Appendix Table 1. Variable checklist for each database

Database	Variables	Location	Definition
National Ambulatory Care Reporting System (NACRS)[1]-Patient Level	Number of patients	Table 1, Table 2	Count of patients
	Sex	Table 1, Table 2	Original data
	Age	Table 1, Table 2	Original data
	Rural/urban	Table 1, Table 2	Derived from the truncated postal code. Rural residence had "0" in the second position of the truncated postal code.
	Weighted Charlson Comorbidity Index	Table 1, Table 2	Derived from primary ED diagnosis. This index combines patients' status on 17 medical comorbidities into a score with predictive validity for mortality.
	Number of ED visits per person	Table 1, Table 2	Count of ED visits individually
National Ambulatory Care Reporting System (NACRS)[1]-Visit Level	Number of ED visits	Table 1, Table 2	Count of ED visits
	Arrival by ambulance	Table 1, Table 2	Original data
	Triage level (CTAS)	Table 1, Table 2	Original data
	Alcohol-related visits	Table 1, Table 2	Identified from primary ED diagnosis based on standard in supplementary Table 1.
	Substance use-related visits	Table 1, Table 2	Mental and behavioural disorders related to psychoactive substance use identified from primary ED diagnosis based on

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			ICD-10-CA code F10-F19
	Top 5 ICD-10-CA ED diagnosis	Table 1, Table 2	Top 5 primary ED diagnosis with ICD-10-CA code
	Visit disposition	Table 1, Table 2	Original data
Hospitalization Characteristics (DAD)[2]	Number of patients	Table 1, Table 2	Count of patients
	Number of admissions	Table 1, Table 2	Count of admissions
	Number of admissions per person	Table 1, Table 2	Count of admissions individually
	Median time admitted (days)	Table 1, Table 2	Original data: the total number of days the patient was hospitalized.
	Top 5 ICD-10-CA primary diagnosis	Table 1, Table 2	Top 5 the most responsible diagnosis for the patient during hospitalization
	Top 5 ICD-10-CA primary diagnosis chapters	Table 1, Table 2	Classified the most responsible diagnosis for the patient during hospitalization into ICD-10-CA diagnosis chapter and selected top 5.
	Discharge disposition	Table 1, Table 2	Original data
Mental Health Hospitalization Characteristics (HMHDB)[3]	Number of patients	Table 1, Table 2	Count of patients
	Number of mental health admissions	Table 1, Table 2	Count of mental health admissions
	Homelessness	Table 1, Table 2	Original data: indicates whether a person was homeless on admission

	Length of stay at hospital (days)	Table 1, Table 2	Original data: the total number of days the person was hospitalized.
	Diagnosis category	Table 1, Table 2	Original data
	Discharge disposition	Table 1, Table 2	Original data: broad mental health category based on the most responsible separation diagnosis code

Footnote: Emergency department (ED), Canadian triage and acuity scale (CTAS), International Statistical Classification of Diseases and Related Health Problems (ICD-10-CA).

1. Canadian Institute for Health Information. Data Quality Documentation, National Ambulatory Care Reporting System, Current-Year Information, 2017-2018. Ottawa, ON: 2018. Available from: www.cihi.ca/sites/default/files/document/current-year-information-nacrs-2017-2018-en-web.pdf

2. Canadian Institute for Health Information. Discharge Abstract Database Metadata (DAD). Ottawa, ON. Available from: www.cihi.ca/en/discharge-abstract-database-metadata-dad.

3. Canadian Institute for Health Information. Hospital Mental Health Database, 2018-2019, User Documentation. 2020. Available from: secure.cihi.ca/free_products/HMHDB-user-documentation-2018-2019-en.pdf

