

Comparison of Methods to Define High Use of Inpatient Services Using Population-Based Data

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BACKGROUND: A variety of methods have been proposed to define “high users” of inpatient services, which may have implications for targeting subgroups for intervention.

OBJECTIVE: To compare 3 common definitions of high inpatient service use and their influence on patient capture, outcomes, and inpatient burden.

DESIGN, SETTING, AND PATIENTS: Cross-sectional population-level study of 219,106 adults in Alberta, Canada, with ≥ 1 hospitalization from April 1, 2012, to March 31, 2013.

MEASUREMENTS: We defined “high use” based on the upper 5th percentile of the population by 3 definitions: (1) number of inpatient episodes (≥ 3 hospitalizations/year), (2) cumulative length of stay (≥ 56 days in hospital/year), and (3) cumulative cost based on hospitalization resource intensity weights ($\geq \$63,597$ Canadian dollars/year). Clinical characteristics, health outcomes, and overall health burden were compared across definitions and stratified by age.

RESULTS: Of that population, 10.3% of individuals were common to all definitions. High users based on number of inpatient episodes were more likely to be admitted for acute conditions, with most high users based on length of stay admitted for mental health-related conditions, while those based on costs were more likely to have hospitalizations resulting in death (9.3%). High-episode individuals accounted for 16.6% of all inpatient episodes, high-length of stay individuals for 46.4% of all hospital days, and high-cost individuals for 38.9% of total cost.

CONCLUSIONS: Three definitions of high users of inpatient services captured significantly different groups of patients. This has implications for targeting subgroups for intervention and highlights important considerations for selecting the most suitable definition for a given objective. *Journal of Hospital Medicine* 2017;12:596-602. © 2017 Society of Hospital Medicine

BACKGROUND

As healthcare system use and costs continue to rise, increased importance has been placed on identifying the small subgroup of patients that drive this trend.¹ It is estimated that 5% of healthcare users account for over 60% of healthcare spending.²⁻⁶ Furthermore, care for these “high users” is expensive due to an over-reliance on inpatient services. Approximately 40% of all health spending is for inpatient care, the largest single category of health spending, which is similarly skewed toward high users.^{1,3,5} Improving our understanding of this population may provide an opportunity to direct improvement efforts to a select group of patients with a potentially high benefit, as well as move care away from the costly inpatient setting.

However, the development of effective interventions to improve patient experience and outcomes while decreasing costs

(referred to as the “Triple Aim” by the Institute for Health Improvement) for high users of inpatient services hinges on the methodology used to identify this high-risk population.⁷ There is substantial variability in definitions of high users; the most common definitions are based on the number of hospital encounters, days spent in the hospital, and hospital costs.⁸⁻¹⁵ Definitions have intrinsic differences in their implications around appropriateness, efficiency, and financial sustainability of inpatient resource use. Though the constructs underlying these definitions are highly variable, direct comparisons of differences in patient capture are limited.

A recent study from a single US center explored the clinical characteristics of hospital patients based on definitions of use vs cost and observed important differences in patients’ profiles and outcomes.¹² While this suggests that the choice of definition may have major implications for whom to target (and the efficacy of any proposed interventions), this concept has not been explored at the population level. Therefore, we used population-based administrative data from a single-payer healthcare system to compare 3 common definitions of high inpatient service use and their influence on patient capture, health outcomes, and inpatient system burden.

METHODS

Data Sources and Study Population

We conducted a retrospective population-based study using

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TABLE 1. Demographic and Clinical Characteristics Stratified by Definition of High Use

