequent (n = 1,069; 42.8%) infectious causes of emergency room utilization were skin and soft tissue infections, with rates of 36.67 and 9.40 visits per 1000 person-years among persons with and without HIV, respectively (rate ratio 3.90, 95% confidence interval 3.46 to 4.40). Visits where HIV was designated as the main problem accounted for 14.9% (n = 187) of infectious diseases related visits among persons with HIV. The most common mental health

diagnoses for persons with HIV were related to alcohol and substance use, with rates of 34.86 visits per 1000 person-years, compared with 7.73 visits per 1000 person-years among HIV-negative individuals (rate ratio 4.51, 95% confidence interval 3.97 to 5.12).

We observed similar results when stratifying according to visit acuity. Specifically, persons with HIV had higher rates of visits that were categorized as 'low-urgency' (22.3 versus 11.2 visits per 100 person-years; adjusted rate ratio 1.55, 95% confidence interval 1.45 to 1.65) and high urgency (44.9 versus 19.9 visits per 100 person-years; adjusted rate ratio 1.61, 95% confidence interval 1.53 to 1.69) (supplemental Table 2). In addition, with the exception of hypertension, emergency room utilization rates for ambulatory care sensitive conditions were higher among persons with HIV (Table 3).

To compare the risk of hospitalization following an emergency department visit, we frequency matched 9,670 emergency room visits made by persons with HIV to 38,670 visits made by HIV-negative individuals on age, sex and geographic residence within the province. Although the distribution of visits by CTAS score was similar between the two groups (Table 4), the proportion of visits resulting in hospitalization was higher among persons with HIV (15.6%; 95% confidence interval 14.9% to 16.4%) than HIV-negative individuals (9.6%; 95% confidence interval 9.3% to 9.9%). Following multivariable regression, persons with HIV were at greater risk of being admitted to hospital than HIV-negative individuals (adjusted odds ratio 1.55; 95% confidence interval 1.43 to 1.69) (Table 5). In an analysis stratified by CTAS score, persons with HIV were more likely to be admitted to hospital at all levels of visit severity, with the exception of CTAS 1 (resuscitation required) (Figure 1).

DISCUSSION

In our population-based study, we observed higher rates of emergency department utilization among persons with HIV relative to a matched sample of HIV-negative individuals. We found consistent results when considering emergency room utilization for less urgent visits. We also found higher odds of hospital admission among persons with HIV, including for visits triaged as less urgent. Our study suggests that developing community-based interventions that promote access to outpatient-based mental health care, substance use treatment, oral health care and timely primary care could reduce the burden of potentially preventable emergency room visits among persons with HIV.

Our findings build upon those of other recently published studies. Specifically, rates of emergency department utilization in our study are similar to those of a US study comparing emergency room use among a nationally representative sample of persons with and without HIV.[14] However, persons with HIV in that study were less likely to have private insurance than HIV-negative individuals, whereas our findings, arising from a publicly funded health care system, should not be influenced by such disparities. Our results are also similar to those of a Canadian study of 438 HIV-infected injection drug users, in that the cumulative incidence of emergency department use during the one year study period was 63.7%, with skin and soft tissue infections accounting for 17.6% of visits.[11] However, our study was population-based in nature, and therefore included all individuals with HIV who had entered care, including those who have never injected drugs.

