Mortality among patients with frequent emergency department use for alcohol-related reasons in Ontario: a population-based cohort study

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ABSTRACT

BACKGROUND: Little is known about the risk of death among people who visit emergency departments frequently for alcohol-related reasons, including whether mortality risk increases with increasing frequency of visits. Our primary objective was to describe the sociodemographic and clinical characteristics of this high-risk population and examine their 1-year overall mortality, premature mortality and cause of death as a function of emergency department visit frequency in Ontario, Canada.

METHODS: We conducted a population-based retrospective cohort study using linked health administrative data (Jan. 1, 2010, to Dec. 31, 2016) in Ontario for people aged 16–105 years who made at least 2 emergency depart-

ment visits for mental or behavioural disorders due to alcohol within 1 year. We subdivided the cohort based on visit frequency (2, 3 or 4, or ≥ 5). The primary outcome was 1-year mortality, adjusted for age, sex, income, rural residence and presence of comorbidities. We examined premature mortality using years of potential life lost (YPLL).

RESULTS: Of the 25 813 people included in the cohort, 17 020 (65.9%) had 2 emergency department visits within 1 year, 5704 (22.1%) had 3 or 4 visits, and 3089 (12.0%) had 5 or more visits. Males, people aged 45–64 years, and those living in urban centres and lower-income neighbourhoods were more likely to have 3 or 4 visits, or 5 or more visits. The all-cause 1-year mortality rate was 5.4%

overall, ranging from 4.7% among patients with 2 visits to 8.8% among those with 5 or more visits. Death due to external causes (e.g., suicide, accidents) was most common. The adjusted mortality rate was 38% higher for patients with 5 or more visits than for those with 2 visits (adjusted hazard ratio 1.38, 95% confidence interval 1.19–1.59). Among 25 298 people aged 16–74 years, this represented 30 607 YPLL.

INTERPRETATION: We observed a high mortality rate among relatively young, mostly urban, lower-income people with frequent emergency department visits for alcohol-related reasons. These visits are opportunities for intervention in a high-risk population to reduce a substantial mortality burden.

Alcohol is a leading driver of morbidity and mortality worldwide.[1] An estimated 3 million deaths in 2016 — 5% of all global deaths — were attributable to alcohol consumption.[2] The 2016 Global Burden of Disease Study showed that alcohol was the single greatest risk factor for ill health worldwide among people aged 15–49 years.[3] In Canada, hospital admissions for alcohol-attributable conditions outnumber those for myocardial infarction.[4] Alcohol-related harms cost Canadians about $14.6 billion annually, with $3.3 billion in health care costs.[5]

In addition to the societal impact of mental and behavioural disorders due to alcohol (henceforth referred to as alcohol-related) — mainly acute intoxication and withdrawal — these disorders are common reasons for emergency department visits.[6,7] Data from the United States and Canada, furthermore, suggest that alcohol-related emergency department visits have increased in recent years.[8,9] For example, a study in Ontario showed that, between 2003 and 2016, the age-standardized rates of alcohol-attributable emergency department visits increased by 86.5% in women and 53.2% in men.[8] People who

visit emergency departments frequently for alcohol-related reasons have high levels of comorbidity and social disadvantage,[10,11] and represent a readily identifiable patient population for whom interventions to address unmet social and health care needs could be developed.[12–14] A systematic review suggested that screening and brief intervention for alcohol-related problems in the emergency department is a promising approach for reducing problematic alcohol consumption.[13]

Despite this, little is known about the risk of death, a key outcome for health system performance, among people who use emergency departments frequently for alcohol-related reasons, including whether mortality risk increases with increasing frequency of visits. To address this gap, our primary objective was to describe the sociodemographic and clinical characteristics of this high-risk population and examine their 1-year overall mortality, premature mortality and cause of death as a function of emergency department visit frequency in Ontario, the most populous Canadian province.[15]

Methods

Study design and setting
We conducted a retrospective population-based cohort study of all residents aged 16–105 years in Ontario (population 13.5 million in 2016[15]) who made frequent emergency department visits for alcohol-related reasons between Jan. 1, 2010, and Dec. 31, 2016.

Data sources
We used the Registered Persons Database, the central population registry that enables linkage across health administrative data sets, to identify all residents covered under Ontario's publicly funded health insurance and to ascertain sociodemographic characteristics. We obtained information on emergency department use from the National Ambulatory Care Reporting System, and on hospital admissions from the Canadian Institute for Health Information Discharge Abstract Database and the Ontario Mental Health Reporting System, which contains information on all designated psychiatric beds in Ontario. We also used the Office of the Registrar General Deaths data set to ascertain cause of death. These data sets were linked by means of unique encoded identifiers and analyzed at ICES, an independent, non-profit research institute.