Characteristics	Inpatient Episodes		Length of Stay		Cost	
	Nonhigh	High	Nonhigh	High	Nonhigh	High
Number of patients (%)	206,399 (94.2)	12,707 (5.8)	208,001 (94.9)	11,095 (5.1)	208,150 (95.0)	10,956 (5.0)
# of visits, median, (IQR)	1 (1-1)	3 (3-4)	1 (1-1)	2 (1-3)	1 (1-1)	2 (1-3)
Cumulative length of stay, median, (IQR)	3 (1-7)	27 (14-54)	3 (1-7)	90 (70-127)	3 (1-7)	87 (59-127)
Cumulative cost, median, (IQR)	6218.22 (4123.22-12,109.17)	36,648.17 (21,186.27-62,955.64)	6218.22 (4123.22-12,213.37)	89,015.81 (64,041.66-136,232.20)	6218.22 (4123.22-12,247.86)	98,143.91 (77,012.68- 14,3446.50)
Patient Characteristics						
Age (years), mean (SD)	51.5 (21.7)	61.2 (21.0)	51.1 (21.6)	69.3 (19.4)	51.2 (21.6)	67.7 (19.3)
Age (years) category						
18-44	87,343 (43.1)	2642 (21.2)	88,648 (43.4)	1337 (12.1)	88,764 (43.4)	1218 (11.3)
45-64	51,897 (25.6)	3558 (28.6)	53,091 (26.0)	2364 (21.5)	52,739 (25.8)	2711 (25.1)
65-74	25,039 (12.4)	2305 (18.5)	25,433 (12.5)	1911 (17.4)	25,164 (12.3)	2179 (20.1)
75+	38,431 (19.0)	3941 (31.7)	36,977 (18.1)	5395 (49.0)	37,659 (18.4)	4710 (43.5)
Male sex	75,531 (36.6)	6069 (47.8)	76,335 (36.7)	5272 (47.5)	76,018 (36.5)	5582 (50.9)
First Nations Status	9346 (4.5)	736 (5.8)	9757 (4.7)	325 (2.9)	9691 (4.7)	391 (3.6)
Location of residence						
Rural	55,054 (26.7)	4440 (35.0)	56,788 (27.3)	2706 (24.4)	56,618 (27.2)	2876 (26.3)
Urban	151,322 (73.3)	8259 (65.0)	151,190 (72.7)	8381 (75.6)	151,499 (72.8)	8072 (73.7)
Median neighborhood household income quintile						
1 (lowest)	53,165 (25.8)	3911 (30.8)	53,593 (25.8)	3483 (31.4)	53,694 (25.8)	3382 (30.9)
2	45,632 (22.1)	2887 (22.7)	45,978 (22.1)	2541 (22.9)	46,026 (22.1)	2493 (22.8)
3	37,679 (18.3)	2199 (17.3)	37,963 (18.3)	1915 (17.3)	37,909 (18.2)	1969 (18.0)
4	32,958 (16.0)	1683 (13.2)	33,235 (16.0)	1406 (12.7)	33,290 (16.0)	1351 (12.3)
5 (highest)	30,089 (14.6)	1454 (11.5)	30,199 (14.5)	1344 (12.2)	30,209 (14.5)	1334 (12.2)
Unknown	6876 (3.3)	573 (4.5)	7033 (3.4)	406 (3.7)	7022 (3.4)	427 (3.9)
General Practitioner Attachment (n = 214,532)						
<50%	93,496 (46.3)	7951 (63.2)	93,779 (46.1)	7668 (69.5)	94,243 (46.3)	7204 (66.3)
50%-74%	66,073 (32.7)	3372 (26.8)	66,798 (32.8)	2647 (24.0)	66,717 (32.8)	2728 (25.1)
75%-100%	42,386 (21.0)	1254 (10.0)	42,924 (21.1)	716 (6.5)	42,713 (21)	927 (8.5)

administrative and clinical data for the province of Alberta, including the discharge abstracts database, physician claims, ambulatory care records, population health registry file, and aggregated data from the Canadian census.¹⁶ We identified all adults who had 1 or more hospitalizations with a discharge date between April 1, 2012, and March 31, 2013, though the admission date could be prior to April 1, 2012.

Definition of High-Inpatient Use

High-inpatient use was defined using 3 metrics: number of inpatient episodes, length of stay, and cost. As in prior studies, for each definition, individuals in the upper 5th percentile of the relevant distribution were designated “high users,”^{2,15} while patients in the lower 95th percentile were considered “nonhigh users.” Patients could be defined as a high user in more than 1 definition.

Patients with 3 or more hospital episodes were defined as high users for the “number of inpatient episodes” definition. A hospital episode of care was defined as an event that resulted in discharge (or death) from an inpatient facility. If an individual was admitted to a hospital and transferred to another facility within 1 day of discharge, the hospitalizations were considered part of the same episode of care.