Appendix Table 2. ICD-10-CA Alcohol-related Diagnostic Codes

ICD-10-CA Code	Description
E244	Alcohol-induced pseudo-Cushing's syndrome
E52	Niacin deficiency [pellagra]
F10.-	Mental and behavioural disorders due to use of alcohol
F100	Mental and behavioural disorders due to use of alcohol, acute intoxication
F101	Mental and behavioural disorders due to use of alcohol, harmful use
F102	Mental and behavioural disorders due to use of alcohol, dependence syndrome
F103	Mental and behavioural disorders due to use of alcohol, withdrawal state
F104	Mental and behavioural disorders due to use of alcohol, withdrawal state with delirium
F105	Mental and behavioural disorders due to use of alcohol, psychotic disorder
F106	Mental and behavioural disorders due to use of alcohol, amnesic syndrome
F107	Mental and behavioural disorders due to use of alcohol, residual and late-onset psychotic disorder
F108	Mental and behavioural disorders due to use of alcohol, other mental and behavioural disorders
F109	Mental and behavioural disorders due to use of alcohol, unspecified mental and behavioural disorder
G312	Degeneration of nervous system due to alcohol
G621	Alcoholic polyneuropathy
G721	Alcoholic myopathy
I426	Alcoholic cardiomyopathy
K292	Alcoholic gastritis
K70.–	Alcoholic liver disease
K700	Alcoholic fatty liver
K701	Alcoholic hepatitis
K702	Alcoholic fibrosis and sclerosis of liver
K703	Alcoholic cirrhosis of liver
K704	Alcoholic hepatic failure
K709	Alcoholic liver disease, unspecified
K852	Alcohol-induced acute pancreatitis
K860	Alcohol-induced chronic pancreatitis
O354	Maternal care for (suspected) damage to fetus from alcohol
R780	Finding of alcohol in blood
T510	Toxic effects of alcohol, Ethanol

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X65	Intentional self-poisoning by and exposure to alcohol
Y15	Poisoning by and exposure to alcohol, undetermined intent
Y90	Evidence of alcohol involvement determined by blood alcohol level
Y91	Evidence of alcohol involvement determined by level of intoxication
Z040	Blood-alcohol and blood-drug test
Z714	Alcohol abuse counselling and surveillance
Z721	Alcohol use

Footnote: International Statistical Classification of Diseases and Related Health Problems (ICD-10-CA).

Appendix Table 3. Summary of ICD-10-CA codes for substance use-related diagnoses based on the Canadian Institute for Health Information (CIHI) standard

Substance use category	ICD-10-CA codes	ICD-10-CA Description
Alcohol	E244	Alcohol-induced pseudo-Cushing's syndrome
	F10.–	Mental and behavioural disorders due to use of alcohol
	G312	Degeneration of nervous system due to alcohol
	G621	Alcoholic polyneuropathy
	G721	Alcoholic myopathy
	I426	Alcoholic cardiomyopathy
	K292	Alcoholic gastritis
	K70.–	Alcoholic liver disease
	K852	Alcohol-induced acute pancreatitis
	K860	Alcohol-induced chronic pancreatitis
	O354–	Maternal care for (suspected) damage to fetus from alcohol
	Q860	Fetal alcohol syndrome (dysmorphic)
	R780	Finding of alcohol in blood
	T51.–	Toxic effects of alcohol
	X45	Accidental poisoning by and exposure to alcohol
	X65	Intentional self-poisoning by and exposure to alcohol
	Y15	Poisoning by and exposure to alcohol, undetermined intent
Opioids	F11.–	Mental and behavioural disorders due to use of opioids
	T400	Poisoning by opium
	T401	Poisoning by heroin
	T402	Poisoning by other opioids
	T403	Poisoning by methadone
	T404	Poisoning by other synthetic narcotics
	T406	Poisoning by other and unspecified narcotics
Stimulants, cocaine, psychoactive and hallucinogens-related	F15.–	Mental and behavioural disorders due to use of other stimulants, including caffeine
	T436	Poisoning by other stimulants and amphetamines
	F14.–	Mental and behavioural disorders due to use of cocaine
	T405	Poisoning by cocaine
	F19.–	Mental and behavioural disorders due to use of multiple drug use and use of other psychoactive substances
	T438	Poisoning by other psychotropic drugs, not elsewhere classified

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	T439	Poisoning by psychotropic drug, unspecified
	X41 (when coded without T42–T43)	Accidental poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified
	X61 (when coded without T42–T43)	Intentional self-poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified
	Y11 (when coded without T42–T43)	Poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified, undetermined intent
	Y12 (when coded without T40.–)	Poisoning by and exposure to narcotics and psychodysleptics, [hallucinogens], not elsewhere classified, undetermined intent
	F16.–	Mental and behavioural disorders due to use of hallucinogens
	T408	Poisoning by lysergide [LSD]
	T409	Poisoning by other and unspecified psychodysleptics [hallucinogens]
	X42 (when coded without T40.–)	Accidental poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified
	X62 (when coded without T40.–)	Intentional self-poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified
Other substance use	F12.–	Mental and behavioural disorders due to use of cannabinoids
	T407	Poisoning by cannabis (derivatives)
	F13.–	Mental and behavioural disorders due to use of sedatives or hypnotics
	T423	Poisoning by barbiturates
	T424	Poisoning by benzodiazepines
	T426	Poisoning by other antiepileptic and sedative-hypnotic drugs
	T427	Poisoning by antiepileptic and sedative-hypnotic drugs, unspecified
	F18.–	Mental and behavioural disorders due to use of volatile solvents
	F55	Abuse of non-dependence-producing substances

Footnote: International Statistical Classification of Diseases and Related Health Problems (ICD-10-CA).

