Health Reports

High use of acute care hospital services at age 50 or older

by Michelle Rotermann

Release date: September 20, 2017

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Statistics Canada, Catalogue no. 82-003-X • Health Reports, Vol. 28, no. 9, pp. 3-16, September 2017
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High use of acute care hospital services at age 50 or older

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Abstract

Background: A small fraction of the population accounts for a disproportionate share of health care spending and resources. Linking data from health surveys with hospital and death records offers an opportunity to examine high use of acute care in more depth than is possible with administrative data alone.

Data and methods: Data for 62,675 respondents to three cycles of the Canadian Community Health Survey were linked to the Discharge Abstract Database and the Canadian Mortality Database. Respondents were categorized according to cumulative annual days in hospital: high users (30 days or more), non-high users (1 to 29), or not hospitalized. Cross-tabulations stratified by age (50 to 74 and 75 or older) were used to describe the socio-demographic, health, health behaviour, and hospital experience characteristics of the three groups. Multinomial logit and logistic regression were used to examine associations between these characteristics and high use or no hospitalization versus non-high use.

Results: High users made up 0.5% of the population aged 50 to 74 and 2.6% of those aged 75 or older, but they accounted for 45.6% and 56.1%, respectively, of the days that people of these ages spent in hospital. Not having a partner, being at the end of life, having a neurological condition, as well as inactivity and comorbidity (ages 50 to 74) increased the odds of high use. Being female, not having major chronic conditions, not being at the end of life, normal/overweight, and being active were associated with no hospitalization.

Interpretation: Linking survey, hospital, and death data improves understanding of factors associated with high hospital use.

Keywords: Data linkage, health survey, hospital costs, hospital records, hospitalization, length of stay, mortality, vital statistics

Health care spending amounted to an estimated $218 billion in 2016 and represented more than 11% of Canada's Gross Domestic Product.[1] A small percentage of the population (1% to 5%) accounts for a large share of these health care costs and resource use.[2-8]

Disproportionate health care use has been observed in other countries, notably, the United States[9-14] and Australia.[15] However, American and Australian high users' experiences under two-tiered public/private health care systems may not be comparable to those of Canadian high users who have access to universal care.

In the context of a rapidly aging population, information about high users of hospital services continues to be of interest and importance. Better understanding of high use can help reduce hospital costs and improve outcomes.[16,17] Linked data from national health surveys, hospital administrative records, and death records offer an opportunity to study a broad range of factors associated with hospitalization.

The objectives of this analysis were to: 1) classify people aged 50 or older as: high hospital users, non-high users, or not hospitalized; and 2) compare the socioeconomic characteristics, health outcomes, health behaviours, and hospital experiences of the three groups. The analysis was based on a combined sample of household-dwelling respondents aged 50 or older from three cycles of the Canadian Community Health Survey, who were linked to hospital and death records.

Methods

Data sources

Canadian Community Health Survey

The cross-sectional Canadian Community Health Survey (CCHS) collects information about the health, lifestyle, and health care of the household population aged 12 or older. The survey excludes full-time members of the Canadian Forces, residents of institutions including long-term care facilities, and residents of Indian reserves and some remote areas (together representing around 4% of the target population).

Data for the three CCHS cycles used in this analysis (2007, 2008, and 2009) were collected over one-year periods by computer-assisted telephone and in-person interviews.[18] If individuals were unable to complete the survey, another knowledgeable person (proxy) could reply on their behalf (about 2% of all respondents). The average 2007-to-2009 response rate and sample size were 75.3% and 64,546, respectively (Appendix Table A).

Discharge Abstract Database

The Discharge Abstract Database (DAD) is a census of discharges from public hospitals (excluding Quebec).[19] Each year, the DAD compiles about 3 million records that contain demographic, administrative, and clinical information.[20] The present analysis used records from fiscal years 2006/2007 through 2009/2010.

Canadian Mortality Database

The Canadian Mortality Database (CMDB) is a census of deaths registered in Canada. It includes cause of death, birth and death dates, names, and postal code. Deaths that occurred from January 2007 through January 2010 were linked to the 2007-to-2009 CCHS.