The “length of stay” definition refers to the cumulative number of days spent in an inpatient facility for all eligible episodes of care. Patients with 56 or more days in hospital during the study period were considered high users. Day of admission and discharge were considered full inpatient days, regardless of the time of admission and discharge.

The “cost” definition considered the cumulative estimated cost of every eligible episode of care. We estimated costs for each hospitalization using resource intensity weights (RIW). This is a relative weighted value for the average inpatient case after taking factors such as age, comorbidity, and procedures into account. The RIW for each episode was multiplied by the national average inpatient cost.¹⁷ Based on this definition, patients with a cumulative hospital cost of ≥ \$63,597 were deemed high users. All costs were calculated in Canadian Dollars (CAD, \$) and adjusted to 2013 dollars based on Statistics Canada’s Consumer Price Index.¹⁸

Demographic, Clinical, and Encounter Characteristics

Individual characteristics were measured using a combination of provincial administrative data sources. All measures were recorded as of the admission date of the first eligible hospitalization. Demographic characteristics included age,

TABLE 1. Demographic and Clinical Characteristics Stratified by Definition of High Use (continued)

Characteristics	Inpatient Episodes		Length of Stay		Cost	
	Nonhigh	High	Nonhigh	High	Nonhigh	High
Comorbidities of interest						
Alcoholism	16,285 (7.9)	2164 (17.0)	16,778 (8.1)	1671 (15.1)	16,822 (8.1)	1627 (14.9)
Asthma	13,205 (6.4)	1469 (11.6)	13,689 (6.6)	985 (8.9)	13,725 (6.6)	949 (8.7)
Atrial Fibrillation	16,812 (8.1)	2367 (18.6)	16,847 (8.1)	2332 (21.0)	16,897 (8.1)	2282 (20.8)
Cancer (Lymphoma)	1977 (1.0)	348 (2.7)	2066 (1.0)	259 (2.3)	1989 (1.0)	336 (3.1)
Cancer (Metastatic)	7358 (3.6)	1072 (8.4)	7674 (3.7)	756 (6.8)	7601 (3.7)	829 (7.6)
Cancer (Nonmetastatic)	15,670 (7.6)	1690 (13.3)	16,116 (7.7)	1244 (11.2)	16,035 (7.7)	1325 (12.1)
CHF	21,455 (10.4)	3425 (27.0)	21,728 (10.4)	3152 (28.4)	21,592 (10.4)	3288 (30.0)
Chronic Pain	25,671 (12.4)	2606 (20.5)	26,196 (12.6)	2081 (18.8)	26,275 (12.6)	2002 (18.3)
Chronic Obstructive Pulmonary Dis	41,984 (20.3)	5220 (41.1)	42,961 (20.7)	4243 (38.2)	42,868 (20.6)	4336 (39.6)
Chronic Hepatitis B	381 (0.2)	46 (0.4)	401 (0.2)	26 (0.2)	397 (0.2)	30 (0.3)
Cirrhosis	1475 (0.7)	434 (3.4)	1663 (0.8)	246 (2.2)	1586 (0.8)	323 (2.9)
Dementia	12,133 (5.9)	1200 (9.4)	10,602 (5.1)	2731 (24.6)	11,228 (5.4)	2105 (19.2)
Depression	32,121 (15.6)	3330 (26.2)	31,817 (15.3)	3634 (32.8)	32,457 (15.6)	2994 (27.3)
Diabetes	35,674 (17.3)	4054 (31.9)	36,106 (17.4)	3622 (32.6)	35,966 (17.3)	3762 (34.3)
Epilepsy	7065 (3.4)	894 (7.0)	7246 (3.5)	713 (6.4)	7254 (3.5)	705 (6.4)
Hypertension	83,815 (40.6)	8094 (63.7)	83,955 (40.4)	7954 (71.7)	84,043 (40.4)	7866 (71.8)
Hypothyroidism	25,505 (12.4)	2303 (18.1)	25,499 (12.3)	2309 (20.8)	25,666 (12.3)	2142 (19.6)
Inflammatory Bowel Disease	3759 (1.8)	491 (3.9)	4017 (1.9)	233 (2.1)	3994 (1.9)	256 (2.3)
Irritable Bowel Syndrome	6620 (3.2)	721 (5.7)	6821 (3.3)	520 (4.7)	6864 (3.3)	477 (4.4)
Multiple Sclerosis	2104 (1.0)	231 (1.8)	2095 (1.0)	240 (2.2)	2106 (1.0)	229 (2.1)
Myocardial Infarction	13,261 (6.4)	1584 (12.5)	13,574 (6.5)	1271 (11.5)	13,369 (6.4)	1476 (13.5)
Parkinson Disease	2263 (1.1)	284 (2.2)	2100 (1.0)	447 (4.0)	2178 (1.0)	369 (3.4)
Peptic Ulcer Disease	1138 (0.6)	218 (1.7)	1188 (0.6)	168 (1.5)	1169 (0.6)	187 (1.7)
Peripheral Vascular Disease	5553 (2.7)	884 (7.0)	5637 (2.7)	800 (7.2)	5580 (2.7)	857 (7.8)
Psoriasis	1984 (1.0)	219 (1.7)	2023 (1.0)	180 (1.6)	2007 (1.0)	196 (1.8)
Rheumatoid Arthritis	7080 (3.4)	885 (7.0)	7161 (3.4)	804 (7.2)	7161 (3.4)	804 (7.3)
Schizophrenia	5629 (2.7)	744 (5.9)	5044 (2.4)	1329 (12.0)	5485 (2.6)	888 (8.1)
Stroke	24,904 (12.1)	2758 (21.7)	24,313 (11.7)	3349 (30.2)	24,505 (11.8)	3157 (28.8)
Number of Comorbidities						
0	60,696 (29.4)	909 (7.2)	61,325 (29.5)	280 (2.5)	61,246 (29.4)	359 (3.3)
1	41,472 (20.1)	1342 (10.6)	41,966 (20.2)	848 (7.6)	41,881 (20.1)	933 (8.5)
2-3	56,755 (27.5)	3709 (29.2)	57,110 (27.5)	3354 (30.2)	57,158 (27.5)	3306 (30.1)
4+	47,476 (22.8)	6747 (53.1)	47,610 (22.9)	6613 (59.6)	47,865 (23.0)	6358 (58.0)

