Characterizing Frequent Emergency Department Users in BC: A retrospective analysis of linked provincial databases

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ABSTRACT

Background

This study aimed to characterize frequent emergency department (ED) users in British Columbia (BC) using provincial data.

Methods

We identified patients ≥18 years who made ≥1 ED visit from 2012/13-2015/16, and linked to hospitalization, physician billing, prescription, and mortality data. We defined frequent users as the top 10% of patients by annual ED visits.

Results

From 2012/13 to 2015/16, frequent users' visits increased by 63.3% (95% CI: 61.5%, 65.0%), compared to 47.5% (95% CI: 46.7%, 48.3%) for ED visits overall. Frequent users accounted for 17.8-19.7% of visits, with a median of six/year (interquartile interval [IQI]: 5-8). Only 1.51% remained frequent users in all years. Mental illness was prevalent among those <60 years, and circulatory and respiratory complaints among those ≥60 years.

In 2015/16, frequent users were older than non-frequent users, more frequently resided in the lowest two quintiles of average household incomes, and had similar sex distributions. They had more prescription medications (median 11 [IQI: 6-17] versus 5 [IQI: 2-9], p<0.001), visited more unique primary care physicians (median 9 [IQI: 6-13] versus 3 [IQI: 2-5], p<0.001) and received less care continuity. Annual hospitalizations (median 2 [IQI: 1-4] versus 1 [IQI: 1-2], p<0.001), and 365-day mortality (12.9% versus 4.1%, p<0.001) were higher among frequent versus non-frequent users.

Interpretation

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Frequent ED users' visits are increasing in BC. They are heterogenous, high utilizers of other healthcare, and have higher mortality than non-frequent users. Frequent use is rarely persistent. Future efforts to address frequent ED use should account for this heterogeneity and complexity.

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INTRODUCTION

Health expenditures in Canada continue to grow year over year; Canadians spent $7068 per capita on healthcare in 2019 with emergency department (ED) expenses accounting for an increasing proportion of costs.[1,2] High healthcare users have been identified as a national priority for cost containment.[3,4] Specifically, frequent ED users comprise 4.5-8% of ED patients, yet account for 21-30% of visits.[5,6] They are high users of other healthcare services and incur disproportionately high healthcare costs.[7-9] Existing literature suggests they are also high-risk: they make higher acuity visits, and are admitted and die more often than non-frequent users.[10-14]

Effective solutions require a detailed and generalizable understanding of frequent ED users in Canada. Most characterization studies have been conducted at institution levels and other countries.[15-20] Previous provincial analyses in Canada have examined frequent users in a cross-sectional rather than longitudinal manner.[9,21,22] Population-level temporal trends and transitions into and out of frequent ED use have not been explored.

Interventions described to-date (e.g., case management and care plans) may decrease ED visits.[17,19,23] However, their effectiveness has not been rigorously studied in Canada. Sustainable solutions require a nuanced understanding of the nature (not just quantity) of frequent ED users' healthcare system interactions. For instance, the proposed solution of greater linkages to primary care contradicts evidence that over 93% of North American frequent ED users are already attached to primary care.[15,24-28] Liaising frequent users with primary care providers at discharge has had mixed effects on ED use.[29,30] It is unknown whether improving the quality of the primary care relationship can redirect frequent users towards non-acute care and improve outcomes.

This study's objective was to characterize frequent ED users in British Columbia (BC) using a comprehensive, longitudinal, linked provincial database of demographic, clinical, and healthcare utilization data.

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METHODS

Study Design, Setting and Participants

This was a retrospective administrative database study capturing patients who visited an ED in BC between 2012/13 and 2015/16. Data were split into four fiscal years groupings. The **study cohort** was created by identifying all patients aged ≥18 years who made at least one ED visit during the study timeframe. We identified ED visits based on classification within the National Ambulatory Care Reporting System (NACRS) database.[31]

Data Sources

We created a study database by linking patient-level data for our cohort (NACRS) to hospitalization (Discharge Abstract Database [DAD]),[32] physician billing (Medical Services Plan [MSP]),[33] prescription medications (PharmaNet),[34] and mortality (Vital Statistics) data.[35] Population Data BC housed and linked all databases using personal health number, age, sex, and postal code as linkage variables. All patients were assigned non-identifiable study numbers that remained consistent across databases. The University of British Columbia Clinical Research Ethic Board approved this study.

Study variables and definitions

Frequent Users

Frequent users were defined as patients within our cohort in the top 10% of ED utilization in each fiscal year, consistent with a Canadian Institute for Health Information (CIHI) definition.[36]

To determine visit counts, we first attempted to identify and remove scheduled revisits. Based on our clinical experience, the majority of scheduled ED revisits in BC are made for intravenous antibiotics for cellulitis. We therefore defined strings of ED visits within 48

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hours of one another with an initial diagnosis of cellulitis as presumed scheduled revisits. We examined the diagnostic categories of all ED visits that occurred within 48 hours of one another and confirmed that no diagnoses other than cellulitis commonly appeared.