Several intersecting mechanisms may explain our findings. First, previous research has shown that low socioeconomic status is associated with greater use of emergency departments for conditions amenable to outpatient management.[23] Although matching on geographic residence mitigated between-group differences in socioeconomic status, our previous work has demonstrated that persons with HIV are disproportionately represented in low income neighborhoods and are more socially and economically marginalized when measures of neighborhood instability and material deprivation are examined.[32,33] In addition, ecologic measures of socioeconomic status may not wholly capture the detrimental impact of social determinants such as food and housing insecurity, stigma and unemployment on health outcomes and health services utilization. These challenges are faced by up to 50% of Ontario residents with HIV and have been associated with poor health outcomes and heightened rates of emergency department utilization in several studies.[34-38] Second, our finding of high rates of mental health and substance use related emergency room visits could be explained by earlier work highlighting a greater relative burden of mental health related morbidity among Ontario residents with HIV and less engagement in continuous HIV outpatient care among individuals with a history of injection drug use.[39,40] Although higher rates of infectious diseases related visits among persons with HIV are not unexpected, only a minority of visits were related to underlying HIV infection. In contrast, skin and soft tissue infections accounted for the majority of these episodes in persons with HIV, possibly reflecting complications of injection drug use among susceptible individuals.[11] Finally, a higher prevalence of physical and mental health multimorbidity among persons with HIV relative to the general Ontario population could account for the higher odds of hospitalization following an emergency room visit among these patients, particularly for conditions triaged as less urgent and non-urgent.[39]

Our findings are strengthened by the population-based nature of our data, thereby allowing us to examine all Ontario residents with HIV who have entered care. However, our study has some limitations. We used administrative databases and did not have access to laboratory data, including viral load and CD4 cell count. Similarly, we did not have reliable data on antiretroviral use. However, as noted earlier, there were few visits attributable to underlying HIV infection, and an earlier study did not find an association between these indices and emergency department use in persons with HIV.[11] Although triage level and ambulatory care sensitive conditions are routinely used as indicators of potentially preventable emergency department visits, these visits may not always avoidable, even with timely access to primary care. Finally, we could not identify individuals with undiagnosed HIV and/or persons with HIV who have not linked to care; we hypothesize that emergency department visits rates would be higher in that population.

In conclusion, we found higher rates of emergency department utilization among people with HIV relative to the general Ontario population, including for conditions that could be potentially managed in outpatient settings. These findings have important implications for future research and the management of persons with HIV. Most notably, our findings provide a rationale for interventions to strengthen access to comprehensive primary care, community-based mental health and drug and alcohol treatment services for persons with HIV. In addition, integration of wound care management into existing harm reduction services may prevent visits for skin and soft tissue infections associated with injection drug use. Because emergency room utilization for less urgent conditions is associated with an inability to access timely primary care, we recommend further research to understand impediments to procuring such care among persons with HIV. Overall, these efforts will contribute to a more complete understanding of the reasons

underlying the observed disparities in emergency department utilization and ultimately inform programming which optimizes primary care engagement and chronic disease management for persons with HIV.

Competing interests

None of the authors have competing interests related to this work.

Funding

This study was funded as an Applied Health Research Question through the Institute for Clinical Evaluative Sciences (ICES), which is funded by an annual grant from the Ontario Ministry of Health and Long-Term Care (MOHLTC). The sponsors had no role in the design or conduct of the study; in the collection, analysis or interpretation of the data; or in the preparation, review or approval of the manuscript. The opinions, results and conclusions reported in this paper are those of the authors and are independent from the funding source. No endorsement by ICES or the Ontario MOHLTC is intended or should be inferred.

Tony Antoniou is supported by a New Investigator Award from the Canadian Institutes for Health Research-Ontario HIV Treatment Network. Ann N. Burchell is supported by a New Investigator Award from the Canadian Institutes for Health Research. Mona Loutfy is the recipient of salary support from Women's College Hospital, the University of Toronto and the Women's College Research Institute. Janet Raboud is supported by an Ontario HIV Treatment Network Career Scientist Award and the Skate the Dream Fund, Toronto and Western Hospital

Foundation. Richard H. Glazier is a Clinician Scientist in the Department of Family and Community Medicine of St. Michael's Hospital and the University of Toronto.

Author contributions

All authors contributed to the concept and design of the study. Ryan Ng and Tony Antoniou acquired the data, and all authors were involved in the analysis and interpretation of the data. Ryan Ng and Tony Antoniou drafted the manuscript, and all authors were involved in critical revision of the manuscript. All authors approved the manuscript submitted for publication. Ryan Ng and Tony Antoniou provided administrative, technical or material support. Tony Antoniou is the guarantor for the manuscript.