NOTE: Abbreviations: CHF, congestive heart failure; Dis, disease; IQR, interquartile range; SD, standard deviation.

sex, First Nations status, urban/rural status (based on the individual's residential postal code), and median neighborhood income quintile. Clinical characteristics included 28 comorbid conditions defined based on separate validated *International Statistical Classification of Disease and Health Related Problems, Tenth Revision, Canada* (ICD-10-CA) coding algorithms reported individually and cumulatively (categorized as 0, 1, 2–3, and 4+).¹⁹ Primary care attachment was defined as the percentage of all outpatient primary care visits made to a single practitioner in the 2-year period prior to their first hospitalization (among those with ≥ 3 visits). Attachment was categorized as 75%–100% (good attachment), 50%–74% (moderate attachment), or <50% (low attachment).^{20,21}

We also identified hospital encounter-level characteristics. These included the most responsible diagnosis, admission category (elective or urgent/emergent), and discharge disposition for each hospital episode. Reported health outcomes included the proportion of patients with in-hospital mortality and those with at least one 30-day, all-cause readmission to hospital.

Analysis

Patient characteristics were described using proportions and means (standard deviation) as appropriate for high users and nonhigh users within and across each definition. Encounter characteristics were also described and stratified by age category (18–64 or 65+ years). Comparison of patient capture was then analyzed among patients who were high use by at least 1 definition. The overlap and agreement of the 3 definitions were compared using a Venn diagram and kappa statistic. The 10 most responsible diagnoses (based on frequency) were also compared across definitions and stratified by age.

Finally, the percentage of system burden accounted for by each measure was calculated as the amount used by high users divided by the total amount used by the entire study population ($\times 100$). To assess the potential modifying effect of age, results were stratified by age category for each definition.