Non-Frequent Users

We defined non-frequent users as patients in the bottom 90% of ED utilization in each fiscal year, based on visit totals after removing presumed scheduled revisits.

Demographics

Sex, age, rural/urban residence, and average neighbourhood income adjusted for household size[37] were available for frequent and non-frequent users. Population estimates were obtained from the Government of British Columbia.[38]

Acute Care

ED visit characteristics (ambulance arrival, triage level, diagnoses, disposition) were available through NACRS.

Visit acuity is defined using the Canadian Triage and Acuity Scale (CTAS), a national tool that allows Canadian EDs to prioritize patient care.[39] It defines five illness acuity levels with differing time-to-physician goals.[40]

We obtained hospitalization dates and diagnoses from DAD.

Physician Visits and Majority Source of Care

We used the general practitioner specialty code to identify primary care providers and visits using MSP data.

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We counted both number of visits to primary care physicians and number of unique primary care physicians seen. To describe continuity of primary care, we calculated a majority source of care variable based on whether the patient received at least three services in one year, and at least 50% of services from one general practitioner. [42,43]

Mortality

We obtained dates and causes for death in the Vital Statistics database, and examined mortality by sex, age, and age groups.

Diagnostic Categories

ED, hospitalization, and mortality diagnoses are recorded within NACRS, DAD and Vital Statistics using the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). The ICD-10 classification system comprises 22 diagnostic chapters, within which specific diagnoses are listed. We summarized frequent and non-frequent users' diagnoses within diagnostic categories (i.e. ICD-10 chapters).[41]

Prescription Medications

Using the provincial PharmaNet database, we defined unique medications as those with distinct generic drug names, consistent with previous literature.[44] We summarized unique medication counts by age groups, and also medication categories using American Hospital Formulary Service (AHFSC) classifications.

Analyses

We characterized our frequent user and non-frequent user groups for each fiscal year, using all data sources available. We reported descriptive statistics based on the type and distribution of each variable. We calculated percentage change in ED visit numbers overall and for visits made by frequent users over the study period, standardized for

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annual BC population. We used chi-square tests for categorical variables and Wilcoxon rank-sum tests for continuous variables to evaluate statistical significance.

All analyses were performed using R (R Development Core Team, 2011). We used an alpha<0.05 threshold for significance.

RESULTS

From 2012/13 to 2015/16, visits made by frequent users increased from 136,960 to 233,866 and accounted for 17.8% to 19.7% of total ED visits. Frequent ED users' visits increased from 2999.06/100,000 population to 4896.29/100,000 population, an absolute increase of 63.3% (95% CI: 61.5%, 65.0%). In comparison, total ED visits rose from 16,818.04/100,000 population to 24,805.54/100,000, an increase of 47.5% (95% CI: 46.7%, 48.3%). The top 10% of users made a median of six annual ED visits (interquartile interval [IQI]: 5, 8). Visits related to mental illness and injury/poisoning were prevalent among frequent users aged 18 to 60 years. Proportionally, visits attributable to mental illness and injury increased from 2012/13 to 2015/16. Frequent users ≥60 years old proportionally made more visits related to circulatory and respiratory disorders (Table 1).

A minority of patients classified as frequent ED users each year remained so in the year that immediately followed (11.7%, 11.7% and 12.7% respectively in 2012/13, 2013/14 and 2014/15). Only 15.7% of patients were frequent users in multiple consecutive or non-consecutive years. Furthermore, only 1.51% of patients remained frequent users in all study years; 1.91% remained frequent users in all years when only examining those who were alive during the entire study.

We report frequent users' characteristics in 2015/16, our most recent year of data, and compare them to non-frequent users (Table 2). Frequent users were older than non-frequent users (median 54.0 years [IQI 36, 73] versus 50.5 years [IQI: 33, 67], p<0.001), and disproportionately represented neighborhood incomes (measured by average household income) in the lowest two quintiles (52% versus 43%, p<0.001). There was no

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difference in sex distribution between frequent and non-frequent users (52% female in both groups, p=0.053).

When comparing ED visit characteristics, frequent users arrived more commonly by ambulance (30% versus 20%, p<0.001), made a greater proportion of higher acuity visits (p<0.001), and were admitted more often (18.9% versus 15.3%, p<0.001) than non-frequent users. The most common ED discharge diagnoses for both frequent and non-frequent users related to a broad category encompassing a range of clinical findings, such as abdominal pain, chest pain, headache, fever, and hyperglycemia.[41] Mental and behavioral disorders accounted for 8% of frequent users' visits. Frequent users had a greater number of annual admissions compared to non-frequent users (median 2 [IQI: 1, 4] versus median 1 [IQI: 1, 2], p<0.001). The most common reasons for hospitalization were mental and behavioural disorders for frequent users (19%), versus circulatory diseases for non-frequent users (17%).

