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Title

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Permalink

<https://escholarship.org/uc/item/8f99r7j0>

Journal

Academic Emergency Medicine: A Global Journal of Emergency Care, 30(9)

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Publication Date

2023-09-01

DOI

10.1111/acem.14738

Peer reviewed



Published in final edited form as:

Acad Emerg Med. 2023 September ; 30(9): 946–954. doi:10.1111/acem.14738.

Emergency Department Utilization, Admissions, and Revisits in the United States (New York), Canada (Ontario), and New Zealand: A Retrospective Cross-Sectional Analysis

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Abstract

Background: Emergency department (ED) utilization is a significant concern in many countries, but few population-based studies have compared ED use. Our objective was to compare ED utilization in New York (NY, United States), Ontario (Canada), and New Zealand (NZ).

Methods: A retrospective cross-sectional analysis of all ED visits between Jan 1, 2016, and September 30, 2017, for adults ≥ 18 years using data from the State Emergency Department and Inpatient Databases (New York), the National Ambulatory Care Reporting System and Discharge Abstract Data (Ontario), and the National Non-Admitted Patient Collection and the National Minimum Data Set (New Zealand). Outcomes included age- and sex-standardized per-capita ED

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Prior presentations: none

utilization (overall and stratified by neighborhood income), ED disposition, and ED revisit and hospitalization within 30-days of ED discharge.

Results: There were 10,998,371 ED visits in New York, 8,754,751 in Ontario, and 1,547,801 in New Zealand. Patients were older in Ontario (mean age 51.1 years) compared to New Zealand (50.3) and New York (48.7). Annual sex- and age-standardized per-capita ED utilization was higher in Ontario than New York or New Zealand (443.2 vs. 404.0 or 248.4 visits per-1,000 population/year, respectively). In all countries, ED utilization was highest for residents of the lowest income quintile neighborhoods. The proportion of ED visits resulting in hospitalization was higher in New Zealand (34.5%) compared to New York (20.8%) and Ontario (12.8%). Thirty-day ED revisits were higher in Ontario (27.0%) than New Zealand (18.6%) or New York (21.4%).

Interpretation: Patterns of ED utilization differed widely across three high-income countries. These differences highlight the varying approaches that our countries take with respect to urgent visits, suggest opportunities for shared learning through international comparisons, and raise important questions about optimal approaches for all countries.

Keywords

emergency department; utilization; international comparison

Introduction:

Emergency department (ED) utilization is a significant concern in many high-income countries.¹⁻⁷ Finite capacity and high demand can contribute to ED overcrowding, which is associated with delays in timely assessment of life-threatening conditions and poor patient outcomes and experience.^{3,6,7} Despite these concerns, there are few international population-based studies that have compared ED utilization across high-income countries.

The health systems of the United States (US), Canada and New Zealand (NZ) afford an interesting opportunity to compare ED utilization in three countries that share common values and strong political and economic ties, but vary substantially in how healthcare is financed and organized.^{8,9} Furthermore, these countries differ in health system performance in international rankings, with New Zealand typically ranked very favorably compared to the US and Canada.^{10,11} In Canada and New Zealand, the government provides health care and services to all residents funded primarily through tax revenue.^{12,13} Though out-of-pocket payments are required for primary care visits in New Zealand, neither Canada nor New Zealand have fees for ED visits. In contrast, the US lacks universal health insurance and visits to the ED, as well as primary care, include variable amounts of cost-sharing. The cost of health care varies widely in the US and medical debt is a common reason for bankruptcy.¹⁴

There is growing interest in international health system comparisons¹⁵ as a mechanism for understanding how differences in healthcare policy, funding, and delivery across countries affect population health.¹⁶ While several studies have compared utilization and outcomes across countries for hospital-based procedures^{17,18}, few studies have assessed differences in ED use across countries.⁵ Our objective was to use population-based administrative data to

compare ED visit rates among residents of the state of New York (NY, US), the province of Ontario (Canada), and New Zealand both for the total adult population and for key subgroups defined by age and socioeconomic status. We also compared ED disposition (discharge, hospitalization), ED revisits, and hospitalization rates after initial ED discharge.