Study population
In the absence of validation studies for ascertaining a cohort of frequent users of the emergency department for alcohol-related reasons, we relied on previous work examining a broader set of alcohol-attributable conditions.[4,8] To generate a sample of people who presented for alcohol use disorder issues (and not medical complications of chronic alcohol use), which could inform the development of interventions, we used a subset of alcohol-attributable diagnostic codes, selecting code F10 (alcohol-related mental and behavioural disorders) of the enhanced Canadian version of the *International Classification of Diseases and Related Health Problems, 10th Revision* (ICD-10-CA) as the main reason for the emergency department visit. We defined

frequent users as having had at least 2 unscheduled emergency department visits with ICD-10-CA code F10 within a 1-year time frame. A 2010 review showed that definitions of frequent emergency department use can vary from 2 to 12 visits per year.[16] We used the minimum threshold to yield a higher-sensitivity sample that reflected our population of interest.

To generate the cohort, we first identified emergency department visits, then identified the unique patients attached to those visits. Of all unscheduled alcohol-related visits within the study period, we restricted potential index events to those that were preceded by at least 1 additional visit within a 365-day time frame to establish a minimum annual visit frequency. Visits during which the patient died were excluded. Since multiple index visits per person were possible, we randomly selected a visit for each person represented within the frequent emergency department visit sample to arrive at a cohort of unique patients. We then classified this cohort into 3 groups based on the total frequency of alcohol-related visits in a 1-year look-back from index: 2 visits (i.e., minimum cohort-entry criterion), 3–4 visits, and 5 or more visits.

Outcomes
The primary outcome was all-cause mortality 1 year following the index alcohol-related emergency department visit. We report crude and age- and sex-standardized rates (standardized to the 2006 Ontario population by means of the direct method).[17] Given recent evidence of increasing alcohol-related emergency department use among young adults,[8] we further examined premature mortality by calculating years of potential life lost (YPLL), an estimate of the average years a person would have lived if he or she had not died prematurely.[18,19] The numerator was the sum of all YPLL, which, for each age group, was calculated as the difference between 75 years and the median age at death, multiplied by the number of deaths.[18] The denominator comprised people aged 16–74 years.[19] We then similarly standardized the resulting YPLL rates to enable group comparisons.

We further examined the frequency of causes of death in the cohort using the ICD-10-CA classification system. To comply with our institution's privacy requirements, we present the following ICD-10-CA categories with frequency greater than 5%: mental and behavioural disorders, diseases of the circulatory system, diseases of the digestive system, and external causes of morbidity and mortality (e.g., accidents, including accidental poisoning, accidental injuries, injuries, intentional self-harm, assault). In addition, we examined cause of death using alcohol-attributable ICD-10-CA codes (Appendix 1, Supplemental Table S2, available at www.cmaj.ca/lookup/doi/10.1503/cmaj.191730/tab-related-content),[8] as well as ICD-10-CA codes for death by suicide.[20]

Covariates
To describe the cohort, we captured age, sex, area-based income quintiles, and urban or rural residence using census information. Given the Ontario legal drinking age (19 yr), we examined ages 16–18 years separately. We ascertained neighbourhood income using individual postal codes at the level of

dissemination area, the smallest available census geographic unit. We determined whether patients arrived at the emergency department by ambulance at the index visit as a measure of severity. We defined level of acuity as high (triage level I [resuscitation], II [emergent] or III [urgent]) or low (triage level IV [less urgent] or V [nonurgent]) using the Canadian Triage and Acuity Scale.[21] In-hospital length of stay was captured if the patient was admitted. We documented the presence of medical and psychosocial comorbidities using the Johns Hopkins Adjusted Clinical Groups System Version 10.0,[22] whereby patients were assigned up to 32 Aggregated Diagnosis Groups characterizing medical conditions based on their use of health care services in the preceding year.

Statistical analysis

To compare sociodemographic characteristics across the study groups at the time of the index emergency department visit, we report the largest pairwise standardized difference. To examine mortality at 1-year follow-up, we calculated crude and age- and sex-standardized rates, generated Kaplan–Meier survival curves, and used a multivariable Cox proportional hazards model adjusted for age, sex, income, rural residence, acuity and presence of comorbidities using a weighted score. The inclusion of comorbidities as a weighted score has been validated to have predictive value for mortality and illness burden.[22] We adjusted for comorbidities to address the potential confounding of frequent emergency department use and death. We also examined total YPLL, as well as crude and age- and sex-standardized rates of YPLL across the study groups. Last, we calculated the frequency of causes of death across the study groups. To minimize the risk of reidentifying patients owing to small cell counts, we present the 5 most frequent causes of death, comparing groups with the χ^2 test. We conducted statistical analyses using SAS software version 9.4 (SAS Institute).