In 2015/16, frequent ED users made a median of 22 primary care visits (IQI: 13, 38) to a median of nine unique primary care physicians (IQI: 6, 13). By contrast, non-frequent users made a median of eight primary care visits (IQI: 4, 13) to a median of three unique primary care physicians (IQI: 2, 4). Among frequent users, 36.5% had a practitioner who served as their majority source of care, compared to 42.5% among non-frequent users (p<0.001). Only 0.4% (137/30,777) of frequent users had made no primary care visits, and only 1.1% (325/30,777) had made two or fewer visits. Frequent users had a higher number of prescription medications compared to non-frequent users (median 11 [IQI: 6, 17] versus 5 [IQI: 2, 9], p<0.001).

Frequent ED users had a higher mortality rate within one year of their last ED visit in 2015/16 compared to non-frequent users (12.9% versus 4.1%, p<0.001), with a larger proportion of deaths occurring in patients aged <70 years (p<0.001).

INTERPRETATION

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Our analyses indicate that ED visits increased uniformly in BC from 2012 to 2016, and that visits made by the top 10% of highest utilizing patients increased disproportionately. Standardized for population growth, overall ED visit rates increased by 54% from 2012 to 2016, whereas ED visits by frequent users increased by 63%. Our study highlights important characteristics of frequent ED users in BC. First, frequent use tends to be transient; only 1.51% remained frequent users in all study years (1.91% among those surviving all four years). Second, frequent users are heterogenous, demonstrated by the differing predominance of ED diagnoses among age subgroups (e.g., mental health and injury among younger frequent users, and circulatory and respiratory diagnoses among older frequent users). Third, frequent ED users are high utilizers of many healthcare services. They were hospitalized more often, visited a greater number of primary care physicians, and made more primary care visits than non-frequent users. However, they experienced less continuity of primary care, consistent with prior research.[45,46] Finally, frequent users are complex and high-risk patients. We observed high relative numbers of prescription medications (which could indicate inappropriate prescribing and/or a large co-morbid illness burden),[44] high comparative admission rates, and a mortality rate over three times greater than non-frequent users (12.9% versus 4.1%).

Our study confirms extensive healthcare system use among frequent ED users and thus the potential for efficiency from interventions aimed at addressing this use. Our results highlight income disparity between frequent and non-frequent users that policy interventions could target. Our analyses corroborate previous studies illustrating that frequent ED users are heterogenous, high utilizers of primary care and other services, have prevalent mental health and chronic illness, and die often.[7,13,14,17,47-50] Our study supports findings that very few frequent users remain so across years. A previous study of high-cost healthcare users overall indicated that one third remained high utilizers over multiple years,[4] while the current study found that only 15.7% of frequent users of EDs specifically remained in this category over two or more years. The relatively evanescent nature of frequent ED use may indicate that this is a naturally self-limiting state triggered

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by acute crisis. For clinicians who identify frequent ED use patterns, understanding contributing co-morbidities, exploring triggers for frequent use episodes and providing early intervention may shorten the duration and morbidity of these episodes. Importantly, our results also point to an important growing prevalence of mental health and substance use among younger frequent user subgroups over time. For these subgroups, clinicians should consider initiating treatment in the ED when appropriate (e.g., opioid use disorder), and ensuring that timely and direct access to community-based treatment and supports are available from the ED.

Future studies should focus on further characterizing heterogeneity and distinct subgroups of frequent ED users that are highlighted here. Previous literature has incompletely explored differential mortality risk among frequent user subgroups. This exploration is a required next step in identifying modifiable risk factors that could be mitigated to improve patient outcomes. Secondly, studies should assess predictors of episodic and persistent high ED use over multiple years, to target these populations separately for interventions. Moreover, future qualitative work should engage healthcare providers and patients within specific frequent user subgroups to understand these patients' unmet needs and underlying drivers of ED utilization, and to develop collaborative solutions. Studies should pay particular attention to understanding increasing trends in mental health and substance use presentations. Finally, clinicians, hospitals and regions should pilot targeted approaches to address frequent users' heterogeneous needs, utilizing non-ED settings where possible. These directed interventions include: strategies to improve continuity of primary care, targeted mental health or substance use follow-up, medication reviews for frequent users with polypharmacy (especially if multiple prescribers), and chronic disease management for elderly patients coordinated with a most responsible primary care provider.

Limitations

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Our study has limitations inherent in large administrative database analyses. We relied on NACRS ED records to create our study cohort. The observed increase in ED visits partially reflects an increase in number of institutions reporting to NACRS: from 20 in 2012/13 to 29 by 2013/14.[31] Our approach may disproportionately identify EDs in larger urban/suburban centres reporting to NACRS, while missing visits to non-reporting institutions. Nonetheless, NACRS is the most comprehensive provincial repository of ED visits, increasing the robustness of our analysis. By 2015/16, our most recent year of data, 29 BC EDs contributed 1.57 million records, accounting for a 74% provincial coverage rate.[51] Secondly, while a scheduled ED revisit flag exists within NACRS, it is unreliably coded. We therefore developed an algorithm to identify presumed revisits for cellulitis treatment, based on our clinical experience. Our algorithm is unvalidated; however, we explored all ED visits within 48 hours of one another, and cellulitis was the only commonly appearing diagnosis. Thirdly, we could not explore important variables not captured in the included databases (e.g., homelessness, employment, ethnicity, individual/family income). Fourth, while a graded analysis of frequent use would strengthen our analysis, we chose to examine the top 10% of users to remain consistent with CIHI standards. Finally, our analyses will be affected by accuracy and completeness of available data. We observed 28.7% and 29.3% missing data for discharge diagnoses for frequent and non-frequent users, respectively; while high, we do not suspect a systematic difference between groups. To mitigate coding inconsistencies, we collapsed diagnosis information into ICD-10 chapters, a previously supported approach.[52,53]