Methods:

Study Design and Data Sources

We performed a retrospective cross-sectional study using administrative data from the state of New York, the province of Ontario, and New Zealand to identify all ED visits among adults aged 18-years or older between Jan 1, 2016, and September 30, 2017. We chose New York and Ontario to represent the US and Canada respectively because of extensive prior research comparing care in these two regions, their geographic proximity, and similarity with respect to large cities (New York City and Toronto) but also significant rural areas.^{17,19–22} We selected New Zealand because the country is consistently recognized for high performance in international rankings of health system performance.²³

We used New York's State Emergency Department Databases (SEDD)²⁴ and State Inpatient Databases (SID),²⁵ which were obtained from the US Agency for Healthcare Research and Quality. The SEDD includes patient-level information for all visits to EDs in New York that do not result in hospitalization and is complemented by the SID, which allows for identification of ED visits that result in hospitalization. Thus, in combination, the SEDD and SID identify all ED visits and resultant hospitalizations in New York state, exclusive of hospitals operated by the Veterans Administration and certain psychiatric hospitals. Key data elements for each ED visit include demographic characteristics (age, sex, race), zip code of residence, and ED disposition (e.g., discharged home, admitted, died and other). For each patient, we mapped their zip code of residence to 2016 US census data to obtain neighborhood income. We used a unique patient identifier in the SEDD and SID to create a longitudinal record to allow for identification of ED re-visits and hospital admissions within 7-days and 30-days of an initial ED visit.

Ontario, Canada data came from the National Ambulatory Care Reporting System (NACRS)²⁶ and Discharge Abstract Data (DAD).²⁷ These databases provide patient demographic and visit information that is analogous to the New York SEDD and SID for all ED visits and hospitalizations paid for by the Ontario Health Insurance Plan (OHIP). OHIP pays for hospital and physician health care for all legal residents of Ontario (>99% of the population); all hospitals and EDs in Ontario are publicly funded. Analogous methods were used to link data from the NACRS and DAD as well as neighborhood level income to 2016 Canadian census data.

Comparable data from New Zealand came from the National Non-Admitted Patient Collection (NNPAC)²⁸ which records all ED visits and the National Minimum Data Set (NMDS)²⁹ for hospitalizations. All EDs in New Zealand are publicly funded and included in the NMDS. Socioeconomic status for each patient was determined by linking address of residence to the New Zealand Index of Deprivation (NZDep2013)³⁰; NZDep2013 combines census data relating to income based on small geographical areas defined by Statistics NZ.³¹

Analytic cohort

We identified all ED visits among adults aged 18-years or older in New York state, Ontario, and New Zealand between Jan 1, 2016, and September 30, 2017. We excluded visits with missing age, sex, and valid income quintile, and those whose reported residence was outside of the region of study. Exclusions constituted 4.9% of total adult ED visits in Ontario, 3.3% in New York and 1.5% in New Zealand. Like our prior studies^{17–21}, analytic cohorts were created locally at ICES (Ontario), University Health Network (New York), and Auckland (New Zealand) because of local rules and regulations related to data sharing; summary files were then combined, and statistical testing (described below) was conducted using meta-analytic methods.

Statistical Analyses and Outcomes

Our primary analyses were descriptive in nature, reflecting our extremely large sample sizes and our objective of evaluating clinically (and policy) relevant differences. First, we compared demographic characteristics (age, sex, race for New York and New Zealand only as race is not collected in Ontario) for patients who visited the ED in each region. We compared socioeconomic status (SES) across quintiles, which we defined by neighborhood income as described above. We compared differences across countries using ANOVA for continuous measures and chi-square tests for categorical measures.

Second, we compared the annual per-capita rate of ED utilization (visits per 1,000 adult population per year) in New York, Ontario, and New Zealand after standardizing to the age and sex distribution of the Ontario population³² using fixed effects meta-analysis and Cochran's Q test for heterogeneity.³³ The numerator for these calculations was the total number of ED visits in each jurisdiction and the denominator was the number of adults age 18-years in each jurisdiction. We calculated ED utilization rates for sex, age, and neighborhood SES quintile subgroups using analogous methods with numerators and denominators accordingly. Because Statistics New Zealand only provides population level data in 5-year increments (e.g., 15–19, 20–24, etc.), the denominator for patients in New Zealand ages 18–19 was estimated using 2/5 of the 15–19-year age band.³⁰ Rates were annualized to account for the 21-month study period.