Data linkage

The CCHS was linked to the DAD and CMDB using a probabilistic approach based on given and family names (CCHS-CMDB only), birthdate, sex, and postal code.[21-23] Linkages were con-

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ducted in accordance with the Directive on Record Linkage[24] and approved by Statistics Canada's Executive Management Board.[25]

Statistics Canada ensures respondent privacy during linkage and subsequent analysis of linked files. Only employees directly involved in the linkage process can access the identifying information; they do not have access to health- and/or death-related data. When linkage is complete, an analytical file is created from which identifying information has been removed. Linkage and validation documentation is available.[21,22]

Study sample

The study sample consisted of 62,675 respondents aged 50 or older to the 2007, 2008 or 2009 CCHS living in the provinces (excluding Quebec and the territories) who had agreed that their information might be shared and linked with other databases: 750 high users, 5,898 non-high users, and 56,027 people who were not hospitalized (Appendix Figure A). The three cycles were combined to attain sample sizes large enough to yield reliable estimates by hospital user category. Each cycle contributed one-third of study participants. The combined estimates do not represent the population in any particular year; rather, they reflect the average 2007-to-2009 household population. More information about combining CCHS cycles is available.[26]

Definitions

This analysis employs a Canadian Institute of Health Information definition of high use (30 or more days in hospital).[27] The percentile cut-off approach, which is typical of most high user studies, was not appropriate for the present analysis because the CCHS excludes some high-use subpopulations: children younger than age 12 and the institutionalized population (for example, seniors in long-term care).

Eligible CCHS respondents were classified based on acute care hospital days accumulated in the 365-day period

(according to admission date) after their CCHS interview (Appendix Figure A): high user (cumulative total of 30 or more days); non-high user (1 to 29 days); or not hospitalized (not linked; 0 days).

Before total hospital days per person were calculated, hospital episodes were constructed, whereby records with overlapping or nearly overlapping admission and discharge dates (one-day gaps accepted) were combined. Restructured episode-based hospital data are less susceptible to overestimating admission rates and underestimating length of stay.[28]

Socio-demographic variables were sex, household income, and marital status. *Household income deciles* were derived by calculating the ratio of total annual household income to Statistics Canada's low-income cut-off and were collapsed into the lowest 30% of households versus others (with imputation; no missing). To minimize regional differences, province-specific income deciles were estimated separately and then combined.

Marital status was split into with partner (married or common-law) or no partner (single never married, separated, divorced, or widowed).

The year before death often involves greater health care use. By linking CCHS respondents to the CMDB, it was possible to identify *end-of-life* respondents (died within one year of the CCHS interview).

Health status variables included six chronic conditions: *incontinence, mental health condition* (mood and anxiety disorders), *heart disease, diabetes, neurological conditions* (stroke, dementia or Alzheimer's), and *chronic obstructive pulmonary disease* (emphysema).

Health behaviours were *physical activity* and corrected *body mass index* (BMI = weight in kilograms/height in meters squared). Among older adults, physical inactivity may be indicative of mobility impairment, a risk factor for morbidity, hospitalization, disability, and death.[29] Based on the sum of average daily energy expenditure, respondents

What is already known on this subject?

- High users are a small fraction of the population, but they account for a disproportionate share of total health expenditures and resources.

- Hospital administrative data show that high use tends to be associated with advancing age, chronic disease, and mobility impairment.

- Less is known about factors *not* available in hospital data, such as end of life, marital status, weight, and inactivity.

- Most Canadian studies of hospital use pertain to individual provinces.

What does this study add?

- Linking survey and hospital administrative data yielded a large national database with which to study high use of acute care hospital services at age 50 or older.

- A neurological condition, non-zero Charlson score (ages 50 to 74), discharge to long-term care, end of life, inactivity and not having a partner increased the odds of high use versus non-high use.

- Being female, normal or overweight, physically active, not having several major diseases, and not being at the end of life were associated with no hospitalization versus being a non-high user.

were classified as inactive (less than 1.5 kilocalories/kilogram of body-weight/day) or active.

Weight extremes can increase the risk of death and chronic conditions.[30,31] The BMI categories were: underweight (less than 18.5), normal/overweight (18.5 to less than 30.0), and obese (30.0 or more). Normal and overweight were combined, as some excess weight can be protective.[30] A correction factor was applied to reduce bias from self-reported weight

and height.[32] A missing category was included to retain as many records as possible in the multivariate analyses.