Conclusion

In conclusion, ED utilization by the top 10% of highest ED users is a substantial and growing issue in BC. These patients are heterogeneous, high users of multiple facets of healthcare, and high-risk for mortality. Frequent use is rarely persistent over multiple years. Interventions that permit early identification of frequent ED users and that systematically address needs and triggers for frequent use episodes have the potential for health system efficiencies and more importantly, improved patient outcomes.

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REFERENCES

1. Canadian Institute for Health Information. National health expenditure trends, 1975 to 2019. 2019.

2. Canadian Institute for Health Information. Hospital cost drivers technical report - what factors have determined hospital expenditure trends in Canada? 2012.

3. Canadian Institute for Health Information. Pan-Canadian forum on high users of health care: Summary report. Canadian Institute for Health Information 2014 March 20-21.

4. Wodchis WP, Austin PC, Henry DA. A 3-year study of high-cost users of health care. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne 2016 Feb 16;188(3):182.

5. LaCalle E, Rabin E. Frequent users of emergency departments: The myths, the data, and the policy implications. Annals of Emergency Medicine 2010 Jul 1;56(1):42-48.

6. Canadian Institute for Health Information. Emergency department visits in 2014-2015. 2015.

7. Mitchell MS, Leon CLK, Byrne TH, Lin W, Bharel M. Cost of health care utilization among homeless frequent emergency department users. Psychological Services 2017 May 1,;14(2):193-202.

8. Korczak V, Shanthosh J, Jan S, Dinh M, Lung T. Costs and effects of interventions targeting frequent presenters to the emergency department: A systematic and narrative review. BMC Emergency Medicine 2019 Dec;19(1):1-83.

9. Ovens HJ, Chan BT. Heavy users of emergency services: A population-based review. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne 2001 Oct 16,;165(8):1049-1050.

13

10. Fuda KK, Immekus R. Frequent users of Massachusetts emergency departments: A statewide analysis. Annals of Emergency Medicine 2006;48(1):16.e1-16.e8.

11. Hansagi H, Olsson M, Sjöberg S, Tomson Y, Göransson S. Frequent use of the hospital emergency department is indicative of high use of other health care services. Annals of Emergency Medicine 2001;37(6):561-567.

12. Moe J, Kirkland S, Ospina MB, Campbell S, Long R, Davidson A, et al. Mortality, admission rates and outpatient use among frequent users of emergency departments: A systematic review. Emergency Medicine Journal 2016 Mar;33(3):230-236.

13. Pines JM, Asplin BR, Kaji AH, Lowe RA, Magid DJ, Raven M, et al. Frequent users of emergency department services: Gaps in knowledge and a proposed research agenda. Academic Emergency Medicine 2011 Jun;18(6):e64-e69.

14. Ruger JP, Richter CJ, Spitznagel EL, Lewis LM. Analysis of costs, length of stay, and utilization of emergency department services by frequent users: Implications for health policy. Academic Emergency Medicine 2004 Dec;11(12):1311-1317.

15. Ovens HJ, Chan BT. Heavy users of emergency services: A population-based review. Canadian Medical Association Journal 2001 Oct 16,;165(8):1049-1050.

16. van Tiel S, Rood P, Bertoli-Avella A, Erasmus V, Haagsma J, van Beeck E, et al. Systematic review of frequent users of emergency departments in non-US hospitals: State of the art. European Journal of Emergency Medicine 2015 Oct;22(5):306-315.

17. Soril LJJ, Leggett LE, Lorenzetti DL, Noseworthy TW, Clement FM. Reducing frequent visits to the emergency department: A systematic review of interventions. PloS one 2015;10(4):e0123660.

18. Dufour I, Chouinard M, Dubuc N, Beaudin J, Lafontaine S, Hudon C. Factors associated with frequent use of emergency-department services in a geriatric population: A systematic review. BMC geriatrics 2019 Jul 5,;19(1):185.

14

19. Moe J, Kirkland SW, Rawe E, Ospina MB, Vandermeer B, Campbell S, et al. Effectiveness of interventions to decrease emergency department visits by adult frequent users: A systematic review. Academic Emergency Medicine 2017 Jan;24(1):40-52.