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Table 1: Baseline characteristics of persons with HIV and frequency matched sample of HIV-negative individuals, 2011-2012

Covariate	HIV (n = 14,534)	Non-HIV (n = 58,136)	Standardized Difference
Mean age ± standard deviation (years)	46.4 ± 11.0	46.4 ± 11.0	0.00
18 to 25 years	355 (2.4%)	1,427 (2.5%)	
26 to 35 years	1,927 (13.3%)	7,703 (13.2%)	
36 to 45 years	4,468 (30.7%)	17,933 (30.8%)	
46 to 55 years	5,175 (35.6%)	20,609 (35.4%)	
>55 years	2,609 (18.0%)	10,464 (18.0%)	
Sex			
Female	2,858 (19.7%)	11,432 (19.7%)	0.00
Male	11,676 (80.3%)	46,704 (80.3%)	
Neighborhood income quintile			
5 (highest)	2,241 (15.4%)	11,065 (19.0%)	0.20
4	2,171 (14.9%)	10,012 (17.2%)	
3	2,348 (16.2%)	10,533 (18.1%)	
2	2,999 (20.6%)	12,391 (21.3%)	
1 (lowest)	4,555 (31.3%)	13,606 (23.4%)	
Rural residence	628 (4.3%)	2,898 (5.0%)	0.03
Primary care physician visits in the past year			
Mean ± standard deviation	6.0 ± 8.9	3.3 ± 5.2	0.43
Median (IQR)	4 (1 to 7)	2 (0 to 4)	
Aggregated diagnostic groups			
Mean ± standard deviation	4.3 ± 3.1	2.7 ± 2.5	0.61
Median (IQR)	4 (2 to 6)	2 (1 to 4)	
Resource utilization band			
Non-users	856 (5.9%)	13,032 (22.4%)	1.12
Healthy users	204 (1.4%)	4,942 (8.5%)	
Low resource utilization	566 (3.9%)	13,778 (23.7%)	
Moderate resource utilization	8,809 (60.6%)	22,868 (39.3%)	
High resource utilization	2,869 (19.7%)	2,745 (4.7%)	
Very high resource utilization	1,230 (8.5%)	771 (1.3%)	
Diabetes	1,500 (10.3%)	6,206 (10.7%)	0.01
Hypertension	2,685 (18.5%)	12,863 (22.1%)	0.09
Chronic obstructive pulmonary disease	1,469 (10.1%)	3,624 (6.2%)	0.15
Asthma	1,945 (13.4%)	5,906 (10.2%)	0.10
Congestive heart failure	327 (2.2%)	677 (1.2%)	0.09

Table 2: Rates of emergency department visits and regression results for predictors of Emergency Department visits

Covariate	ED visits	Person-years	ED visits per 100 person-years (95% CI)		Adjusted rate ratios (95% CI)	
HIV status						
Non-HIV	17967	57672.8	31.2	(29.9, 32.5)	1.00	
HIV	9670	14370.0	67.3	(63.6, 71.2)	1.58	(1.51, 1.65)
Neighborhood income quintile						
5 (highest)	3987	13224.6	30.1	(28.3, 32.1)	1.00	
4	3933	12101.2	32.5	(30.7, 34.4)	1.06	(0.99, 1.13)
3	4978	12798.6	38.9	(36.3, 41.7)	1.21	(1.14, 1.29)
2	5977	15274.5	39.1	(36.9, 41.5)	1.23	(1.16, 1.31)
1 (lowest)	8484	18015.8	47.1	(43.5, 50.9)	1.35	(1.27, 1.43)
Rural residence						
Urban residence	25208	68225.9	36.9	(35.6, 38.3)	1.00	
Rural residence	2337	3504.2	66.7	(60.7, 73.3)	1.71	(1.61, 1.91)
Primary care visits (prior year)						
0 visits	4309	18544.3	23.2	(21.6, 25)	1.00	
1 to 2 visits	5762	19538.4	29.5	(27.7, 31.4)	1.27	(1.20, 1.34)
3 or more visits	17566	33960.1	51.7	(49.4, 54.1)	1.47	(1.40, 1.55)
Aggregated diagnosis groups (prior year)						
0 to 5	16263	60123.7	27.0	(26.0, 28.2)	1.00	
6 to 9	7416	9979.9	74.3	(69.9, 79.0)	2.29	(2.17, 2.41)
10 or more	3958	1939.2	204	(184.1, 226.3)	6.16	(5.60, 6.76)