Hospital experience factors were the Charlson comorbidity index and discharge to long-term care. The *Charlson comorbidity index* identifies 17 comorbidities, each of which has an associated weight (1 to 6), based on diagnosis codes from hospital records, excluding post-admission conditions.[33,34] These weights were summed to create a per patient comorbidity score. For this analysis, scores were collapsed into 0 (no comorbidity) and 1 (comorbidity/more serious). Hospital records with admission dates within 365 days of the CCHS interview were examined; multiple occurrences of comorbidities were counted only once.

Patients transferred to "homes for the aged" or "nursing homes" were considered to have been discharged to long-term care. All other transfer destinations were grouped as non-long-term care. The last chronological hospital record, based on admission and discharge dates, was used to ascertain discharge to long-term care.

Each hospital record contains up to 25 diagnoses from the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Canada* (ICD-10-CA). The first one or two characters of the "most responsible diagnosis," which refer to the most significant diagnosed condition and/or account for the longest stay, were used to sort hospital records (and the associated patients) into diagnostic chapters. The first three digits were used for the ICD-10 subcategory.

Analytical techniques

Cross-tabulations were used to estimate the percentage distribution of the household population aged 50 or older among the three hospital use categories and the corresponding total/average hospital days used, number of episodes of care, leading diagnoses, and other characteristics.

Unadjusted and adjusted multinomial logit and logistic regression models were fitted to assess independent associations between the three hospital user groups and health status (end of life, incontinence, mental health condition, heart disease, diabetes, neurological condition, and chronic obstructive pulmonary disease), socio-demographic characteristics (sex, household income, marital status), health behaviours (inactivity, BMI), and hospital experience factors (Charlson comorbidity index score, transfer to long-term care). Selection of covariates was guided by the literature and data availability.

High users and no hospitalization were compared with non-high users (reference category). Because the Charlson comorbidity index score and discharge to long-term care pertained only to people who were hospitalized, models were also run to estimate the odds of high use versus non-high use.

Sampling weights were used to account for survey design and non-response, and to adjust for agreement to share and link. Because three cycles of data were combined, the sampling weights were further adjusted by a factor of three. All tabulations were produced by age group, and all computations used weighted data.

Bootstrap weights were applied using SAS and SAS callable SUDAAN 11.0 to account for underestimation of standard errors due to the complex survey design.[35] Results at the $p < 0.05$ level were considered statistically significant.

Results

Minority use half of hospital days

At age 50 or older, the norm for the vast majority (91.4%) of Canadians population is ***no*** hospitalization. Each year from 2006/2007 through 2009/2010, about 7% (449,900) of people aged 50 to 74 were admitted to acute care hospitals; at age 75 or older, the percentage was close to 17% (239,300). Of these hospital patients, a minority—an average of 33,800 aged 50 to 74 and 36,000 aged 75 or older—were high users, in that they spent at least 30 days in hospital during the year (Tables 1 and 2).

High users made up 0.5% of the household population aged 50 to 74, but accounted for 45.6% (2.0 million) of all hospital days accumulated by people of these ages (Table 3). High users aged 75 or older represented 2.6% of the household population in that age range, but 56.1% (2.2 million) of all hospital days attributable to the 75-or-older age group.

The percentage of each senior age group who were high users was similar in most provinces. The exceptions were Ontario, where the estimate for those aged 75 or older was relatively low, and Saskatchewan and Manitoba, where estimates were relatively high for the 50-to-74 age group and the 75-or-older age group, respectively (Table 3). The shares of hospital days attributable to high users varied from 35.6% (New Brunswick) to 57.1% (Prince Edward Island) of patients aged 50 to 74, and from 46.5% (Newfoundland and Labrador) to 73.3% (Manitoba) of patients aged 75 or older.

Multiple admissions/Long stays

High users' hospital experiences differed from those of non-high users (1 to 29 days in hospital). Close to 60% of high users aged 50 to 74 were admitted more than once in the year; for high users aged 75 or older, the percentage was 51.8% (Table 4). Among non-high users, the percentages admitted more than once were 16.2% at ages 50 to 74 and 22.4% at age 75 or older.