Given that problematic alcohol use can also present as medical complications, we conducted a sensitivity analysis examining a more sensitive case definition using a set of ICD-10-CA codes from the Canadian Institute for Health Information indicator "hospitalizations entirely caused by alcohol" as the primary reason for the emergency department visit.[4,8] We generated a second cohort using the same methods but included all alcohol-attributable conditions (Appendix 1, Supplemental Table S2),[8] and repeated all analyses described above.

Ethics approval

The use of data in this project was authorized under Section 45 of Ontario's *Personal Health Information Protection Act*, which does not require review by a research ethics board.

Results

We identified 337 776 unscheduled emergency department visits for alcohol-related mental and behavioural disorders between Jan. 1, 2009, and Dec. 31, 2016. As per our definition of frequent emergency department use, we excluded 177 606 visits that were not preceded by another visit within a 365-day look-back

(Figure 1). We further excluded 1402 visits because of data inconsistencies, non-Ontario residency, age younger than 16 or older than 105 years, or death in the emergency department. We also excluded 14 273 visits before Jan. 1, 2010, which were used only to fulfill our frequency criterion for potential index visits during the study period. Of the remaining 144 495 index emergency department visits, we selected 1 at random for each patient, which resulted in a cohort of 25 813 unique patients, of whom 17 020 (65.9%) had 2 visits within a 1-year look-back, 5704 (22.1%) had 3 or 4 visits, and 3089 (12.0%) had 5 or more visits within 1 year. For frequency of diagnoses occurring at index, see Appendix 1, Supplemental Table S1.

Patients with 5 or more alcohol-related visits were more likely than those with fewer visits to be male (2208 [71.5%]), be aged 45–64 (1435 [46.5%]), live in urban centres (2768 [89.6%]), live in the lowest-income neighbourhoods (1239 [40.1%]) and have arrived at the emergency department by ambulance (2071 [67.0%]) (Table 1). About 1 in 10 patients in this highest-frequency group were admitted to hospital during their index visit, most often with a stay of 1–3 days. Triage acuity did not differ among the frequency groups, and patients with 5 or more visits were less likely than those in lower-frequency groups to have been admitted during their index emergency department visit. The number of medical and psychosocial comorbidities increased significantly with increasing number of emergency department visits.

One-year mortality

Overall, 1406 deaths (5.4%) were observed within 1 year of the index emergency department visit (Table 2). The 1-year mortality rate among patients with 5 or more alcohol-related visits was about double that among patients with 2 visits (8.8% v. 4.7%). Cox proportional hazards models similarly showed a severity gradient by frequency of emergency department use: compared to patients with 2 visits, patients with 3 or 4 visits and those with 5 or more visits were 7% (adjusted hazard ratio [HR] 1.07, 95% confidence interval [CI] 0.94–1.21) and 38% (adjusted HR 1.38, 95% CI 1.19–1.59) more likely to die within 1 year, respectively, after adjustment for sociodemographic factors and comorbidities (Figure 2). Among patients aged 16–74 years (*n* = 25 298), there were 30 607 YPLL; the age- and sex-adjusted rate was 116.3 (95% CI 114.8–117.7) YPLL per 100 patients (Table 2).