Table 3: Visits for ambulatory care sensitive conditions (visits per 1000 person-years)

	Rate (95% confidence interval) of visits in persons with HIV	Rate (95% confidence interval) of visits in HIV-negative individuals	Rate ratio (95% confidence interval)
Epilepsy	3.55 (2.64 to 4.67)	1.08 (0.82 to 1.38)	3.30 (2.28 to 4)
Chronic obstructive pulmonary disease	6.05 (4.85 to 7.47)	1.86 (1.52 to 2.24)	3.26 (2.46 to 4.33)
Asthma	3.41 (2.52 to 4.51)	1.53 (1.22 to 1.88)	2.24 (1.57 to 3.17)
Heart failure	2.64 (1.87 to 3.63)	1.35 (1.07 to 1.69)	1.96 (1.33 to 2.88)
Diabetes	3.62 (2.70 to 4.75)	2.10 (1.74 to 2.51)	1.73 (1.25 to 2.39)
Dental	5.36 (4.23 to 6.70)	3.35 (2.89 to 3.85)	1.60 (1.23 to 2.09)
Angina	2.23 (1.52 to 3.14)	1.82 (1.49 to 2.20)	1.22 (0.82 to 1.82)
Gastroenteritis	1.39 (0.85 to 2.15)	0.26 (0.15 to 0.43)	5.35 (2.74 to 10.45)
Hypertension	1.39 (0.85 to 2.15)	1.72 (1.40 to 2.09)	0.81 (0.50 to 1.31)
Cellulitis	27.00 (24.38 to 29.83)	6.92 (6.26 to 7.63)	3.90 (3.39 to 4.49)
Ear nose and throat (including upper respiratory infection)	14.41 (12.51 to 16.51)	6.95 (6.29 to 7.67)	2.07 (1.75 to 2.45)