High users spent an average of two months in hospital, compared with about a week for non-high users.

Lack partner, end of life

Regardless of whether they were high users or non-high users, a slight majority of hospital patients aged 50 to 74 were men; at age 75 or older, the majority of patients were women (Tables 1 and 2). This imbalance largely reflects greater male mortality.

At ages 50 to 74, high users were more likely than non-high users to be in the lowest household income group (47.0% versus 34.4%). At age 75 or older, the

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Table 1

Distribution of socio-demographic, health, health behaviour and hospital experience characteristics, by hospital user category, household population aged 50 to 74, Canada excluding Quebec and territories, 2007 to 2009

| Characteristics | High users (30 or more days in one year) | | | | Non-high users† (fewer than 30 days in one year) | | | | Not hospitalized | | | |
| | 000s | % | 95% confidence interval | | 000s | % | 95% confidence interval | | 000s | % | 95% confidence interval | |
			from	to			from	to			from	to
Population aged 50 to 74 (number and %)	33.8	0.5	0.4	0.6	416.1	6.2	5.9	6.6	6,253.2	93.3	92.9	93.6
Socio-demographic												
Average age (years)	...	63.6	61.3	65.8	...	62.3	61.9	62.7	...	59.6*	59.5	59.7
Sex												
Men	17.8	52.8	42.9	62.5	216.7	52.1	49.4	54.7	3,063.0	49.0	48.4	49.5
Women	15.9	47.2	37.5	57.1	199.4	47.9	45.3	50.6	3,190.2	51.0	50.5	51.6
Household income												
Not lowest	17.9	53.0	42.4	63.3	273.2	65.6	63.0	68.2	4,567.5	73.0	72.2	73.9
Lowest	15.9	47.0*	36.7	57.6	143.0	34.4	31.8	37.0	1,685.7	27.0*	26.1	27.8
Marital status												
With partner	21.2	62.8	53.5	71.2	307.0	74.1	71.7	76.3	4,791.1	76.8	75.9	77.7
No partner	12.6	37.2*	28.8	46.5	107.6	25.9	23.7	28.3	1,446.6	23.2*	22.3	24.1
Health												
End of life												
Alive full 365 days	26.8	79.5	71.6	85.6	395.9	95.1	94.0	96.0	6,240.0	99.8	99.7	99.8
Died	6.9	20.5E*	14.4	28.4	20.2	4.9	4.0	6.0	13.2	0.2*	0.2	0.3
Incontinence												
No	29.5	87.4	81.7	91.5	369.3	88.8	87.2	90.2	5,930.0	94.9	94.6	95.2
Yes	4.3	12.6E	8.5	18.3	46.6	11.2	9.8	12.8	317.3	5.1*	4.8	5.4
Mental health condition												
No	26.6	78.8	71.2	84.8	352.5	84.8	82.8	86.7	5,555.2	89.0	88.4	89.5
Yes	7.2	21.2	15.2	28.8	63.2	15.2	13.3	17.2	689.2	11.0*	10.5	11.6
Heart disease												
No	25.2	74.6	66.1	81.5	341.4	82.3	80.3	84.2	5,760.2	92.4	92.0	92.8
Yes	8.6	25.4	18.5	33.9	73.4	17.7	15.8	19.7	475.6	7.6*	7.2	8.0
Diabetes												
No	25.1	74.2	66.6	80.6	331.8	79.8	77.4	82.0	5,548.5	88.8	88.3	89.3
Yes	8.7	25.8	19.4	33.4	84.0	20.2	18.0	22.6	699.3	11.2*	10.7	11.7
Neurological												
No	29.4	87.2	80.4	91.9	396.7	95.7	94.5	96.6	6,120.6	98.0	97.8	98.2
Yes	4.3	12.8E*	8.1	19.6	18.0	4.3	3.4	5.5	125.2	2.0*	1.8	2.2
Chronic obstructive pulmonary disease												
No	28.7	85.0	77.1	90.6	379.1	91.5	90.1	92.7	6,032.4	96.7	96.5	97.0
Yes	5.0	15.0E	9.4	22.9	35.3	8.5	7.3	9.9	202.7	3.3*	3.0	3.5
Health behaviour												
Physical activity												
Active	6.3	20.1E	13.7	28.5	163.2	40.8	38.3	43.5	3,007.5	49.2	48.4	50.1
Inactive	25.2	79.9*	71.5	86.3	236.5	59.2	56.5	61.7	3,101.5	50.8*	49.9	51.6
Body mass index (corrected)												
Underweight	F	F	...	...	6.3	1.5E	1.0	2.4	47.6	0.8*	0.6	0.9
Normal/Overweight	19.2	57.0	47.4	66.0	237.9	57.2	54.4	59.9	4,174.2	66.8*	66.0	67.5
Obese	11.2	33.2	25.2	42.3	150.4	36.1	33.5	38.8	1,770.7	28.3*	27.6	29.0
Missing	2.8	8.2E	5.2	12.6	21.6	5.2	4.1	6.6	260.8	4.2	3.8	4.5
Hospital experience												
Charlson comorbidity index score												
Average	...	0.48*	0.35	0.61	...	0.23	0.20	0.25	...	...	...	...
0	21.1	62.4*	51.6	72.1	328.4	78.9	76.6	81.0	...	...	...	...
1	12.7	37.6*	27.9	48.4	87.8	21.1	19.0	23.4	...	...	...	...
Discharged to long-term care												
No	32.3	95.7	92.6	97.5	414.8	99.7	99.4	99.8	...	...	...	...
Yes	1.5	4.3E	2.5	7.4	F	F	...	...	...	...	...	...