Appendix Table 4: Demographic, ED Utilization, and Hospitalization Characteristics for People Who Made Frequent ED Visits in Ontario from April 1st, 2015 to March 31st, 2016, By Persistent Frequent ED Use Subgroups (Detailed Diagnostic Codes).

Persistent frequent ED use subgroups: Number of study years in which frequent ED use definition met (Years)	1	2	3	4	5
Patient Characteristics (NACRS)					
Number of patients in persistent frequent ED use subgroups, among those who made frequent ED visits in April 1st, 2015 to March 31st, 2016, n (%)	112,048 (44.3)	62,813 (24.9)	37,338 (14.8)	23,397 (9.3)	17,141 (6.8)
Number of ED visits made by patients in persistent frequent ED use subgroups, among all visits by patients who made frequent ED visits in April 1st, 2015 to March 31st, 2016, n (%)	583,092 (37.9)	362,668 (23.6)	238,976 (15.5)	171,694 (11.2)	183,162 (11.9)
Top 5 ICD-10-CA ED diagnosis, n (%)					
1	Other chemotherapy (Z512), 25,570 (4.4)	Abdominal pain/colic (R104), 12,194 (3.4)	Abdominal pain/colic (R104), 8,453 (3.5)	Abdominal pain/colic (R104), 7,056 (4.1)	Abdominal pain/colic (R104), 9,150 (5.0)
2	Abdominal pain/colic (R104), 18,609 (3.2)	Other chemotherapy (Z512), 11,110 (3.1)	Urinary tract infection (N390), 7,187 (3.0)	Urinary tract infection (N390), 4,956 (2.9)	Chest pain (R074), 5,559 (3.0)
3	Urinary tract infection (N390), 14,799 (2.5)	Urinary tract infection (N390), 10,829 (3.0)	Other chemotherapy (Z512), 5,843 (2.4)	Chest pain (R074), 4,509 (2.6)	Mental disorder alcohol intoxication (F100), 5,000 (2.7)
4	Chest pain (R074), 12,142 (2.1)	Chest pain (R074), 8,651 (2.4)	Chest pain (R074), 5,792 (2.4)	Other chemotherapy (Z512), 3,485 (2.0)	Urinary tract infection (N390), 4,798 (2.6)

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	Cellulitis of lower limb (L0311), 10,178 (1.7)	Cellulitis of lower limb (L0311), 5,787 (1.6)	Chronic obstructive pulmonary disease with acute exacerbation, unspecified (J441), 3,576 (1.5)	Chronic obstructive pulmonary disease with acute exacerbation, unspecified (J441), 2,631 (1.5)	Other chemotherapy (Z512), 3,610 (2.0)
5					
NA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Hospitalization Characteristics (DAD)

Overall Years of Frequent ED Use (Years)	1 (N=112,048)	2 (N=62,813)	3 (N=37,338)	4 (N=23,397)	5 (N=17,141)
Number of patients with at least one admission, among persistent frequent ED use subgroups, n (%)	43,548 (38.9)	24,536 (39.1)	14,465 (38.7)	8,948 (38.2)	6,717 (39.2)
Number of admissions	84,784	50,951	31,194	20,212	16,672
Top 5 ICD-10-CA primary diagnosis among admissions, n (%)					
1	Congestive heart failure, unspecified (I500), 3,865 (4.6)	Congestive heart failure, unspecified (I500), 2,826 (5.5)	Congestive heart failure, unspecified (I500), 1,774 (5.7)	COPD exacerbation (J441), 987 (4.9)	COPD exacerbation (J441), 751 (4.5)
2	Urinary tract infection (N390), 1,950 (2.3)	COPD exacerbation (J441), 1,642 (3.2)	COPD exacerbation (J441), 1,474 (4.7)	Congestive heart failure, unspecified (I500), 984 (4.9)	Congestive heart failure, unspecified (I500), 610 (3.7)
3	Pneumonia (J189), 1,715 (2.0)	Urinary tract infection (N390), 1,453 (2.9)	COPD, with acute lower respiratory infection (J440), 954 (3.1)	COPD, with acute lower respiratory infection (J440), 632 (3.1)	COPD, with acute lower respiratory infection (J440), 453 (2.7)