Table 4: Characteristics of emergency department visits by HIV status

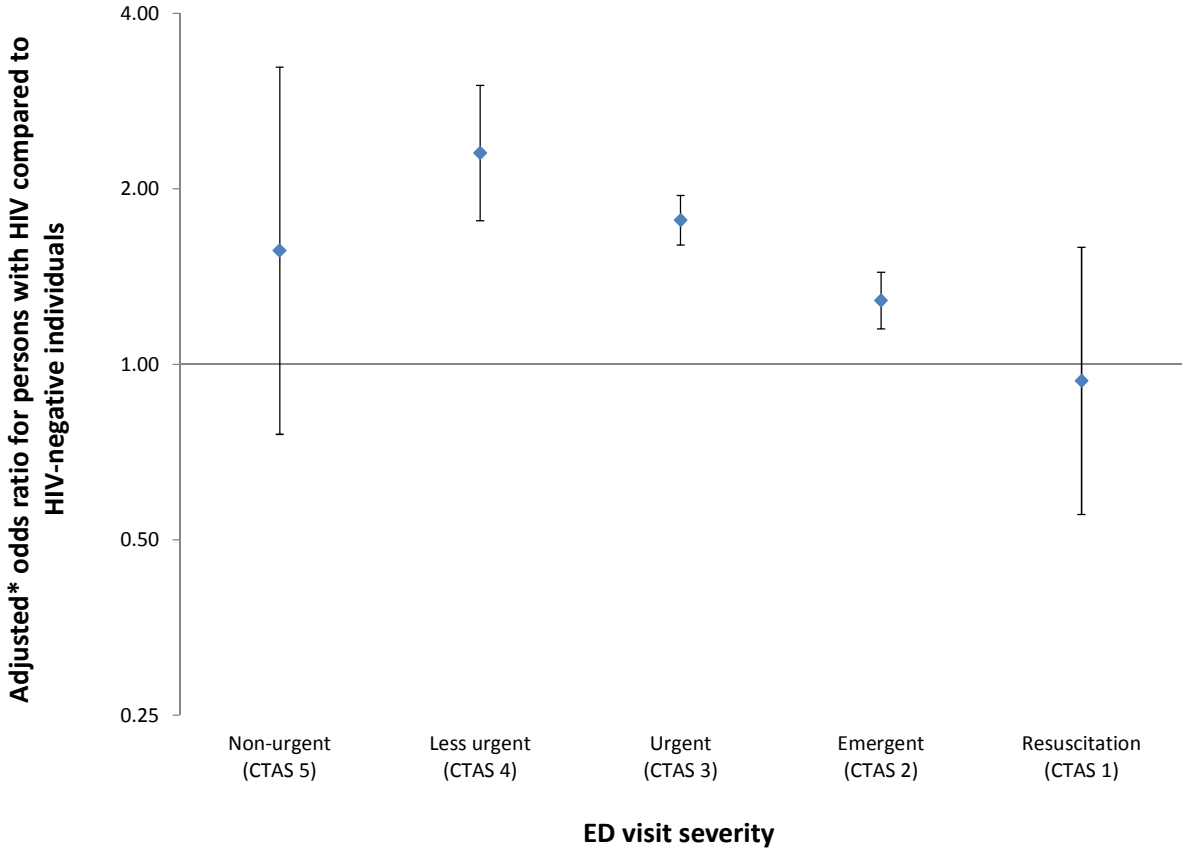
Covariate	HIV (n = 9,670)	Non-HIV (n = 38,670)	Standardized difference
Mean age ± SD (years)	45.62 ± 12.04	45.62 ± 12.03	0.01
18 to 25 years	279 (2.9%)	1,122 (2.9%)	
26 to 35 years	1,656 (17.1%)	6,762 (17.5%)	
36 to 45 years	3,034 (31.4%)	12,030 (31.1%)	
46 to 55 years	2,921 (30.2%)	11,758 (30.4%)	
>55 years	1,780 (18.4%)	6,998 (18.1%)	
Sex			
Female	2,260 (23.4%)	9,040 (23.4%)	0.00
Male	7,410 (76.6%)	29,630 (76.6%)	
Income quintile			
5 (highest)	1,222 (12.6%)	5,833 (15.2%)	0.28
4	1,126 (11.6%)	6,184 (16.1%)	
3	1,623 (16.8%)	6,832 (17.8%)	
2	1,918 (19.8%)	8,612 (22.5%)	
1 (lowest)	3,646 (37.7%)	10,860 (28.3%)	
Rural residence	657 (6.8%)	3,269 (8.5%)	0.08
Primary care physician visits in the past year			
Mean ± standard deviation	10.2 ± 13.7	6.3 ± 10.0	0.37
Visit severity			
Non-urgent	475 (4.9%)	1,851 (4.8%)	0.09
Less urgent	2,723 (28.2%)	12,430 (32.1%)	
Urgent	4,406 (45.6%)	16,816 (43.5%)	
Emergent	1,960 (20.3%)	7,235 (18.7%)	
Resuscitation	78 (0.8%)	250 (0.6%)	
Emergency room volume			
High volume	7,418 (76.7%)	29,950 (77.5%)	0.02
Low volume	479 (5.0%)	1,837 (4.8%)	
Medium volume	1,773 (18.3%)	6,883 (17.8%)	
Teaching hospital	5,206 (53.8%)	11,220 (29.0%)	0.54
Minutes in the ED			
Mean ± standard deviation	367.0 ± 498.7	271.0 ± 361.7	0.24