... not applicable
E use with caution
F too unreliable to be published
* significantly different from reference category (p < 0.05)
† reference category
Source: 2007 to 2009 Canadian Community Health Surveys linked to 2006/2007 to 2009/2010 Discharge Abstract Database and 2007 to 2010 Canadian Mortality Database.

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Table 2
Distribution of socio-demographic, health, health behaviour and hospital experience characteristics, by hospital user category, household population aged 75 or older, Canada excluding Quebec and territories, 2007 to 2009

| Characteristics | High users (30 or more days in one year) | | | | Non-high users† (fewer than 30 days in one year) | | | | Not hospitalized | | | |
| | 000s | % | 95% confidence interval | | 000s | % | 95% confidence interval | | 000s | % | 95% confidence interval | |
			from	to			from	to			from	to
Population aged 75 or older (number and %)	36.0	2.6	2.2	3.1	203.3	14.8	13.9	15.6	1,138.3	82.6	81.7	83.5
Socio-demographic												
Average age (years)	…	82.4	81.5	83.3	…	81.4	81.1	81.7	…	80.5*	80.4	80.6
Sex												
Men	15.6	43.4	36.1	51.0	96.5	47.5	44.5	50.5	477.2	41.9*	40.7	43.1
Women	20.4	56.6	49.0	63.9	106.8	52.5	49.5	55.5	661.1	58.1*	56.9	59.3
Household income												
Not lowest	14.7	40.8	33.8	48.3	94.3	46.4	43.5	49.3	589.7	51.8*	50.2	53.4
Lowest	21.3	59.2	51.7	66.2	109.0	53.6	50.7	56.5	548.6	48.2*	46.6	49.8
Marital status												
With partner	14.1	39.1	31.9	46.8	104.8	51.7	48.8	54.6	606.1	53.3	51.7	54.8
No partner	21.9	60.9*	53.2	68.1	97.9	48.3	45.4	51.2	531.7	46.7	45.2	48.3
Health												
End of life												
Alive full 365 days	26.4	73.3	65.9	79.7	180.3	88.7	86.6	90.4	1,127.4	99.0	98.7	99.3
Died	9.6	26.7*	20.3	34.1	23.0	11.3	9.6	13.4	10.9	1.0*	0.7	1.3
Incontinence												
No	25.0	71.5	63.1	78.6	163.4	80.5	78.0	82.8	967.1	85.2	84.1	86.2
Yes	10.0	28.5	21.4	36.9	39.5	19.5	17.2	22.0	168.0	14.8*	13.8	15.9
Mental health condition												
No	30.9	87.8	83.3	91.2	186.0	91.6	89.9	93.1	1,055.2	93.0	92.3	93.7
Yes	4.3	12.2	8.8	16.7	17.0	8.4	6.9	10.1	79.0	7.0	6.3	7.7
Heart disease												
No	22.0	61.8	53.7	69.2	133.4	66.0	63.0	68.8	895.3	79.1	77.9	80.2
Yes	13.6	38.2	30.8	46.3	68.8	34.0	31.2	37.0	236.3	20.9*	19.8	22.1
Diabetes												
No	28.6	80.0	72.1	86.1	159.2	78.4	75.7	80.9	950.7	83.6	82.3	84.7
Yes	7.2	20.0ᴱ	13.9	27.9	43.8	21.6	19.1	24.3	187.1	16.4*	15.3	17.7
Neurological condition												
No	26.6	74.7	65.9	81.8	178.8	88.5	86.3	90.4	1,035.7	91.3	90.4	92.1
Yes	9.0	25.3	18.2	34.1	23.3	11.5	9.6	13.7	99.0	8.7*	7.9	9.6
Chronic obstructive pulmonary disease												
No	29.8	86.4	80.4	90.9	178.2	88.2	86.2	90.0	1,059.2	93.7	92.9	94.4