All analyses were conducted using Stata 11.2 (StataCorp LP, College Station, TX).²² The Conjoint Health Research Ethics Board of the University of Calgary approved this study and granted waiver of patient consent. This manu-

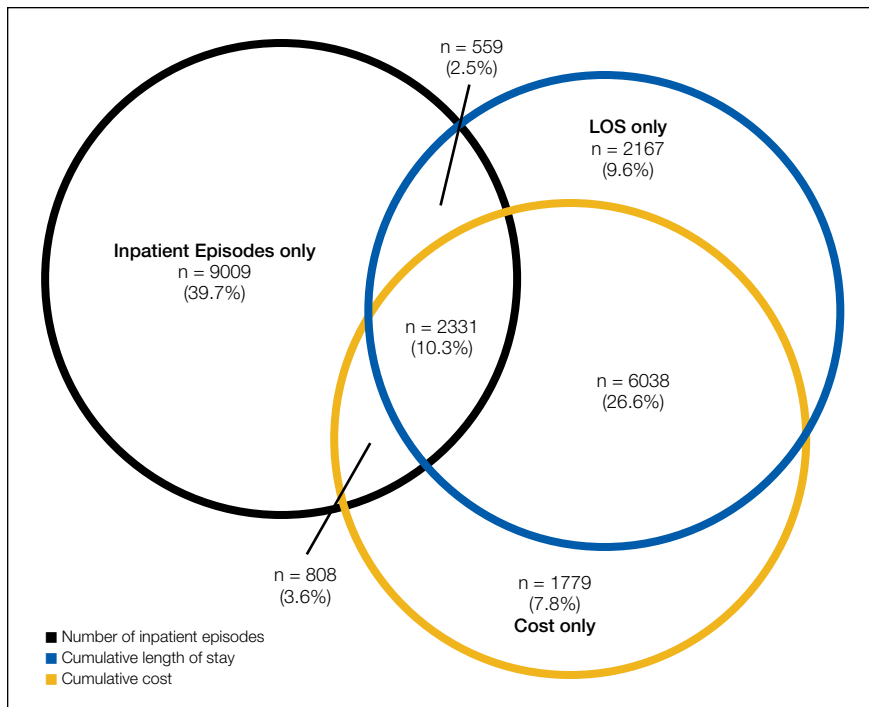


FIG. 1. Comparison of overlap and exclusivity of each definition of high use. Abbreviations: LOS: Length of Stay

script is written in accordance with reporting guidelines for studies conducted using observational routinely collected health data (RECORD statement).²³

RESULTS

Comparison of Patient and Encounter-level Characteristics

A total of 219,106 adults had 283,204 inpatient episodes of care within the study timeframe. There were 12,707 (5.8%), 11,095 (5.1%), and 10,956 (5.0%) patients defined as high users based on number of inpatient episodes, length of stay, and cost, respectively (supplementary Figure 1). Regardless of definition, when compared to their non-high use counterparts, patients classified as high use were more likely to be male, older, in a lower median neighborhood income quintile, and have a higher level of comorbidity. Comparing across definitions of high use, those defined by number of inpatient episodes were more likely to be younger, live in rural areas, have better primary care attachment, and have fewer comorbidities, compared to the other definitions. High users by length of stay were more likely to be older and had a higher proportion of mental health-related comorbidities, including dementia and depression, as compared with the other definitions. Results were largely similar for those defined by cost (Table 1).

Encounter-level analyses showed that high users were more likely to die within hospital (range 3.6%-9.3%) or be discharged to a long-term care setting (range 4.2%-15.2%), compared with nonhigh users. High users were also more likely to be readmitted within 30 days during the study period. Comparing across definitions, those defined by number of inpatient episodes were more often discharged home.

High users defined by length of stay were more likely to have been discharged to a long-term care facility, while those defined by cost were more likely to have died in hospital (Table 2). Similar trends were observed across definitions when stratified by age with proportions increasing with advancing age (supplementary Table 1).