Third, we compared ED visit characteristics including ED length-of-stay (LOS, hours), ED disposition (discharged, hospitalized, died or other), ED revisits within 7 and 30 days of an initial ED discharge, and hospitalization within 7 days and 30 days of an initial ED discharge. The numerator for these calculations was the number of adults that re-presented to the ED or were admitted to hospital, and the denominator was adult visits for those age 18-years who were discharged home from their previous ED visit. ED LOS for patients discharged from the ED were compared across all three jurisdictions; ED LOS for hospitalized patients were compared between Ontario and New Zealand, as these data were not available for New York.

All analyses were conducted locally for each jurisdiction and were performed using either SAS (Cary, North Carolina) or R statistical software packages. This analysis was approved by the Research Ethics Board at University Health Network, Toronto and the Auckland

Regional Health Ethics Committee (AH22079) in New Zealand. Our study protocol was developed before initiation of any analyses and is available online through Open Science (https://osf.io/rvsgdt/?view_only=7ead84a8db044e2d88a46f2544b8094a).

Results:

Between January 1, 2016, and Sept 30, 2017, there were 10,998,371 ED visits in New York, 8,754,751 in Ontario, and 1,547,801 in New Zealand (Table 1). The mean age of adults visiting the ED was younger in New York (48.7 years) compared to Ontario or New Zealand (51.1 years and 50.3 years, respectively). Standardized ED visit rates for women were 18% higher than for men in New York, 11% higher in Ontario, and 3% higher in New Zealand (Table 2).

The overall age- and sex-standardized ED utilization rate was higher in Ontario (443.2 visits per-1,000 population/year) compared to New York (404.0) or New Zealand (248.4) (Table 2 and Figure 1). In stratified analyses, Ontario had the highest ED utilization and New Zealand had the lowest utilization across subgroups defined by patient sex and age and most SES quintiles (Table 2).

There was an inverse association between neighborhood SES quintile and ED utilization in all countries (higher income, lower ED utilization) (Table 2 and Figure 2). However, the relative magnitude of the difference in utilization between those in the lowest SES quintile and highest SES quintile was larger in New York and New Zealand (+220% and +232%) than Ontario (167%).

The country with the lowest ED utilization rate (New Zealand) had the highest percentage of ED visits resulting in hospitalization (34.5%), while the jurisdiction with the highest ED utilization rate (Ontario) had the lowest percentage of ED visits resulting in hospitalization (12.8%) (Table 3 and Figure 1). While Ontario had the highest percentage of ED visits discharged (83.2%), Ontario had higher 7-day and 30-day ED revisit rates (17.3% and 27.0%, respectively) than either New Zealand (12.0% and 18.6%) or New York (10.9% and 21.4%). Rates of hospitalization within 7-days and 30-days of a prior ED discharge were similar across jurisdictions (Table 3). ED LOS among patients discharged from the ED was significantly longer in New York than either Ontario or New Zealand, while ED LOS among patients who were subsequently admitted to hospital was significantly longer in Ontario than New Zealand (14.7 vs 4.7 hours).

Discussion:

In an analysis of population-level administrative data from the US (New York), Canada (Ontario), and New Zealand we found marked differences in patterns of per-capita ED utilization, hospitalizations, and re-visit rates. Canada had the highest ED utilization and the lowest percentage of ED visits resulting in hospital admission, but also the highest ED revisit rate. New Zealand had the lowest ED utilization rate as well as the highest percentage of ED visits admitted to the hospital. Residents of less affluent neighborhoods in all three countries had higher ED utilization than residents of more affluent neighborhoods. Our

results serve to highlight differences among countries' healthcare systems with respect to emergency care, and identifies opportunities for improvement and shared learning.

Several of our findings warrant discussion. First, it is important to comment on the higher overall ED utilization in Ontario compared to New York and New Zealand. In considering our analysis it is important to note that our findings differ from the only other US-Canada comparison of ED utilization that we are aware of; a 2003 study by Li et al. found ED visit rates to be similar in the US and Canada.⁴ This difference in results may be due to differences in the US data sources that were used (National Hospital and Ambulatory Medical Care Survey, versus New York SEDD and SID) or temporal changes between 2003 and 2016, such as passage of the US Affordable Care Act in 2010. In considering the higher ED utilization observed in Canada, it is worthwhile considering that Canadians have no out-of-pocket fees for ED visits, thus eliminating cost as a deterrent for ED visits or revisits. Simultaneously, this finding should be considered in the context of other system factors including access to primary care and urgent care.^{23, 34-36} In Canada, there is particular concern about access to primary care during off-hours periods, which encompasses nights, weekends, and holidays. In one international comparison of ED utilization, Van den berg et al. (2016) found that Canadians were more likely to cite limited access to primary care as a driving factor for ED use compared to New Zealanders.³⁴ Paradoxically, multiple studies have shown a reduction in ED visits based on proximity to an urgent care centers.³⁷⁻³⁹ Therefore, the high ED utilization we observed in Ontario may reflect patients' inability to obtain timely care from primary care or other urgent care centers.