Causes of death

External causes of morbidity and mortality accounted for the highest number of deaths in the cohort within 1 year after the index visit (424 [30.2%]), followed by diseases of the digestive system (221 [15.7%]) (Table 3). One hundred people (7.1%) died by suicide; this represented 23.6% of external causes of death. Alcohol-attributable codes[19] accounted for 482 (34.3%) of all causes of death, with the most frequent conditions being alcohol dependence syndrome, cirrhosis of the liver and accidental poisoning due to alcohol. External causes of death (e.g., accidental poisoning [ICD-10-CA code X45]), were more common in higher-frequency groups (*p* = 0.04), whereas other conditions showed no significant dose response.
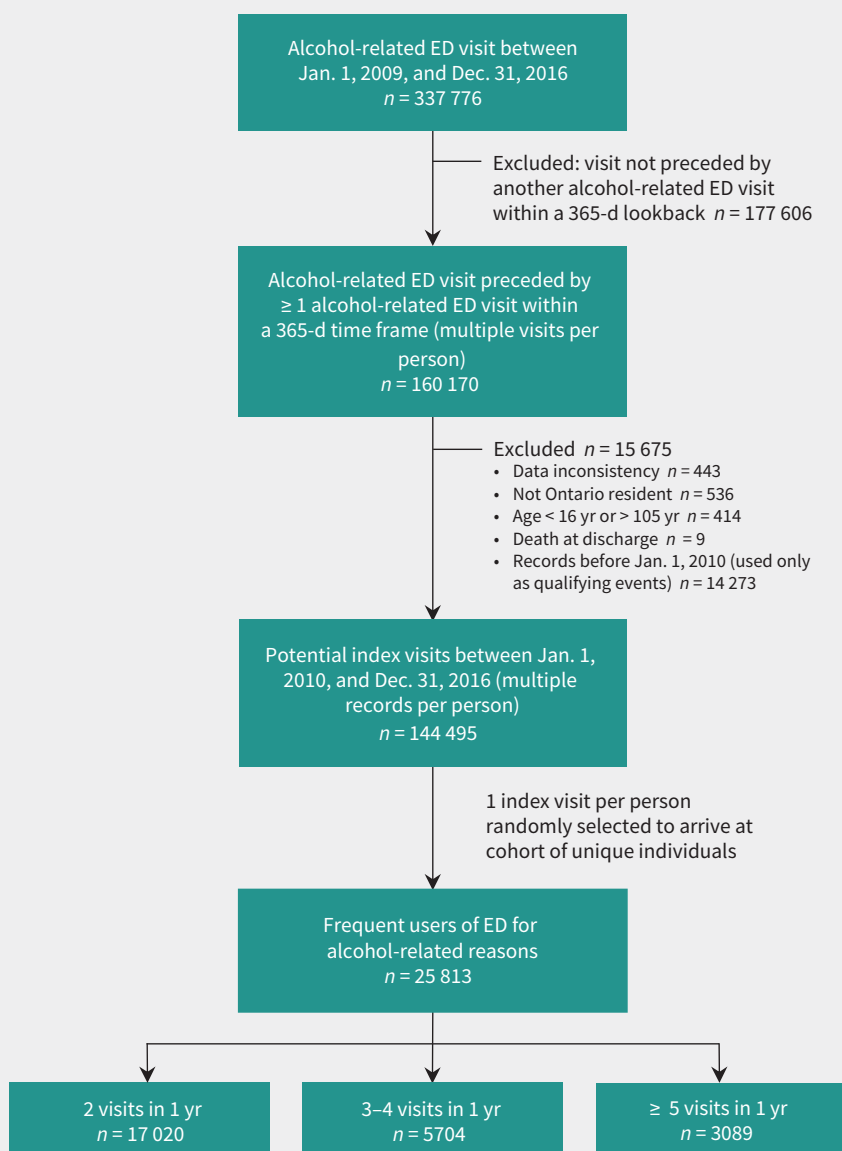
Figure 1: Flow diagram showing cohort creation. For frequency of diagnoses occurring at index, see Appendix 1, Supplemental Table S1. Note: ED = emergency department.

Sensitivity analysis

Including a broader set of alcohol-attributable conditions resulted in a cohort of 28 237 patients (18 878 [66.9%] with 2 visits, 6173 [21.9%] with 3 or 4 visits, and 3186 [11.3%] with ≥ 5 visits). The most common diagnoses at index remained acute alcohol intoxication, harmful use, dependence and withdrawal (Appendix 1, Supplemental Table S2). Sociodemographic characteristics and clinical presentation at index were similar to those

of the F10-specific cohort, except that a larger proportion of patients were admitted to hospital at the index visit (17% v. 13%) (Table 4). The 1-year mortality rate was higher in the sensitive cohort than in the specific cohort (7.4% v. 5.4%), but mortality similarly increased with more frequent emergency department use in the sensitive cohort. Last, in contrast to the specific cohort, diseases of the digestive system accounted for a larger proportion of deaths in the sensitive cohort than external causes

Table 1: Sociodemographic and clinical characteristics of patients with 2 or more emergency department visits within 1 year for alcohol-related reasons between Jan. 1, 2010, and Dec. 31, 2016