20. Althaus F, Paroz S, Hugli O, Ghali WA, Daeppen J, Peytremann-Bridevaux I, et al. Effectiveness of interventions targeting frequent users of emergency departments: A systematic review. Annals of Emergency Medicine 2011;58(1):41-52.e42.

21. Chan BTB, Ovens HJ. Frequent users of emergency departments. do they also use family physicians' services? Canadian Family Physician 2002 Oct 1,;48(10):1654.

22. Doupe MB, Palatnick W, Day S, Chateau D, Soodeen R, Burchill C, et al. Frequent users of emergency departments: Developing standard definitions and defining prominent risk factors. Annals of Emergency Medicine 2012 Jul;60(1):24.

23. Kumar GS, Klein R. Effectiveness of case management strategies in reducing emergency department visits in frequent user patient populations: A systematic review. The Journal of Emergency Medicine 2013 Mar;44(3):717-729.

24. Lucas RH, Sanford SM. An analysis of frequent users of emergency care at an urban university hospital. Annals of Emergency Medicine 1998;32(5):563-568.

25. Sandoval E, Smith S, Walter J, Schuman SH, Olson MP, Striefler R, et al. A comparison of frequent and infrequent visitors to an urban emergency department. Journal of Emergency Medicine 2010;38(2):115-121.

26. Zuckerman S, Shen Y. Characteristics of occasional and frequent emergency department users: Do insurance coverage and access to care matter? Medical Care 2004 Feb 1,;42(2):176-182.

27. Blank FSJ, Li H, Henneman PL, Smithline HA, Santoro JS, Provost D, et al. A descriptive study of heavy emergency department users at an academic emergency

15

department reveals heavy ED users have better access to care than average users. Journal of Emergency Nursing 2005;31(2):139-144.

28. Palmer E, Leblanc-Duchin D, Murray J, Atkinson P. Emergency department use: Is frequent use associated with a lack of primary care provider? Canadian family physician Médecin de famille canadien 2014 Apr;60(4):e223.

29. McCusker J, Verdon J. Do geriatric interventions reduce emergency department visits? A systematic review. The journals of gerontology. Series A, Biological sciences and medical sciences 2006 Jan;61(1):53-62.

30. Hastings SN, Heflin MT. A systematic review of interventions to improve outcomes for elders discharged from the emergency department. Academic Emergency Medicine 2005 Oct;12(10):978-986.

31. Population Data BC. National Ambulatory Care Reporting System (NACRS). 2018; Available from: https://www.popdata.bc.ca/data/health/nacrs. [cited June 18, 2020].

32. Population Data BC. Discharge Abstracts Database (Hospital Separations file). 2018; Available from: https://www.popdata.bc.ca/data/health/dad. [cited April 29, 2020].

33. Population Data BC. Medical Services Plan (MSP) Payment Information File. 2018; Available from: https://www.popdata.bc.ca/data/health/msp. [cited April 29, 2020].

34. Population Data BC. PharmaNet. 2019; Available from: https://www.popdata.bc.ca/data/health/PharmaNet. [cited April 29, 2020].

35. Population Data BC. Population and vital statistics. 2018; Available from: https://www.popdata.bc.ca/data/population. [cited April 29, 2020].

36. Canadian Institute for Health Information. Dynamic cohort of complex, high system users - 2011-2015: A CIHR-CIHI collaboration. CIHR-CIHI 2017.

16

37. Statistics Canada. Postal code conversion file (PCCF), reference guide, 2017. 2017 December 13.

38. Government of British Columbia. Population Estimates - Province of British Columbia. 2020; Available from: https://www2.gov.bc.ca/gov/content/data/statistics/people-population-community/population/population-estimates. [cited April 19, 2020].

39. CTAS National Working Group. CTAS - ETG: Canadian Triage and Acuity Scale. Available from: http://ctas-phctas.ca/. [cited April 29, 2020].

40. Beveridge R, Ducharme J, Janes L, Beaulieu S, Walter S. Reliability of the canadian emergency department triage and acuity scale: Interrater agreement . Annals of Emergency Medicine 1999 August;34(2):155-159.

41. World Health Organization. ICD-10 Version:2019. Available from: https://icd.who.int/browse10/2019/en. [cited April 29, 2020].

42. Lavergne R, McGrail K, Peterson S. Defining and measuring full service family practice in BC, 1991-2006. : Centre for Health Services and Policy Research, University of British Columbia; 2013.

43. Lavergne MR, Peterson S, McKendry R, Sivananthan S, McGrail K. Full-service family practice in British Columbia: Policy interventions and trends in practice, 1991-2010. Healthcare Policy/Politiques de Santé 2014 May;9(4):32-47.

44. Schneeweiss S, Seeger JD, Maclure M, Wang PS, Avorn J, Glynn RJ. Performance of comorbidity scores to control for confounding in epidemiologic studies using claims data. American Journal of Epidemiology 2001 Nov 1,;154(9):854-864.

45. Gill JM, Mainous 3, A G, Nsereko M. The effect of continuity of care on emergency department use. Archives of family medicine 2000 Apr;9(4):333-338.