Table 5: Regression for hospitalization after emergency department presentation

Covariate	Hospital admissions	Visits	Percent (%) (95% CI)		Adjusted odds ratio (95% CI)	
HIV status						
Non-HIV	3703	38670	9.6	(9.3, 9.9)	1.00	
HIV	1513	9670	15.6	(14.9, 16.4)	1.55	(1.43, 1.69)
Income quintile						
5 (highest)	746	7055	10.6	(9.9, 11.3)	1.00	
4	728	7310	10.0	(9.3, 10.6)	0.96	(0.85, 1.08)
3	891	8455	10.5	(9.9, 11.2)	0.98	(0.87, 1.10)
2	1115	10530	10.6	(10.0, 11.2)	0.98	(0.88, 1.09)
1 (lowest)	1681	14506	11.6	(11.1, 12.1)	1.00	(0.90, 1.11)
Rural residency status						
Urban residence	4906	44352	11.1	(10.8, 11.4)	1.00	
Rural residence	306	3926	7.8	(7.0, 8.6)	1.13	(0.97, 1.32)
Aggregated diagnosis groups						
0 to 5	2717	30728	8.8	(8.5, 9.2)	1.00	
6 to 9	1523	11901	12.8	(12.2, 13.4)	1.31	(1.22, 1.41)
10 or more	976	5711	17.1	(16.1, 18.1)	1.69	(1.53, 1.87)
Canadian Triage and Acuity Scale						
Non-urgent	23	2326	1.0	(0.6, 1.4)	1.00	
Less urgent	260	15153	1.7	(1.5, 1.9)	1.84	(1.25, 2.70)
Urgent	2329	21222	11.0	(10.6, 11.4)	12.08	(8.31, 17.57)
Emergent	2396	9195	26.1	(25.2, 27.0)	34.38	(23.60, 50.09)
Resuscitation	199	328	60.7	(55.4, 66.0)	156.73	(101.34, 236.9)
Emergency department volume						
Low volume	175	2316	7.6	(6.5, 8.6)	1.00	
Medium volume	753	8656	8.7	(8.1, 9.3)	0.63	(0.52, 0.77)
High volume	4288	37368	11.5	(11.2, 11.8)	0.61	(0.50, 0.74)
Teaching hospital						
Nonteaching hospital	3112	31914	9.8	(9.4, 10.1)	1.00	
Teaching hospital	2104	16426	12.8	(12.3, 13.3)	1.12	(1.04, 1.20)

Figure Legend

Figure 1: Hospital admission following emergency department visit, stratified by visit acuity



*Adjusted for: socioeconomic status, urban versus rural residence, patient co-morbidity, emergency department volume and whether the emergency department was located within an academic teaching hospital

Supplemental Table 1: Reasons for emergency department visit (visits per 1000 person-years)

	Rate (95% confidence interval) in persons with HIV	Rate (95% confidence interval) in HIV-negative individuals	Rate ratio (95% confidence interval)
Infectious diseases	87.27 (82.50 to 92.23)	21.55 (20.37 to 22.78)	4.05 (3.74 to 4.38)
Injuries/trauma	86.01 (81.28 to 90.94)	59.47 (57.50 to 61.50)	1.45 (1.36 to 1.54)
Mental health illness	62.21 (58.20 to 66.43)	19.73 (18.60 to 20.91)	3.15 (2.89 to 3.44)
Respiratory	51.29 (47.65 to 55.13)	20.06 (18.92 to 21.25)	1.97 (1.66 to 2.33)
Musculoskeletal	42.10 (38.81 to 45.59)	26.11 (24.81 to 27.47)	1.61 (1.47 to 1.77)
Digestive, including oral cavity	41.34 (38.08 to 44.80)	20.32 (19.17 to 21.52)	2.03 (1.84 to 2.25)
Genitourinary/renal	20.39 (18.12 to 22.86)	10.80 (9.97 to 11.68)	1.89 (1.64 to 2.17)
Circulatory system	19.62 (17.40 to 22.05)	13.39 (12.46 to 14.36)	1.47 (1.28 to 1.68)
Neurologic	12.11 (10.38 to 14.05)	5.17 (4.60 to 5.79)	2.34 (1.94 to 2.83)