Characteristic	No. of ED visits; no. (%) of patients*				
	Overall n = 25 813	2 n = 17 020	3–4 n = 5704	≥ 5 n = 3089	Standardized difference†
Sex					
Female	8224 (31.9)	5548 (32.6)	1795 (31.5)	881 (28.5)	0.09‡
Male	17 589 (68.1)	11 472 (67.4)	3909 (68.5)	2208 (71.5)	0.09‡
Age at index ED visit, yr					
Mean ± SD	43.66 ± 15.42	43.00 ± 16.12	45.05 ± 14.26	44.79 ± 13.12	0.12‡
Median (IQR)	45 (31–55)	44 (29–55)	46 (34–55)	45 (34–54)	0.14§
16–18	873 (3.4)	754 (4.4)	103 (1.8)	16 (0.5)	0.25‡
19–24	2758 (10.7)	2181 (12.8)	410 (7.2)	167 (5.4)	0.26‡
25–44	9152 (35.5)	5760 (33.8)	2117 (37.1)	1275 (41.3)	0.15‡
45–64	10 752 (41.6)	6723 (39.5)	2594 (45.5)	1435 (46.5)	0.14‡
65–105	2278 (8.8)	1602 (9.4)	480 (8.4)	196 (6.3)	0.11‡
Rural status					
Urban	22 590 (87.5)	14 831 (87.1)	4991 (87.5)	2768 (89.6)	0.08‡
Rural	3223 (12.5)	2189 (12.9)	713 (12.5)	321 (10.4)	0.08‡
Neighbourhood income quintile					
Q1 (lowest)	9233 (35.8)	5880 (34.5)	2114 (37.1)	1239 (40.1)	0.12‡
Q2	5384 (20.9)	3553 (20.9)	1208 (21.2)	623 (20.2)	0.02¶
Q3	4173 (16.2)	2792 (16.4)	879 (15.4)	502 (16.3)	0.03§
Q4	3506 (13.6)	2415 (14.2)	761 (13.3)	330 (10.7)	0.11‡
Q5 (highest)	3234 (12.5)	2226 (13.1)	676 (11.9)	332 (10.7)	0.07‡
Missing	283 (1.1)	154 (0.9)	66 (1.2)	63 (2.0)	0.09‡
No. of Johns Hopkins ADG comorbidities					
Mean ± SD	6.18 ± 3.59	5.57 ± 3.41	6.79 ± 3.49	8.44 ± 3.67	0.81‡
Median (IQR)	6 (3–8)	5 (3–8)	6 (4–9)	8 (6–11)	0.85‡
Acuity at index ED visit					
High (CTAS triage level I, II or III)	3338 (12.9)	2180 (12.8)	717 (12.6)	441 (14.3)	0.04¶
Low (CTAS triage level IV or V)	22 317 (86.5)	14 736 (86.6)	4949 (86.8)	2632 (85.2)	0.05**
Missing	158 (0.6)	104 (0.6)	38 (0.7)	16 (0.5)	0.02**
Arrived by ambulance	15 335 (59.4)	9941 (58.4)	3323 (58.3)	2071 (67.0)	0.18¶
Admitted to hospital at index ED visit	3377 (13.1)	2248 (13.2)	771 (13.5)	358 (11.6)	0.06**
Hospital length of stay, d (n = 3377)					
Median (IQR)	3 (1–7)	3 (1–7)	3 (2–6)	2 (1–5)	0.33**
1–3	1873 (55.5)	1221 (54.3)	414 (53.7)	238 (66.5)	0.26**
4–6	642 (19.0)	408 (18.1)	175 (22.7)	59 (16.5)	0.16**
7–9	311 (9.2)	220 (9.8)	66 (8.5)	25 (7.0)	0.10‡
≥ 10	551 (16.3)	399 (17.7)	116 (15.0)	36 (10.0)	0.22‡

Note: ADG = Aggregated Diagnosis Group, CTAS = Canadian Triage and Acuity Scale, ED = emergency department, IQR = interquartile range, SD = standard deviation.
*Except where noted otherwise.
†Pairwise standardized differences were calculated between all study groups. The largest standardized difference is reported as follows: ‡2 visits versus 5 or more visits, §2 visits versus 3–4 visits, ¶tie in largest standardized difference between 2 visits versus 5 or more visits and 3–4 visits versus 5 or more visits, **3–4 visits versus 5 or more visits.

Table 2: Crude and age- and sex-standardized mortality rates and rates of years of potential life lost

Group; no. of alcohol-related ED visits	No. of patients	No. of deaths 1 yr after index visit	Mortality rate per 100	Age- and sex-standardized mortality rate* (95% CI)
Overall cohort				
Overall	25 813	1406	5.4	5.4 (5.0–5.7)
2	17 020	799	4.7	4.8 (4.4–5.2)
3–4	5704	336	5.9	5.4 (4.7–6.2)
≥ 5	3089	271	8.8	8.4 (7.1–10)
		Total YPLL 1 yr after index visit	YPLL rate per 100	Age- and sex-standardized YPLL rate per 100* (95% CI)
Patients aged 16–74 yr				
Overall	25 298	30 607	121.0	116.3 (114.8–117.7)
2	16 635	16 064	96.6	92.9 (91.3–94.5)
3–4	5613	7498	133.6	132.6 (129.0–136.2)
≥ 5	3050	7044	231.0	230.0 (222.6–237.7)