Comparison of Patient Capture and Inpatient Burden

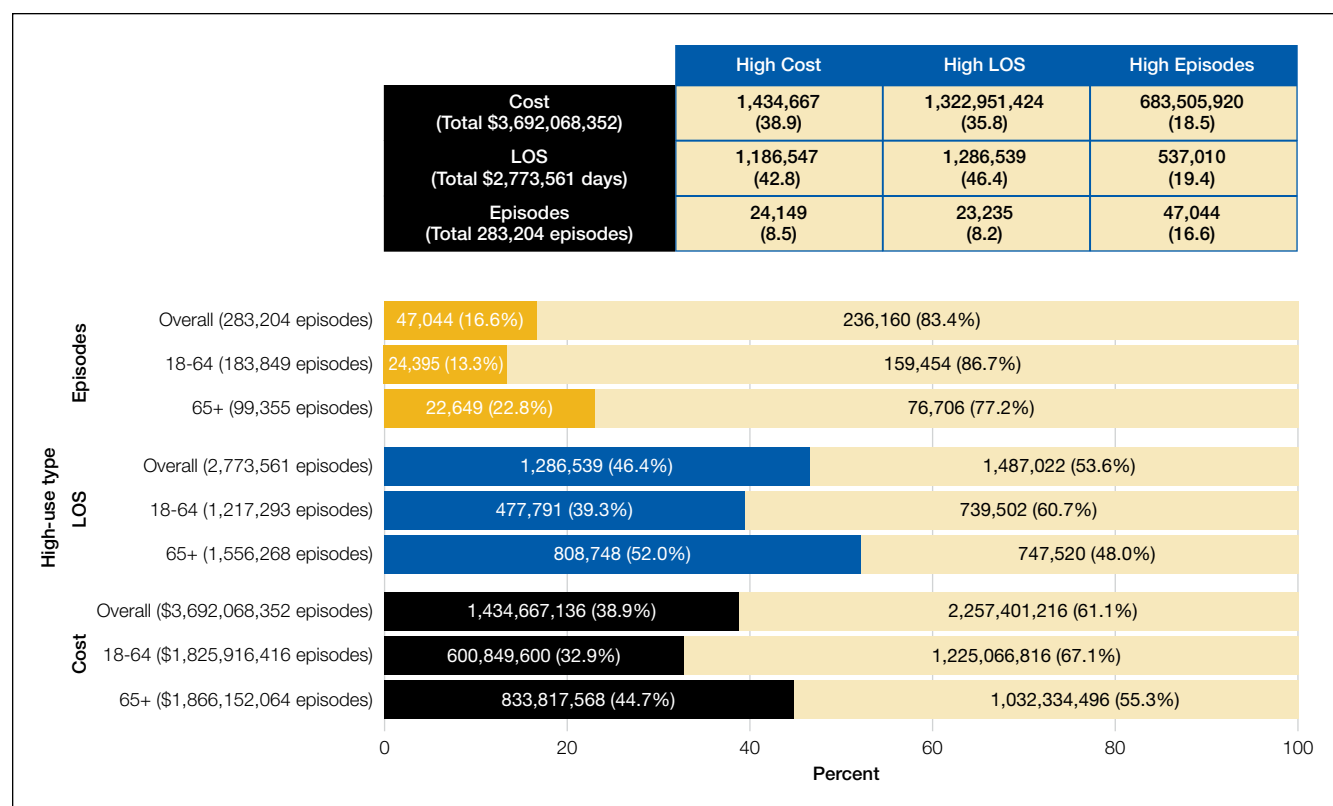
Of the 22,691 individuals who were defined as high use by at least 1 definition, 2,331 (10.3%) were consistently high use across all 3 definitions ($\kappa = 0.38$; Figure 1). Of the 13,682 individuals classified as high use by at least 1 of length of stay or cost, 8369 (61.2%) were defined as high use by both definitions ($\kappa = 0.75$). However, of the 12,707 defined as high use by the number of inpatient episodes, only 3698 (29.1%) were also defined as high use by another definition.

Exploration of the most responsible diagnoses across definitions showed that congestive heart failure (2.8%-3.5%), chronic obstructive pulmonary disease (1.6%-3.2%), and dementia (0.6%-2.2%) were the most frequent. Acute medical conditions (eg, pneumonia [1.8%] or gastroenteritis [0.7%]) that may result in multiple shorter hospitalizations were observed at higher frequencies among high users defined by inpatient episodes, while conditions commonly requiring rehabilitation (eg, fracture [1.8%] and stroke [1.7%]) were more common among high users defined by length of stay and cost (supplementary Table 2). Stratification by age showed marked differences in the diagnoses across high-use definitions. Among high users defined by inpatient episodes, patients aged 18-64 years had a wide range of medical diagnoses, including several for complications of childbirth. Major diagnoses among high users by length of stay aged 18-64 years were dominated by mental health-related conditions. Diagnoses among older adults (65+) were often related to degenerative neurological conditions (dementia and Alzheimer's disease). Diagnoses among high users by cost showed similar trends to length of stay (supplementary Table 3).