17

46. Ionescu-Ittu R, MSc, McCusker J, MD DrPH, Ciampi A, PhD, Vadeboncoeur A, MD, Roberge D, PhD, Larouche D, MSc, et al. Continuity of primary care and emergency department utilization among elderly people. Canadian Medical Association Journal 2007 Nov 20,;177(11):1362-1368.

47. Doupe MB, Palatnick W, Day S, Chateau D, Soodeen R, Burchill C, et al. Frequent users of emergency departments: Developing standard definitions and defining prominent risk factors. Annals of Emergency Medicine 2012 Jul;60(1):24.

48. Althaus F, Paroz S, Hugli O, Ghali WA, Daeppen J, Peytremann-Bridevaux I, et al. Effectiveness of interventions targeting frequent users of emergency departments: A systematic review. Annals of Emergency Medicine 2011;58(1):41-52.e42.

49. T Kerr, E Wood, E Grafstein, T Ishida, K Shannon, C Lai, et al. High rates of primary care and emergency department use among injection drug users in Vancouver. Journal of public health (Oxford, England) 2005 Mar 1,;27(1):62-66.

50. Moe J, Kirkland S, Ospina MB, Campbell S, Long R, Davidson A, et al. Mortality, admission rates and outpatient use among frequent users of emergency departments: A systematic review. Emergency medicine journal : EMJ 2016 Mar;33(3):230-236.

51. Canadian Institute for Health Information. NACRS emergency department visits and length of stay by province/territory, 2016–2017. 2017.

52. Park S. Patient complexity in primary care: Grouping systems with a special focus on validity and
applications in primary care settings. UBC Department of Family Medicine 2016 December 31.

53. Quail JM, Lix LM, Osman BA, Teare GF. Comparing comorbidity measures for predicting mortality and hospitalization in three population-based cohorts. BMC health services research 2011 Jun 10;11(1):146.

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Table 1: Characterization of Top 10% of ED Users in BC, 2012/13 to 2015/16; by Age Categories

Characteristics	2012-2013	2013-2014	2014-2015	2015-2016
Total Number of ED patients	452,405	559,878	642,987	670,976
Total Number of ED Visits	768,041	955,001	1,125,719	1,184,809
Number of frequent users	18,095	22,540	28,917	30,777
Number of ED visits by frequent users	136,960	168,895	216,746	233,866
Total number of ED Visits/ 100,000 population in BC	**16,818.04**	**20,626.03**	**23,915.33**	**24,805.54**
Number of ED visits by frequent users/ 100,000 population in BC	**2999.06**	**3647.78**	**4604.66**	**4896.29**
Percentage of total visits attributable to frequent ED visits				
Top 10% ED Users	17.8	17.7	19.3	19.7
Top 5% ED Users	10.4	10.4	11.1	9.4
Top 1% ED Users	2.3	2.5	2.5	2.5
Number of Visits, median (IQI)	6 (5, 8)	6 (5, 8)	6 (5, 8)	6 (5, 8)
Top five ED Visit Diagnostic Categories (non missing), by age category				
Ages: 18-29				
Symptoms, signs and abnormal clinical and laboratory findings (XVIII)	3296 (15)	4784 (17)	6313 (18)	6777 (18)
Injury, poisoning and certain other consequences of external causes (XIX)	2211 (10)	3059 (11)	4136 (12)	4720 (13)
Mental and Behavioural disorders (V)	1779 (8)	2700 (10)	3502 (10)	4315 (12)

Disease of the genitourinary system (XIV)	1138 (5)	1469 (5)	1929 (5)	2018 (5)
Factors influencing health status and contract with health services (XXI)	878 (4)	1289 (5)	1879 (5)	1918 (5)
Ages: 30-39				
Symptoms, signs and abnormal clinical and laboratory findings (XVIII)	3038 (15)	4186 (17)	5512 (18)	5898 (17)
Injury, poisoning and certain other consequences of external causes (XIX)	1886 (9)	2637 (11)	3390 (11)	4133 (12)
Mental and Behavioural disorders (V)	1756 (9)	2488 (10)	3205 (10)	4081 (12)
Disease of the genitourinary system (XIV)	1016 (5)	1314 (5)	1669 (5)	1718 (5)
Factors influencing health status and contract with health services (XXI)	990 (5)	1256 (5)	1814 (6)	1919 (6)
Ages: 40-49				
Symptoms, signs and abnormal clinical and laboratory findings (XVIII)	3650 (16)	4681 (18)	5755 (18)	6071 (18)
Injury, poisoning and certain other consequences of external causes (XIX)	2376 (10)	2928 (11)	3905 (12)	4015 (12)
Mental and Behavioural disorders (V)	2097 (9)	2491 (9)	3292 (10)	3877 (11)
Factors influencing health status and contract with health services (XXI)	1239 (5)	1549 (6)	2139 (7)	2100 (6)