Note: CI = confidence interval, ED = emergency department, YPLL = years of potential life lost.
*Age- and sex-standardized to the 2006 Ontario population by means of the direct method.[17]
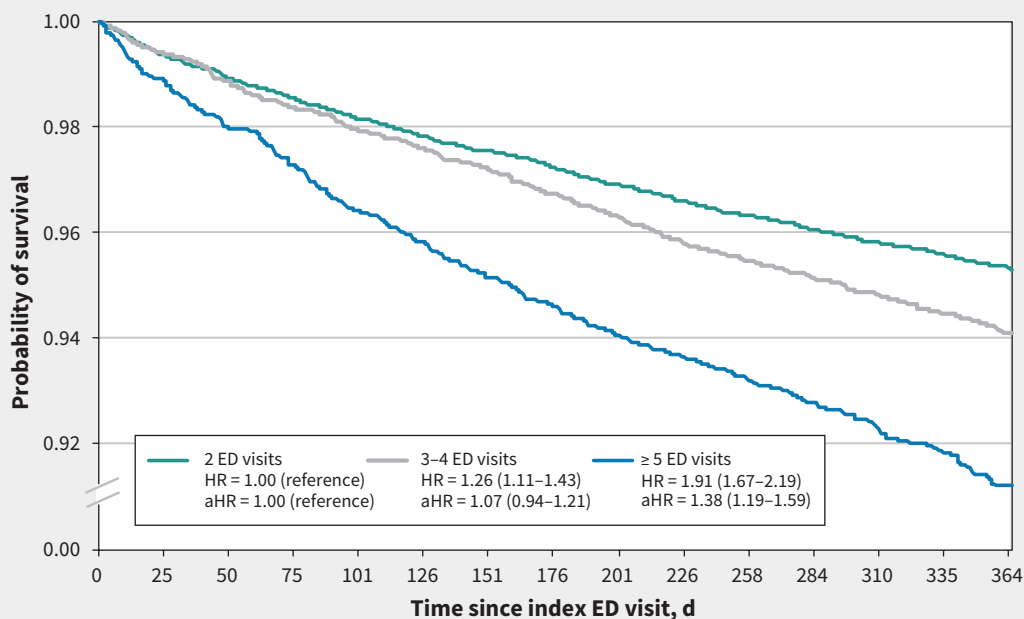
Figure 2: Kaplan–Meier survival plot 1 year after index emergency department (ED) visit. Adjusted and unadjusted hazard ratios are presented with 95% confidence intervals. Note: aHR = adjusted hazard ratio, HR = hazard ratio.

Table 3: Frequency of causes of death and alcohol-attributable deaths

Cause of death, ICD-10-CA code	No. of ED visits; no. (%) of patients*				
	Total n = 1406	2 n = 799	3–4 n = 336	≥ 5 n = 271	p value
F00–F999 Mental and behavioural disorders	256 (18.2)	140 (17.5)	62 (18.4)	54 (19.9)	0.7
I00–I999 Diseases of the circulatory system	170 (12.1)	108 (13.5)	35 (10.4)	27 (10.0)	0.2
K00–K939 Diseases of the digestive system	221 (15.7)	128 (16.0)	54 (16.1)	39 (14.4)	0.8
V01–Y989 External causes of morbidity and mortality†	424 (30.2)	223 (27.9)	111 (33.0)	90 (33.2)	0.1
X60–X84 Death by suicide (subset of external causes of morbidity and mortality)	100 (7.1)	60 (7.5)	22 (6.5)	18 (6.6)	0.8
All alcohol-attributable ICD-10-CA codes (% of this row)4	n = 482	n = 258	n = 127	n = 97	
F101 Mental and behavioural disorders due to use of alcohol, harmful use	52 (10.8)	25 (9.7)	12 (9.4)	15 (15.5)	0.2
F102 Mental and behavioural disorders due to use of alcohol, dependence syndrome	135 (28.0)	71 (27.5)	39 (30.7)	25 (25.8)	0.4
K703 Alcoholic cirrhosis of liver	80 (16.6)	47 (18.2)	23 (18.1)	10 (10.3)	0.2
K704 Alcoholic hepatic failure‡	22 (4.6)	16 (6.2)	S	S	0.3
X45 Accidental poisoning by and exposure to alcohol	97 (20.1)	43 (16.7)	29 (22.8)	25 (25.8)	0.04

Note: ED = emergency department, ICD-10-CA = enhanced Canadian version of the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision*, S = suppressed.
*Frequencies less than 5% in the overall cohort are not shown to minimize risk of reidentification owing to small cell sizes. Therefore, individual causes of death do not add up to the column totals.
†The ICD-10-CA chapter "External causes of morbidity and mortality" includes Transport accidents (codes V01–V99), Other external causes of accidental injury (codes W00–X59), Intentional self-harm (X60–X84), Assault (codes X85–Y09), Event of undetermined intent (codes Y10–Y34), Legal intervention and operations of war (codes Y35–Y36), Complications of medical and surgical care (codes Y40–Y84), Sequelae of external causes of morbidity and mortality (codes Y85–Y89) and Supplementary factors related to causes of morbidity and mortality classified elsewhere (codes Y90–Y98).
‡Decreasing by frequency of ED use; not statistically significant.