Our finding of comparatively low ED utilization in New Zealand in association with a greater proportion of ED visits resulting in hospitalization also warrants discussion. Since 1941 New Zealand's healthcare system has had a deliberate strategy of investment in primary care;⁴⁰ in more recent years the country has developed a system of new urgent care centers and an urgent care medicine sub-specialty.⁴¹ These government policies and investments support programs with resources to adequately manage low acuity urgent medical conditions such as burns, fractures, dental injuries, concussions, and injuries in the community instead of the ED or hospital.^{42,43} As a result, an estimated 2.5 million lower acuity, urgent medical conditions are managed in the community annually instead of the ED.⁴¹ Thus, our finding of low ED utilization with a high proportion of ED visits requiring admission in New Zealand may reflect a system that explicitly devotes resources and support to provide acute care in alternative locations outside of the ED; as a consequence, patients who do present to New Zealand EDs are more likely to require admission relative to our other countries.

The intermediate ED utilization rate observed in the US likely reflects a confluence of factors. For example, most patients presenting to the ED face higher out-of-pocket costs than if they were to visit primary care, thus providing a financial incentive not to seek care in the ED. Moreover, the US has a robust network of free-standing urgent care centers that can serve as an alternative to the hospital based EDs included in our study. At the same time, the lack of universal health insurance in the US limits access for many Americans, thus driving many uninsured and underinsured patients to the ED. In combination, these factors likely contribute to the US having higher ED utilization than New Zealand but lower than Ontario.

Second, our finding that residents of lower income neighborhoods in all countries had higher ED utilization than residents of higher income neighborhoods, suggests that problems of poverty and disadvantage are ubiquitous, even in countries with universal health insurance. This is consistent with previous analyses, including a recent JAMA paper by Drs. Landon, Cram and colleagues.⁴⁴⁻⁵¹ The magnitude of the SES “gap” (higher ED utilization for residents of lowest SES neighborhoods relative to the highest SES neighborhoods) was larger in both the US (+220%) and New Zealand (232%) relative to Canada (167%) and this begets questions of potential explanations for this difference. While the magnitude of the SES utilization difference between residents in the lowest and highest SES neighborhoods was higher in the US and New Zealand compared to Canada, focusing on the two lowest SES groups (Q1 and Q2) offers a different perspective. In particular, the difference in ED utilization between Q1 and Q2 was larger (+39%) in the US than Ontario (23%) or New Zealand (27%); this finding suggests that, perhaps the real “care gap” in the US is for those patients in the lowest SES quintile.

Third, it is important to consider between-country differences in patient disposition after an initial ED visit as well as ED revisit rates. Ontario had the lowest percentage of ED visits resulting in hospitalization (12.8%) but the highest 7-day and 30-day ED revisit rates (17.3% and 27.0%); this pattern is concerning and provides insights into the design and function of the Canadian healthcare system. High revisit rates may suggest that a patient’s primary complaint was not successfully addressed during the initial ED visit. Alternatively, this may also be reflective of an inability for patients to access timely follow-up care with either primary care or specialists; such an explanation is supported by a large body of prior Canadian studies suggesting access is a problem.^{23,52,53} It is also important to consider that, in the context of Ontario’s extremely limited acute-care bed capacity,⁵⁴ the low percentage of ED visits resulting in admission may reflect a proclivity for discharging a subset of patients who might benefit from hospitalization. This is in contrast to New Zealand where the percentage of ED visits requiring hospitalization was high (34.5%), but ED revisit rates were low (18.6%).