	COPD exacerbation (J441), 1,691 (2.0)	Pneumonia (J189), 1,167 (2.3)	Urinary tract infection (N390), 923 (3.0)	Urinary tract infection (N390), 586 (2.9)	Urinary tract infection (N390), 452 (2.7)
4					
5	Acute subendocardial myocardial infarction (I214), 1,627 (1.9)	COPD, with acute lower respiratory infection (J440), 1,162 (2.3)	Pneumonia (J189), 684 (2.2)	Pneumonia (J189), 461 (2.3)	Mental and behavioural disorders due to use of alcohol, withdrawal state (F103), 353 (2.1)
NA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Top 5 ICD-10-CA primary diagnosis chapters among admissions, n (%)					
Diseases of the circulatory system (IX)	15,152 (17.9)	8,663 (17.0)	4,891 (15.7)	2,887 (14.3)	1,951 (11.7)
Diseases of the respiratory system (X)	8,640 (10.2)	6,679 (13.1)	4,700 (15.1)	3,062 (15.1)	2,357 (14.1)
Diseases of the digestive system (XI)	12,393 (14.6)	6,904 (13.6)	4,158 (13.3)	2,707 (13.4)	2,111 (12.7)
Symptoms and abnormal clinical and laboratory findings, not otherwise classified (XVIII)	7,671 (9.0)	5,027 (9.9)	3,230 (10.4)	2,222 (11.0)	2,098 (12.6)
Injury, poisoning and certain other consequences of external causes (XIX)	7,780 (9.2)	4,436 (8.7)	2,608 (8.4)	1,768 (8.7)	1,506 (9.0)
NA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Footnote: Emergency department (ED), Chronic obstructive pulmonary disease (COPD), National Ambulatory Care Reporting System metadata (NACRS), International Statistical Classification of Diseases and Related Health Problems (ICD-10-CA), Discharge Abstract Database metadata (DAD).

Appendix Table 5: Demographic, ED Utilization, and Hospitalization Characteristics for People Who Made Frequent ED Visits in Alberta from April 1st, 2015 to March 31st, 2016, By Persistent Frequent ED Use Subgroups (Detailed Diagnostic Codes).

Persistent frequent ED use subgroups: Number of study years in which frequent ED use definition met (Years)	1	2	3	4	5
Patient Characteristics (NACRS)					
Number of patients in persistent frequent ED use subgroups, among those who made frequent ED visits in April 1st, 2015 to March 31st, 2016, n (%)	28,290 (44.7)	14,730 (23.3)	9,058 (14.3)	5,958 (9.4)	5,202 (8.2)
Number of ED visits made by patients in persistent frequent ED use subgroups, among all visits by patients who made frequent ED visits in April 1st, 2015 to March 31st, 2016, n (%)	206,562 (38.5)	120,083 (22.4)	80,140 (14.9)	59,006 (11.0)	70,934 (13.2)
Top 5 ICD-10-CA ED diagnosis, n (%)					
1	Other chemotherapy (Z512), 35,297 (17.1)	Other chemotherapy (Z512), 17,185 (14.3)	Other chemotherapy (Z512), 9,425 (11.8)	Other chemotherapy (Z512), 6,187 (10.5)	Other chemotherapy (Z512), 8,240 (11.6)
2	Attention to surgical dressings and sutures (Z480), 8,806 (4.3)	Attention to surgical dressings and sutures (Z480), 3,791 (3.2)	Abdominal pain/colic (R104), 1,969 (2.5)	Abdominal pain/colic (R104), 1,647 (2.8)	Abdominal pain/colic (R104), 2,196 (3.1)
3	Abdominal pain/colic (R104), 3,993 (1.9)	Abdominal pain/colic (R104), 2,719 (2.3)	Attention to surgical dressings and sutures (Z480), 1,876 (2.3)	Attention to surgical dressings and sutures (Z480), 1,496 (2.5)	Migraine, unspecified, 2,019 (2.8)

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4	Other specified orthopaedic follow-up care (Z478), 3,773 (1.8)	Urinary tract infection (N390), 2,477 (2.1)	Urinary tract infection (N390), 1,831 (2.3)	Urinary tract infection (N390), 1,450 (2.5)	Mental disorder alcohol intoxication (F100), 1,897 (2.7)
5	Urinary tract infection (N390), 3,611 (1.7)	Chest pain (R074), 817 (1.5)	Chest pain (R074), 1,333 (1.7)	Mental disorder alcohol intoxication (F100), 1,029 (1.7)	Urinary tract infection (N390), 1,499 (2.1)
NA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Hospitalization Characteristics (DAD)