such as accidents (578/2100 [27.5%] and 446/2100 [21.2%], respectively), and the proportion of deaths by suicide was 5.4%. Alcohol-attributable causes of death accounted for a larger proportion of deaths in the sensitive cohort than in the specific cohort (39.2% v. 34.3%). There was an increasing trend by frequency of emergency department use for accidental causes of death ($p < 0.001$).

Interpretation

In this cohort of patients with 2 or more emergency department visits for alcohol-related reasons in a 1-year period, about 1 in 20 patients died within 1 year after the index visit. We found a relation between increasing frequency of emergency department use and mortality, with the 1-year mortality rate for patients with 5 or more visits nearly twice that for patients with 2 visits, even after adjustment for sociodemographic characteristics and comorbidities. External causes of death, including accidental poisoning, suicide and trauma, as well as diseases of the digestive system accounted for the majority of deaths in the cohort.

Although it is known that many people with severe alcohol use disorder are frequent users of emergency departments,[8] the mortality rate of these people is not well documented. We observed a standardized 1-year mortality rate of 5.4%, which was higher than the 1-year mortality among Dutch patients admitted

to intensive care units with alcohol intoxication (4.4%).[23] The mortality rate we observed in the highest-frequency group, 8.8%, is comparable to the rate among patients admitted with myocardial infarction in a French study[24] and is nearly 4 times the rate among people with 5 or more emergency department visits for any substance use in Alberta, 2.3%.[25]

The relatively young age of our cohort resulted in high premature mortality, with more YPLL than for all patients diagnosed with pneumonia, influenza, bronchitis, emphysema and asthma in Ontario during a similar period.[26] The high rates of comorbidities and suicide are consistent with previous studies evaluating the impact of alcohol on mortality and morbidity,[1,5,27–30] and support the strong link between alcohol use and suicide risk.[31]

The observed young age and high mortality rates, including the high rate in the highest prevalence, lower visit frequency group, are concerning. The clinical interventions required to mitigate this risk are unclear. Frequent visits to the emergency department represent opportunities for timely intervention.[32–34] Promising strategies include screening, brief intervention, treatment referrals,[35] managed alcohol programs[36] and case management.[37] Rapid access to addiction medicine clinics has been shown to reduce both substance use[38] and emergency department visits,[39] and may also have an impact on mortality in frequent users of emergency departments for alcohol-related mental and behavioural disorders.

Table 4: Characteristics and outcomes of frequent emergency department users for conditions entirely attributable to alcohol use (sensitivity analysis)