Finally, the large between-country differences in patterns of ED utilization, disposition, and revisits inevitably begs the question of whether any system is best. A common adage in healthcare quality is that “every system is designed to achieve the results it achieves”.⁵⁵ Through this lens, patients visit EDs in the Ontario (Canadian) system frequently, but are seldom admitted and often need to return for revisits; this may reflect the inability of patients to access timely primary and speciality care. While this system could be viewed as suboptimal by patients and ED staff, it is likely less expensive than making major investments in urgent care sites and required staffing. Alternatively, patients in New Zealand visit EDs less frequently, are far more likely to require hospitalization, but typically do not return for revisits. The New Zealand system is appealing in its efficiency but required decades of investment and iterative improvement.

Our analyses are subject to several limitations. First, we compared a single Canadian province and US state so our findings should be generalized with care. Relative to other states, New York has similar utilization and thus an appropriate selection for our analysis.⁵⁶ There is wide variation in ED utilization among US states,⁵⁷ and thus our findings should

be interpreted with caution. Conversely, Ontario and New York are large both in terms of size and population and there is no obvious reason why our findings are not broadly generalizable. Second, our use of administrative data prevents us from comparing the clinical acuity across our three countries, limiting conclusions that can be drawn regarding ED disposition. Third, we were unable to evaluate outpatient visits or deaths that occurred after ED discharge. Fourth, our study period ends in 2017, though there is no clear reason why our findings would differ substantially if we were to use more contemporary data. Fifth, our reliance upon aggregated population estimates from the New Zealand census may have added a measure of imprecision into our results, though the likely impact on our overall findings would be small. Sixth, our analysis did not account for clustering of visits within patients, however this is unlikely to have major impact on our results given the large sample sizes in all countries.

To summarize, patterns of ED utilization differed widely across three high-income countries. In aggregate our study highlights how international comparisons in ED care can uncover opportunities for shared learning and improvement.

Funding sources and acknowledgements:

This work is supported by a grant from the US National Institute of Aging (R01AG058878) to Drs. Cram and Landon. Dr. McNaughton is supported by the Sunnybrook Research Institute, the Practice Plan of the Department of Emergency Services at Sunnybrook Health Sciences Centre, and the University of Toronto. These funding sources had no role in the study design; in the collection, analysis, and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. Drs. Duffy, Hsia, Landon and Jones have no conflicts to declare. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. This study was supported by ICES, which is funded by an annual grant from the Ontario Ministry of Health (MOH) and the Ministry of Long-Term Care (MLTC). ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement. Ontario datasets were linked using unique encoded identifiers and analyzed at ICES. Parts of this material are based on data and information compiled and provided by the Canadian Institute for Health Information (CIHI). The analyses, conclusions, opinions and statements expressed herein are solely those of the authors and do not reflect those of the funding or data sources; no endorsement is intended or should be inferred.

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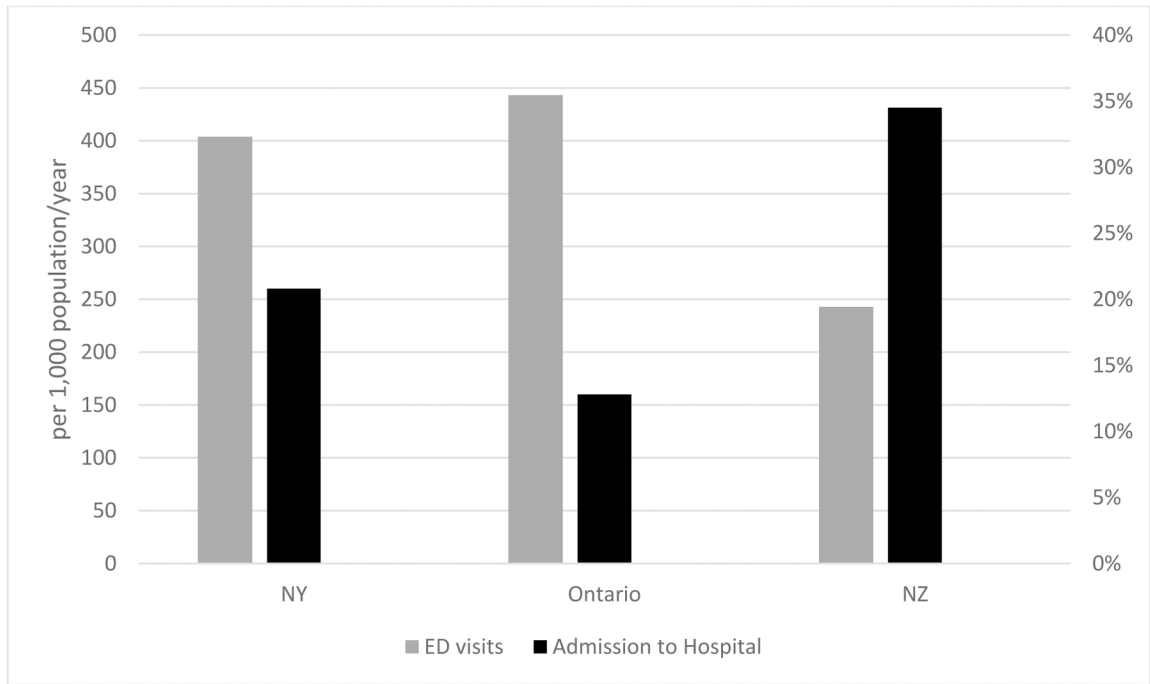