When assessing inpatient system burden, high users by number of inpatient episodes accounted for 47,044 (16.6%) of the 283,204 episodes. High users defined by length of stay accounted for 1,286,539 (46.4%) days of 2,773,561 total days, while high users defined by cost accumulated \$1.4 billion (38.9%) of the estimated \$3.7 billion in inpatient expenditures. High users defined by cost and length of stay each accounted for comparatively few episodes (8.5% and 8.2%, respectively), while high-cost individuals accounted for 42.8% of length of stay, and high length of stay individ-

TABLE 2. Hospital Outcomes by Definition of High Use

Outcome	Inpatient Episodes		Length of Stay		Cost	
	Nonhigh 206,399 n (%)	High 12,707 n (%)	Nonhigh 208,001 n (%)	High 11,095 n (%)	Nonhigh 208,149 n (%)	High 10,956 n (%)
Discharge Disposition (all encounters)						
Transferred to another facility providing inpatient hospital care	1597 (0.7)	404 (0.9)	1538 (0.6)	463 (2.0)	1461 (0.6)	540 (2.2)
Discharged to long-term care facility	7323 (3.1)	1983 (4.2)	5767 (2.2)	3539 (15.2)	6432 (2.5)	2874 (11.9)
Discharged to a home setting with support services	21,233 (9.0)	8593 (18.3)	23,378 (9.0)	6448 (27.8)	23,617 (9.1)	6209 (25.7)
Discharged home	193,469 (81.9)	32,698 (69.5)	216,077 (83.1)	10,090 (43.4)	214,721 (82.9)	11,446 (47.4)
Signed out/Did not return	2883 (1.2)	1453 (3.1)	3718 (1.5)	618 (2.7)	3720 (1.5)	616 (2.5)
Died	8652 (3.7)	1680 (3.6)	8506 (3.3)	1826 (7.9)	8077 (3.1)	2255 (9.3)
Other	999 (0.4)	231 (0.5)	979 (0.4)	251 (1.1)	1021 (0.4)	209 (0.9)
Readmission within 30 days (all encounters)	11,983 (5.8)	6150 (48.4)	15,455 (7.4)	2678 (24.1)	15,289 (7.3)	2844 (26)
Admission Category						
Elective	87,040 (42.2)	2107 (16.6)	87,884 (42.3)	1263 (11.4)	87,762 (42.2)	1385 (12.6)
Urgent/Emergent	119,350 (57.8)	10,596 (83.4)	120,117 (57.7)	9829 (88.6)	120,378 (57.8)	9568 (87.4)

**FIG. 2.** Panel A: Percentage of each inpatient system burden measure attributable to high users of each definition. Panel B: Comparison of percentage of inpatient system burden attributable to each definition, overall and by age category.

uals accounted for 35.8% of cost. High users by number of inpatient episodes accounted for a lower burden of the other definitions (Figure 2). High-user system burden was higher among elderly patients (65+) for all definitions.

DISCUSSION

Using a large population-based cohort of all adults with at least 1 hospitalization in the province of Alberta, Canada, within a 12-month period, we compared 3 commonly used

definitions of high inpatient use. The choice of definition had a substantial influence on the types of patients categorized as high use, as well as the proportion of total inpatient utilization that was associated with high users. The definition based on number of inpatient episodes captured a distinct population of high users, while the populations identified using cumulative length of stay or cost were similar.