Yes	4.7	13.6ᴱ	9.1	19.6	23.8	11.8	10.0	13.8	71.7	6.3*	5.6	7.1
Health behaviour												
Body mass index (corrected)												
Underweight	0.8	2.1	0.9	4.9	5.5	2.7	1.8	4.0	18.2	1.6	1.3	2.0
Normal/Overweight	20.2	56.3	48.4	63.8	126.7	62.3	58.8	65.7	788.5	69.3*	67.9	70.6
Obese	5.3	14.8	11.0	19.7	39.4	19.4	16.9	22.1	193.4	17.0	16.0	18.0
Missing	9.6	26.8*	19.8	35.1	31.7	15.6	13.1	18.4	138.1	12.1	11.0	13.4
Physical activity												
Active	4.4	15.7	11.6	20.8	58.2	32.8	29.6	36.1	399.7	38.7	37.0	40.3
Inactive	24.0	84.3	79.2	88.4	119.5	67.2	63.9	70.4	634.0	61.3*	59.7	63.0
Hospital experience												
Charlson comorbidity index score												
Average	…	0.46*	0.36	0.56	…	0.25	0.22	0.28	…	…	…	…
0	22.7	63.0*	54.7	70.5	158.2	77.8	75.1	80.2	…	…	…	…
1	13.3	37.0*	29.5	45.3	45.1	22.2	19.8	24.9	…	…	…	…
Discharged to long-term care												
No	28.9	80.3	74.9	84.8	194.7	95.8	94.2	96.9	…	…	…	…
Yes	7.1	19.7*	15.2	25.1	8.6	4.2	3.1	5.8	…	…	…	…

… not applicable
ᴱ use with caution
* significantly different from reference category (p < 0.05)
† reference category
Source: 2007 to 2009 Canadian Community Health Surveys linked to 2006/2007 to 2009/2010 Discharge Abstract Database and 2007 to 2010 Canadian Mortality Database.

Table 3
Percentage of household population aged 50 or older classified as high hospital users and number/percentage of total hospital days, by province and age group, Canada excluding Quebec and territories, 2007 to 2009

	High users as % of age group						Hospital days of high users							
	50 to 74			75 or older			50 to 74				75 or older			
								% of total days spent in hospital by age group				% of total days spent in hospital by age group		
		95% confidence interval			95% confidence interval				95% confidence interval				95% confidence interval	
Province	%	from	to	%	from	to	Number (000s)	%	from	to	Number (000s)	%	from	to
Canada (excluding Quebec and territories)	0.5	0.4	0.6	2.6	2.2	3.1	1,995.4	45.6	39.2	51.9	2,243.7	56.1	51.7	60.4
Newfoundland and Labrador	0.4E	0.2	0.7	F	…	…	35.0	35.8E	21.3	50.3	32.1	46.5E	27.6	65.4
Prince Edward Island	0.6E	0.3	1.1	F	…	…	21.8	57.1E	34.5	79.7	25.9	61.5E	40.0	82.9
Nova Scotia	0.4E	0.3	0.7	3.0E	1.8	4.9	93.1	45.1	30.7	59.5	94.3	52.1	36.8	67.3
New Brunswick	0.6E	0.3	1.1	4.2E	2.7	6.5	74.7	35.6E	19.7	51.6	151.3	69.1	54.1	84.2
Ontario	0.4E	0.3	0.7	2.1*	1.6	2.9	936.2	45.4	32.9	57.9	878.2	49.9*	41.9	57.8
Manitoba	0.6E	0.3	1.0	5.4*	4.0	7.4	93.3	43.1	29.6	56.6	230.8	73.3*	64.6	82.1
Saskatchewan	1.0E*	0.7	1.5	2.8E	2.0	4.0	145.3	54.3	41.8	66.9	117.9	52.3	39.8	64.8
Alberta	0.8E	0.5	1.2	2.6E	1.6	4.2	346.9	54.5	39.8	69.2	275.8	59.5	46.0	73.0
British Columbia	0.4E	0.2	0.6	2.7	2.0	3.7	249.1	38.8	28.0	49.6	437.4	60.4	50.6	70.1