Figure 1: Standardized ED visit rates (visits per 1000 adult population per year) and percentage of ED visits admitted to hospital in New York (United States), Ontario (Canada) and New Zealand

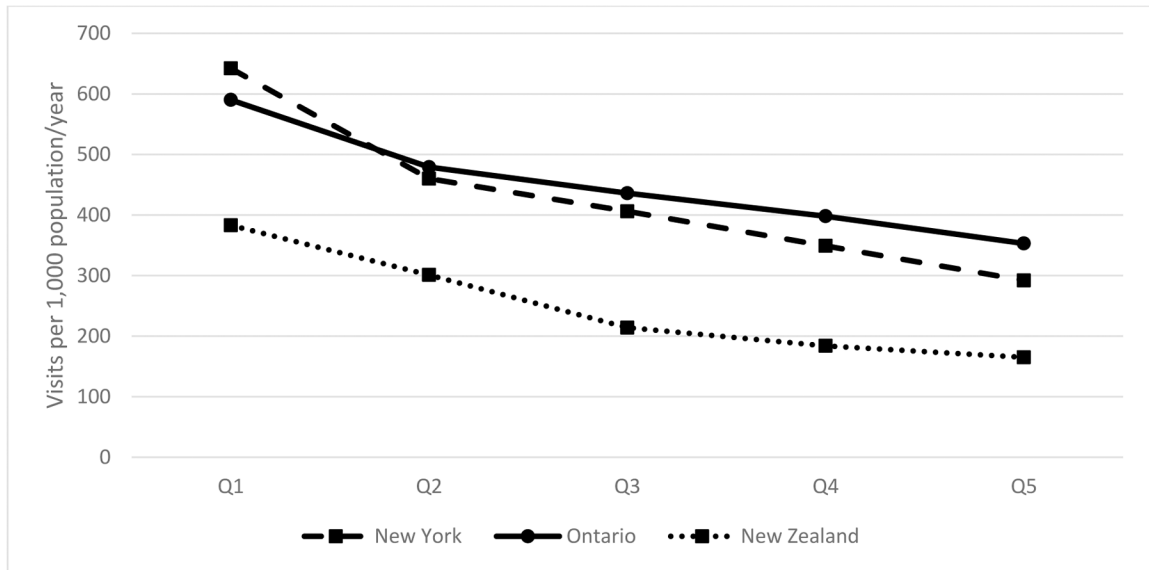


Figure 2:
 Age and sex standardized ED utilization rates (visits per 1,000 adults per year) by neighborhood income quintile (Q1= lowest income; Q5= highest income) in New York, Ontario and New Zealand

Table 1:

Sociodemographic characteristics of adults age ≥ 18 years visiting the emergency department in New York (United States), Ontario (Canada), and New Zealand (NZ) in January 1, 2016- September 30, 2017