Differences within and between definitions were especially apparent in age-stratified analyses: Greater length of stay

or higher cost among patients aged 18-64 years identifies a large proportion of psychological conditions, while a greater number of inpatient episodes identifies acute conditions and childbirth or labor-related complications. Conversely, definitions based on length of stay and cost in the elderly (65+) identified groups with chronic conditions that result in progressive functional decline (often requiring increasing supportive services upon discharge) or conditions that require significant rehabilitation prior to discharge. Regarding inpatient system burden, high users defined by number of inpatient episodes accounted for a small proportion of total inpatient episodes, while high users defined by length of stay and cost accounted for nearly half of the accumulated hospital days and cost for each. These findings highlight the need for careful consideration of how high use is defined when studying high-user populations and implications for targeting subpopulations for intervention.

Our results add to those from previous studies. A US-based, single-center study of 2566 individuals compared definitions of high inpatient use based on cost and frequency of admission and found that patients defined by cost were predominantly hospitalized for surgical conditions, while those fulfilling the episode-based definition were often hospitalized for medical conditions.¹² The most responsible diagnoses for patient hospitalizations in our study reflect this. We extended this comparison to consider the impact of age on outcomes and inpatient system burden and found that older age was also linked to poorer outcomes and increased burden. We also considered a third definition (cumulative length of stay), which provided another opportunity for comparison. The presence of chronic conditions requiring rehabilitation and possible alternate level of care days within our cohort highlights the utility of this length of stay-based approach when considering definitions. Although there were similarities between patients defined by length of stay and cost, partly due to cost being largely a function of length of stay, there were also important differences in their patient profiles. Those defined by cost tended to have conditions requiring surgical procedures not requiring extended in-hospital rehabilitation. Furthermore, the higher proportion of in-hospital mortality among those defined by cost may also reflect the fact that patients tend to accrue the majority of their healthcare expenditures during the final 120 days of life.²⁴

Each definition of high use identified complex patients; however, the differences between the various types of high users identified by these definitions suggest that they are not interchangeable. Arguably, selection of the most appropriate definition should depend on the objective of measuring high users, particularly if an intervention is planned. Interventions for high users are complex, requiring both medical and nonmedical components. The current literature in this area has often focused on case management programs, collaboration with community-based social support programs, and improving coordination and transitions of care.²⁵⁻²⁷ While many of these approaches require considerable involvement

outside of the inpatient setting, these interventions can be informed by defining who high users of inpatient services are. Our findings show several possible subgroups of high users, which could be targeted for intervention. For example, an inpatient episode-based definition, which identifies patients with frequent encounters for acute conditions (eg, pneumonia and urinary tract infections), would be informative if an intervention targeted reductions in inpatient use and readmission rates. Alternatively, an intervention designed to improve community-based mental health programs would best be informed by a definition based on length of stay in which high users with underlying mental health conditions were prevalent. Such interventions are rarely mutually exclusive and require multiple perspectives to inform their objectives. A well-designed intervention will not only address the medical characteristics of high users but also the social determinants of health that place patients at risk of high inpatient use.

Our study should be interpreted in light of its limitations. First, measures of disease severity were not available to further characterize similarities and differences across high-use groups. Furthermore, we were unable to account for other social determinants of health that may be relevant to inpatient system usage. Second, direct cost of hospitalizations was estimated based on RIW and is thus reflective of expected rather than actual costs. However, this will have minimal impact on capture, as patients defined by this metric require substantial costs to be included in the top fifth percentile, and thus deviations in individual hospitalization costs will have minimal influence on the cumulative cost. Finally, while inpatient spending makes up a large proportion of healthcare spending, there is likely a number of different high-use profiles found outside of the acute care setting. Despite these limitations, our study includes several key strengths. The use of population-level data allows for analysis that is robust and more generalizable than studies from single centers. Additionally, the comparison of 3 independent definitions allows for a greater comparison of the nuances of each definition. Our study also considers the important impact of age as an effect modifier of inpatient use in the general population and identifies distinct patient profiles that exist across each definition.

CONCLUSIONS

Definitions of high use of inpatient services based on number of inpatient episodes, days spent in hospital, and total hospital costs identify patient populations with different characteristics and differ substantially in their impact on health outcomes and inpatient burden. These results highlight the need for careful consideration of the context of the study or intervention and the implications of selecting a specific definition of high inpatient use at study conception. Ultimately, the performance of an intervention in high-use populations is likely to be conditional on the fit of the patient population generated by the chosen definition of high inpatient use to the objectives of a study.

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