Diseases of the musculoskeletal system and connective tissue (XIII)	1160 (5)	1377 (5)	1737 (5)	1818 (5)
Ages: 50-59				
Symptoms, signs and abnormal clinical and laboratory findings (XVIII)	3664 (16)	4922 (17)	6375 (18)	6638 (17)
Injury, poisoning and certain other consequences of external causes (XIX)	2117 (9)	2863 (10)	3589 (10)	4085 (11)
Mental and Behavioural disorders (V)	1653 (7)	2417 (9)	2756 (8)	3731 (10)
Factors influencing health status and contract with health services (XXI)	1134 (5)	1500 (5)	2211 (6)	2341 (6)
Diseases of the musculoskeletal system and connective tissue (XIII)	1125 (5)	1433 (5)	1959 (6)	2105 (5)
Ages: 60-69				
Symptoms, signs and abnormal clinical and laboratory findings (XVIII)	2828 (16)	3923 (18)	5389 (19)	5867 (19)
Injury, poisoning and certain other consequences of external causes (XIX)	1283 (7)	1710 (8)	2430 (9)	2444 (8)
Diseases of the Respiratory system (X)	894 (5)	1262 (6)	1640 (6)	1878 (6)
Factors influencing health status and contract with health services (XXI)	675 (4)	1206 (6)	1802 (6)	1981 (7)
Diseases of the circulatory system (IX)	777 (4)	1172 (5)	1706 (6)	1659 (5)
Ages: 70+				

Symptoms, signs and abnormal clinical and laboratory findings (XVIII)	5371 (17)	7858 (19)	11179 (20)	12287 (21)
Diseases of the circulatory system (IX)	1874 (6)	3077 (8)	4615 (8)	4851 (8)
Injury, poisoning and certain other consequences of external causes (XIX)	2022 (6)	2790 (7)	3982 (7)	4098 (7)
Diseases of the Respiratory system (X)	1366 (4)	2005 (5)	3131 (6)	3502 (6)
Disease of the genitourinary system (XIV)	1364 (4)	1958 (5)	2928 (5)	3200 (5)

Table 2: Characteristics of frequent (top 10%) and non-frequent (bottom 90%) ED users in BC, 2015-2016

Characteristics	Frequent ED Users	Non-Frequent ED Users	p-value
Total Patient Number, n	**30,777**	**640,199**	
Sex			
Female, n (%)	15,855 (52)	333,412 (52)	*0.053*
Male, n (%)	14,919 (48)	306,702 (48)	
Unknown, n (%)	3 (0)	85 (0)	
Age, median (IQI)	54.0 (36, 73)	50.5 (33, 67)	*<0.001*
Neighbourhood income Quintile			
1st Quintile, n (%)	9571 (31)	140795 (22)	*<0.001*
2nd Quintile, n (%)	6558 (21)	131333 (21)	
3rd Quintile, n (%)	5428 (18)	124963 (20)	
4th Quintile, n (%)	4755 (15)	122702 (19)	
5th Quintile, n (%)	3866 (13)	108760 (17)	
Rural/Urban			
Rural, n (%)	1285 (4)	34947 (5)	*<0.001*
Urban, n (%)	29337 (96)	600372 (94)	
Number of Visits, median (IQI)	6 (5, 8)	1 (1, 2)	*<0.001*
ED VISIT CHARACTERISTICS			
Arrive by Ambulance			
Ground ambulance	69055 (30)	185289 (20)	*<0.001*
No ambulance	164745 (70)	747774 (80)	
Triage Level (CTAS)			
1 (Resuscitation	1654 (1)	6702 (1)	*<0.001*
2 (Emergent)	41939 (18)	156256 (17)	
3 (Urgent)	119246 (51)	456589 (49)	
4 (Less-urgent)	57724 (25)	282916 (30)	

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5 (Non-urgent)	12586 (5)	28547 (3)	
Unknown	717 (0)	2732 (0)	
Top Five ED Visit Diagnostic Categories (ICD-10 Chapters), non-missing			
	Symptoms, signs and abnormal clinical and laboratory findings (XVIII) 43538 (19)	Symptoms, signs and abnormal clinical and laboratory findings (XVIII) 165625 (18)	
	Injury, poisoning and certain other consequences of external causes (XIX) 23495 (10)	Injury, poisoning and certain other consequences of external causes (XIX) 158485 (17)	
	Mental and Behavioural disorders (V) 19032 (8)	Diseases of the skin and subcutaneous tissue (XIII) 52541 (6)	
	Factors influencing health status and contract with health services (XXI) 13091 (6)	Diseases of the Respiratory system (XI) 41338 (4)	
	Diseases of the musculoskeletal system and connective tissue (XIV) 11012 (5)	Diseases of the circulatory system (X) 41253 (4)	
Discharge Disposition			