	New York	Ontario	New Zealand
	N= 10,998,371	(N=8754751)	(N=1,547,801)
Age, mean (SD)	48.7 ± 20.4	51.1 ± 20.7	50.3 ± 21.7
Age strata, N (%)			
18–44	5,068,857 (46.1%)	3,595,839 (41.1%)	676331 (43.7%)
45–54	1,714,986 (15.6%)	1,332,990 (15.2%)	209385 (13.5%)
55–64	1,586,648 (14.4%)	1,326,721 (15.2%)	202152 (13.1%)
65–74	1,139,635 (10.4%)	1,085,809 (12.4%)	189774 (12.3%)
75–84	862,971 (7.8%)	866,731 (9.9%)	167673 (10.8%)
85	625,274 (5.7%)	546,661 (6.2%)	102486 (6.6%)
Female, N (%)	6,195,724 (56.3%)	4,715,846 (53.9%)	801296 (51.8%)
Race/Ethnicity, N (%)			
White	5,091,907 (46.3%)	NA	1000605 (64.6%)
Black	2,523,971 (22.9%)	NA	5880 (0.4%)
Indigenous (Native American/M ori)	30,788 (0.3%)	NA	280272 (18.1%)
Other	3,351,705 (30.5%)	NA	223737 (14.5%)
Neighborhood income quintile**			
Q1, N (%)	3,750,834 (34.1%)	2,277,886 (26.0%)	462,749 (29.9%)
Q2, N (%)	1,893,595 (17.2%)	1,869,382 (21.4%)	387,242 (25%)
Q3, N (%)	1,762,175 (16.0%)	1,701,412 (19.4%)	272,977 (17.6%)
Q4, N (%)	1,809,700 (16.5%)	1,525,689 (17.4%)	231,684 (15%)
Q5, N (%)	1,782,067 (16.2%)	1,380,382 (15.8%)	193,149 (12.5%)

* Statistics NZ only provide data in 5-year age bands. This is based on a population >18 estimate based on 2/5 of 15–19 year age band added to all >20

** Quintile 1= poorest, 5= richest

All between-country differences were statistically significant (p-values were <0.001). Statistical testing involved use of ANOVA for continuous measures and chi-square statistic for categorical measures.

Table 2:

Annualized age- and sex-standardized ED visits in New York (United States), Ontario (Canada) and New Zealand for overall adult population and key subgroups (visits per 1,000 adult population per-year)

	New York N=10,998,371	Ontario N=8,754,751	NZ N=1,547,801
Overall ED visits per 1000 adult population/year	404.0	443.2	248.4
Sex			
Men	370.7	420.5	244.9
Women	435.5	464.7	251.8
Age			
18–44	399.1	403.8	226.4
45–54	362.0	374.7	185.6
55–64	353.4	403.9	208.4
65–74	380.4	482.1	270.7
75–84	560.0	713.0	456.2
85	815.8	1013.5	707.8
Neighborhood income quintile¹			
Q1	642.5	589.5	382.7
Q2	460.8	479.2	300.8
Q3	406.3	436.0	213.6
Q4	348.9	397.8	183.8
Q5	292.2	352.5	165.3

* Q1= lowest income quintile, Q5= highest income quintile

All between-country differences statistically significant (p-values were <0.001). Statistical testing involved calculation of standard errors using the method of Chiang and subsequent Q-test for heterogeneity.

Table 3:

Outcomes following ED visits in New York (United States), Ontario (Canada), and New Zealand

	New York	Ontario	New Zealand
	(N=10998371)	(N=8754751)	(N=1547801)
Disposition			
Hospitalized	2,290,651 (20.8%)	1,116,806 (12.8%)	534,292 (34.5%)
Discharge home	8,394,841 (76.3%)	7,287,193 (83.2%)	952,391 (61.5%)
Died	17,367 (0.2%)	8,528 (0.1%)	1,393 (0.1%)
Other	295,512 (2.7%)	342,224 (3.9%)	59,725 (3.9%)
ED revisit within 7-days	959,435 (10.9%)	1,320,456 (17.3%)	121,386/1,012,116 (12.0%)
ED revisit within 30-days	1,883,837 (21.4%)	2,058,826 (27.0%)	187,942/1,012,116 (18.6%)
Hospitalization within 7-days	84,983 (1.0%)	189,572 (2.5%)	32,005/1,012,116 (3.2%)
Hospitalization within 30-days	129,992 (1.5%)	377859 (5.0%)	48,821/1,012,116 (4.8%)
ED length of stay (h)			
Discharged	5.70 (7.94)	3.37 (3.1)	3.2 (6.24)
Hospitalized	NA	14.71 (13.9)	4.7 (5.26)

All between-country differences were statistically significant (p-values were <0.001). Statistical testing involved use of ANOVA for continuous measures and chi-square statistic for categorical measures.