Overall Years of Frequent ED Use (Years)	1 (N=28,290)	2 (N=14,730)	3 (N=9,058)	4 (N=5,958)	5 (N=5,202)
Number of patients with at least one admission, among persistent frequent ED use subgroups, n (%)	**11,287 (39.9)**	**6,248 (42.4)**	**3,846 (42.5)**	**2,590 (43.5)**	**2,338 (44.9)**
Number of admissions	**22,389**	**13,125**	**8,437**	**5,895**	**5,729**
Top 5 ICD-10-CA primary diagnosis among admissions, n (%)					
1	Congestive heart failure, unspecified (I500), 844 (3.8)	Congestive heart failure, unspecified (I500), 504 (3.8)	COPD exacerbation (J441), 358 (4.2)	COPD exacerbation (J441), 249 (4.2)	COPD exacerbation (J441), 226 (3.9)
2	COPD exacerbation (J441), 530 (2.4)	COPD exacerbation (J441), 424 (3.2)	Congestive heart failure, unspecified (I500), 260 (3.1)	Mental and behavioural disorders due to use of alcohol, withdrawal state (F103), 165 (2.8)	Mental and behavioural disorders due to use of alcohol, withdrawal state (F103), 210 (3.7)
3	Urinary tract infection (N390), 396 (1.8)	Pneumonia (J189), 274 (2.1)	COPD, with acute lower respiratory	Congestive heart failure,	COPD, with acute lower

			infection (J440), 223 (2.6)	unspecified (I500), 160 (2.7)	respiratory infection (J440), 161 (2.8)
4	Pneumonia (J189), 390 (1.7)	COPD, with acute lower respiratory infection (J440), 264 (2.0)	Pneumonia (J189), 177 (2.1)	COPD, with acute lower respiratory infection (J440), 157 (2.7)	Pneumonia (J189), 157 (2.7)
5	COPD, with acute lower respiratory infection (J440), 318 (1.4)	Urinary tract infection (N390), 257 (2.0)	Urinary tract infection (N390), 166 (2.0)	Pneumonia (J189), 137 (2.3)	Congestive heart failure, unspecified (I500), 129 (2.3)
NA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Top 5 ICD-10-CA primary diagnosis chapters among admissions, n (%)					
1	Diseases of the circulatory system (IX), 3,211 (14.3)	Diseases of the digestive system (XI), 1,729 (13.2)	Diseases of the respiratory system (X), 1,164 (13.8)	Mental and behavioral disorders (V), 945 (16.0)	Mental and behavioral disorders (V), 975 (17.0)
2	Diseases of the digestive system (XI), 3,186 (14.2)	Mental and behavioral disorders (V), 1,573 (12.0)	Mental and behavioral disorders (V), 1,153 (13.7)	Diseases of the respiratory system (X), 850 (14.4)	Diseases of the respiratory system (X), 844 (14.7)
3	Injury, poisoning and certain other consequences of external causes (XIX), 2,373 (10.6)	Diseases of the circulatory system (IX), 1,569 (12.0)	Diseases of the digestive system (XI), 1,004 (11.9)	Diseases of the circulatory system (IX), 524 (8.9)	Diseases of the digestive system (XI), 676 (11.8)
4	Mental and behavioral disorders (V), 2,187 (9.8)	Diseases of the respiratory system (X), 1,562 (11.9)	Diseases of the circulatory system (IX), 874 (10.4)	Diseases of the digestive system (XI), 690 (11.7)	Injury, poisoning and certain other consequences of external causes (XIX), 534 (9.3)
5	Diseases of the respiratory system (X), 2,184 (9.8)	Injury, poisoning and certain other consequences of external causes (XIX),	Injury, poisoning and certain other consequences	Injury, poisoning and certain other consequences	Symptoms, signs and abnormal clinical and laboratory

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		1,315 (10.0)	of external causes (XIX), 870 (10.3)	of external causes (XIX), 604 (10.2)	findings, not elsewhere classified (XVIII), 453 (7.9)
NA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Footnote: Emergency department (ED), Chronic obstructive pulmonary disease (COPD), National Ambulatory Care Reporting System metadata (NACRS), International Statistical Classification of Diseases and Related Health Problems (ICD-10-CA), Discharge Abstract Database metadata (DAD).

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Appendix Table 6: Kolmogorov-Smirnov test of normality for continuous variables

Variables	Statistic	P value
NACRS		
Age	0.08	<0.001
Number of visits to the ED	0.34	<0.001
Weighted Charlson Comorbidity Index	0.46	<0.001
DAD		
Number of admissions	0.28	<0.001
Length of stay	0.28	<0.001
HMHDB		
Number of mental health admissions	0.34	<0.001
Length of stay	0.41	<0.001

Footnote: Emergency department (ED), National Ambulatory Care Reporting System metadata (NACRS), Discharge Abstract Database (DAD), Hospital Mental Health Database Metadata (HMHDB).