Characteristic	No. of ED visits; no. (%) of patients*†				Standardized difference§
	Overall *n* = 28 237	2 *n* = 18 878	3–4 *n* = 6173	≥ 5 *n* = 3186	
Male sex	19 250 (68.2)	12 782 (67.7)	4224 (68.4)	2244 (70.4)	0.06¶
Age at index ED visit, yr					
Mean ± SD	44.03 ± 15.38	43.57 ± 16.03	44.95 ± 14.36	44.91 ± 13.08	0.09**
Median (IQR)	45 (31–55)	45 (30–55)	46 (34–55)	46 (34–54)	0.09**
Urban dweller	24 650 (87.3)	16 431 (87.0)	5358 (86.8)	2861 (89.8)	0.09††
Lowest neighbourhood income quintile	9979 (35.3)	6412 (34.0)	2267 (36.7)	1300 (40.8)	0.14¶
High acuity at index ED visit (CTAS triage level I, II or III)	24 485 (86.7)	16 383 (86.8)	5345 (86.6)	2757 (86.5)	0.01**
Arrived by ambulance	16 313 (57.8)	10 681 (56.6)	3556 (57.6)	2076 (65.2)	0.18¶
No. of Johns Hopkins ADG comorbidities					
Mean ± SD	6.35 ± 3.66	5.78 ± 3.50	6.96 ± 3.61	8.53 ± 3.67	0.77¶
Median (IQR)	6 (4–9)	5 (3–8)	6 (4–9)	8 (6–11)	0.81¶
Admitted to hospital at index ED visit	4830 (17.1)	3378 (17.9)	1077 (17.4)	375 (11.8)	0.17¶
Hospital length of stay, d					
Mean ± SD	7.62 ± 18.30	7.68 ± 17.18	7.98 ± 21.72	6.08 ± 17.29	0.1‡‡
Median (IQR)	3 (2–7)	4 (2–8)	3 (2–7)	3 (1–5)	0.29¶
					p value
Death within 1 yr	2100 (7.4)	1314 (7.0)	483 (7.8)	303 (9.5)	< 0.001
Crude HR (95% CI)	NA	Reference	1.13 (1.01–1.25)	1.38 (1.21–1.56)	< 0.001
Adjusted HR (95% CI)	NA	Reference	0.95 (0.85–1.05)	0.97 (0.85–1.10)	0.6
Cause of death, ICD-10-CA code					
F00–F999 Mental and behavioural disorders	413 (19.7)	260 (19.8)	97 (20.1)	56 (18.5)	0.8
I00–I999 Diseases of the circulatory system	206 (9.8)	120 (9.1)	52 (10.8)	34 (11.2)	0.4
K00–K939 Diseases of the digestive system	578 (27.5)	418 (31.8)	115 (23.8)	45 (14.8)	< 0.001
V01–Y989 External causes of morbidity and mortality	446 (21.2)	230 (17.5)	124 (25.7)	92 (30.4)	< 0.001
X60–X84 Death by suicide (subset of external causes of morbidity and mortality)	113 (5.4)	69 (5.2)	23 (4.8)	21 (6.9)	0.4
All alcohol-attributable ICD-10-CA codes (% of this row)[4]	*n* = 823	*n* = 517	*n* = 197	*n* = 109	
F101 Mental and behavioural disorders due to use of alcohol, harmful use	123 (14.9)	79 (15.3)	30 (15.2)	14 (12.8)	0.6
F102 Mental and behavioural disorders due to use of alcohol, dependence syndrome	189 (23.0)	112 (21.7)	48 (24.4)	29 (26.6)	0.6
K703 Alcoholic cirrhosis of liver	221 (26.8)	163 (31.5)	40 (20.3)	18 (16.5)	< 0.001
K704 Alcoholic hepatic failure‡	41 (5.0)	28 (5.4)	S	S	0.2
X45 Accidental poisoning by and exposure to alcohol	99 (12.0)	39 (7.5)	35 (17.8)	25 (22.9)	< 0.001

Note: ADG = Aggregated Diagnosis Group, CI = confidence interval, CTAS = Canadian Triage and Acuity Scale, HR = hazard ratio, ICD-10-CA = enhanced Canadian version of the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision*, IQR = interquartile range, NA = not applicable, S = suppressed, SD = standard deviation.
*Except where noted otherwise.
†Frequencies less than 5% are not shown to minimize risk of reidentification owing to small cell sizes. Therefore, individual causes of death do not add up to the column totals.
‡Decreasing frequency with increasing ED use; not statistically significant.
§Pairwise standardized differences were calculated between all study groups. The largest standardized difference is reported as follows: ¶2 visits versus 5 or more visits, **tie between 2 visits versus 3–4 visits and 2 visits versus 5 or more visits, ††tie between 2 visits versus 5 or more visits and 3–4 visits versus 5 or more visits, ‡‡3–4 visits versus 5 or more visits.

Limitations

We used ICD-10-CA code F10 to ascertain alcohol use disorders among patients presenting to the emergency department. Although this approach is used by the Canadian Institute for Health Information, it has not been validated. Furthermore, our approach to identifying alcohol use disorders was ad hoc, and although it reflects the clinical scenarios we intended to capture, it has not been validated. Additional work is needed to compare this study population to nonfrequent emergency department users for alcohol-related reasons and to frequent emergency department users for other chronic illnesses. Since our specific cohort focused on people with alcohol-related mental and behavioural disorders as the main reason for the emergency department visit, our study likely underestimates the burden of frequent emergency department use related to alcohol, including both the medical complications of alcohol use and other presentations (e.g., motor vehicle accidents). Our aim, however, was to capture a population with an easily identifiable clinical presentation for whom specific interventions may be targeted. Our sensitivity analysis using a more sensitive case definition illustrated similar increases in mortality as a function of emergency department use. More work is needed to examine alcohol use in secondary diagnoses at emergency department presentation. Finally, we assembled a cohort and imposed an ad hoc severity gradient based on categories of visit frequency. We included this severity gradient to inform the relation between alcohol use and death in the absence of an appropriate control group.

Conclusion

We identified and characterized a population of patients with frequent emergency department visits for alcohol-related reasons who had a high 1-year mortality rate that increased significantly as a function of emergency department use. A combination of high mortality and low hospital admission rates suggests that frequent emergency department visits in this population signal an unmet need. Given our cohort's relatively young age, effective interventions have the potential to prevent premature mortality and reduce hospital use.

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