Supplementary Table 2: Regression results for predictors of emergency department (ED) visits, by visit acuity*

Covariate	High urgency ED visits						Low urgency ED visits					
	ED visits	Person-years	ED visits per 100 person-years (95% CI)		Adjusted rate ratios (95% CI)		ED visits	Person-years	ED visits per 100 person-years patients (95% CI)		Adjusted rate ratios (95% CI)	
HIV status												
Non-HIV	11465	57672.8	19.9	(19.1, 20.7)	1.00		6465	57672.8	11.2	(10.5, 11.9)	1.00	
HIV	6444	14370	44.8	(42.4, 47.5)	1.61	(1.53, 1.69)	3198	14370.0	22.3	(20.6, 24.0)	1.55	(1.45, 1.65)
Income quintile												
5 (highest)	2565	13224.6	19.4	(18.1, 20.7)	1.00		1409	13224.6	10.7	(9.8, 11.6)	1.00	
4	2464	12101.2	20.4	(19.1, 21.7)	1.03	(0.95, 1.11)	1461	12101.2	12.1	(11.1, 13.1)	1.12	(1.01, 1.23)
3	3178	12798.6	24.8	(23.1, 26.7)	1.19	(1.11, 1.28)	1793	12798.6	14.0	(12.7, 15.4)	1.26	(1.15, 1.38)
2	3853	15274.5	25.2	(23.7, 26.8)	1.22	(1.13, 1.31)	2111	15274.5	13.8	(12.7, 15.1)	1.27	(1.16, 1.39)
1 (lowest)	5679	18015.8	31.5	(29.1, 34.1)	1.38	(1.29, 1.48)	2783	18015.8	15.4	(14, 17.1)	1.31	(1.18, 1.43)
Rural residence												
Urban residence	16924	68225.9	24.8	(23.9, 25.8)	1.00		1377	3504.2	39.3	(34.6, 44.6)	1.00	
Rural residence	933	3504.15	26.6	(24.2, 29.3)	1.13	(1.01, 1.25)	40	312.8	12.8	(4.4, 37.0)	2.85	(2.54, 3.19)
Primary care visits (past year)												
0 visits	2604	18544.3	14.0	(13.0, 15.2)	1.00		1697	18544.3	9.2	(8.4, 10.0)	1.00	
1 to 2 visits	3595	19538.4	18.4	(17.2, 19.7)	1.30	(1.22, 1.39)	2149	19538.4	11.0	(10.1, 11.9)	1.22	(1.12, 1.32)
3 or more visits	11710	33960.1	34.5	(33.0, 36.0)	1.51	(1.42, 1.61)	5817	33960.1	17.1	(16.0, 18.3)	1.38	(1.28, 1.49)
Aggregated diagnosis groups												
0 to 5	9973	60123.7	16.6	(16.0, 17.2)	1.00		6246	60123.7	10.4	(9.8, 11.0)	1.00	
6 to 9	5145	9979.93	51.6	(48.5, 54.8)	2.54	(2.39, 2.69)	2257	9979.9	22.6	(20.6, 24.8)	1.84	(1.71, 1.99)
10 or more	2791	1939.23	144.0	(129.9, 159.4)	6.98	(6.30, 7.74)	1160	1939.2	59.8	(51.4, 69.6)	4.62	(4.06, 5.26)

*Categorized using Canadian Triage And Acuity Scale (CTAS); low urgency were visits triaged as CTAS 4 (less urgent) or CTAS 5 (non-urgent), whereas high urgency visits were visits triaged as CTAS 1 (resuscitation required), CTAS 2 (emergent care required) or CTAS 3 (urgent care required)