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Discharged Home or to place of residence (institution)	187,902 (80.3)	787,399 (84.3)	*<0.001*
Left before completion of treatment	1754 (0.8)	2943 (0.3)	
Admitted or Transferred	44,148 (18.9)	142,682 (15.3)	
Died	62 (0.0)	718 (0.1)	
HOSPITALIZATION DATA (DAD)			
Number of Admissions per person, median (IQI)	2 (1, 4)	1 (1, 2)	*<0.001*
Median time admitted (days [IQI])	4 (2, 9)	4 (2, 9)	*<0.001*
Top Five Primary Discharge ICD-10 Diagnosis Category, n (%)			
	Mental and behavioural disorders (F), 9181 (19)	Diseases of the circulatory system (I), 27522 (17)	
	Diseases of the circulatory system (I), 5613 (12)	Injury, poisoning (S&T), 22404 (14)	
	Diseases of the digestive system (K), 5191 (11)	Diseases of the digestive system (K), 21570 (13)	
	Symptoms and abnormal clinical and laboratory findings, not otherwise classified (R), 5044 (11)	Mental and behavioural disorders (F), 16228 (10)	

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	Diseases of the respiratory system (J), 5037 (11)	Diseases of the respiratory system (J), 15117 (9)	
PHYSICIAN BILLING DATA (MSP)			
Number of general practitioner visits, median (IQI)	22 (13, 38)	8 (4, 13)	*<0.001*
Number of individual general practitioners visited, median (IQI)	9 (6, 13)	3 (2, 5)	*<0.001*
Majority Source of Care	11,213 (36.5)	263,215 (42.5)	*<0.001*
PROVINCIAL PRESCRIPTION DATA (PHARMANET)			
Number of Drug prescription, median (IQI)	11 (6, 17)	5 (2, 9)	*<0.001*
Number of Drugs prescriptions by age category, median (IQI)			
18-30	7 (4, 11)	3 (1, 5)	*<0.001*
30-39	8 (5, 13)	3 (2, 6)	*<0.001*
40-49	10 (6, 15)	4 (2, 7)	*<0.001*
50-59	11 (7, 17)	5 (3, 8)	*<0.001*
60-69	14 (9, 20)	6 (3, 10)	*<0.001*
>70	15 (10, 20)	9 (5, 13)	*<0.001*
Top five AHFSC Drug Classifications, n (%)			
	Central Nervous System Agents, 1306708 (41)	Central Nervous System Agents, 5734289 (33)	

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	Cardiovascular drugs, 411435 (13)	Cardiovascular drugs, 2962239 (17)	
	Gastrointestinal Drugs, 244712 (8)	Hormones and Synthetics Substitutes, 1458636 (7)	
	Hormones and Synthetics Substitutes, 185653 (6)	Gastrointestinal Drugs, 1187676 (7)	
	Blood Formation, coagulation and Thrombosis, 117562 (4)	Electrolytic, caloric and Thrombosis, 672281 (4)	
MORTALITY DATA (VITAL STATISTICS)			
Sex			
Male	2200 (55)	13797 (53)	*0.004*
Female	1782 (45)	12452 (47)	
Unknown	1 (0)	17 (0)	
Age when died, median (IQI)	76 (63, 86)	80 (69, 89)	*<0.001*
Top five causes of death by ICD-10 diagnoses			
	Lung Cancer (C349), 302 (8)	Lung cancer (C349), 2021 (8)	
	Ill defined and unknown cause of Mortality (R99), 181 (5)	Unspecified Dementia (F03), 1210 (5)	
	COPD (J449), 149 (4)	Acute Myocardial Infarction (I219), 1205 (5)	

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	Heart disease of the native coronary artery (I251), 147 (4)	Heart disease of the native coronary artery (I251), 921 (4)	
	Unspecified Dementia (F03), 120 (3)	Ill defined and unknown cause of Mortality (R99), 841 (3)	
Top five causes of death by ICD-10 chapters, n (%)			
	Neoplasms and diseases of blood and blood forming organs (II), 1512 (38)	Neoplasms and diseases of blood and blood forming organs (II), 8937 (34)	
	Diseases of the circulatory system (IX), 834 (21)	Diseases of the circulatory system (IX), 6826 (26)	
	Diseases of the Respiratory system (X), 434 (11)	Diseases of the Digestive system (XI), 2662 (10)	
	Diseases of the Digestive system (XI), 241 (6)	Mental and Behavioural disorders (V), 1553 (6)	
	Symptoms, signs and abnormal clinical and laboratory findings (XVIII), 181 (5)	Diseases of the skin and subcutaneous tissue (XII), 1273 (5)	

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Number of deaths within one year of last ED visit, n (%)	3983 (12.9)	26266 (4.1)	<0.001
Number of deaths within one year of last ED visit (percentage per ED visit) Stratified by age at time of death			
18-29 yrs.	70 (2)	294 (1)	<0.001
30-39 yrs.	109 (3)	363 (1)	<0.001
40-49 yrs.	179 (4)	682 (3)	<0.001
50-59 yrs.	431 (11)	1889 (7)	<0.001
60-69 yrs.	720 (18)	3827 (15)	<0.001
≥70 yrs.	2474 (62)	19211 (73)	<0.001

*P-values calculated with chi square test for categorical variables or Wilcoxon rank test for continuous variables where appropriate.

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