… not applicable
E use with caution
F too unreliable to be published
* significantly different from rest of Canada (p < 0.05); for example, Ontario compared with Canada excluding Ontario
Source: 2007 to 2009 Canadian Community Health Surveys linked to 2006/2007 to 2009/2010 Discharge Abstract Database and 2007 to 2010 Canadian Mortality Database.

difference between high and non-high users was not significant. Those in both age groups who had not been hospitalized were less likely to be in the lowest household income group.

High users were more likely than non-high users to lack a partner. As well, at ages 50 to 74, people with a partner were less likely to have been admitted to hospital.

Being at the end of life was strongly related to high hospital use. Among high users, 20.5% of those aged 50 to 74 and 26.7% of those aged 75 or older died within a year of hospitalization. The corresponding figures for non-high users were 4.9% and 11.3%. And among people who were not hospitalized, being near death was rare (0.2% at ages 50 to 74 and 1.0% at age 75 or older).

As might be expected, chronic conditions were more prevalent among high users, but few differences were statistically significant.

Table 4
Number of hospitalization episodes and average hospital days per person, by age group and hospital user category, household population aged 50 or older, Canada excluding Quebec and territories, 2007 to 2009

	50 to 74								75 or older							
	High users				Non-high users				High users				Non-high users			
			95% confidence interval				95% confidence interval				95% confidence interval				95% confidence interval	
Number of episodes	000s	%	from	to	000s	%	from	to	000s	%	from	to	000s	%	from	to
Total	33.8	100.0	…	…	416.1	100.0	…	…	36.0	100.0	…	…	203.3	100.0	…	…
1	13.9	41.1*	30.4	52.8	348.5	83.8	81.8	85.5	17.3	48.2*	40.7	55.7	157.8	77.6	75.0	80.1
2	9.5	28.3*	21.6	36.0	50.9	12.2	10.7	14.0	7.9	22.0	16.9	28.2	34.5	17.0	14.8	19.4
3	3.8	11.3E*	7.5	16.5	11.0	2.6	2.0	3.5	6.8	18.8E*	12.6	27.3	9.0	4.4	3.5	5.6
4	3.6	10.5E*	6.4	16.7	4.0	1.0E	0.7	1.4	2.3	6.5E*	3.5	11.8	1.5	0.8E	0.4	1.4
5 or more	3.0	8.8E*	5.5	13.8	1.7	0.4	0.2	1.0	1.6	4.4E	2.7	7.1	F	…	…	
Average days per person		59.1*	54.1	64.1		5.7	5.4	6.0		62.4*	57.4	67.4		8.6	8.2	9.1

… not applicable
E use with caution
F too unreliable to be published
* significantly different from non-high users (p < 0.05)
Source: 2007 to 2009 Canadian Community Health Surveys linked to 2006/2007 to 2009/2010 Discharge Abstract Database and 2007 to 2010 Canadian Mortality Database.

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Table 5
Unadjusted and adjusted odds relating selected characteristics to high hospital use or not hospitalized versus non-high use during one-year period, household population aged 50 to 74, Canada excluding Quebec and territories, 2007 to 2009

Characteristics	High use versus non-high use									Not hospitalized versus non-high use					
	Unadjusted			Model 1 Adjusted			Model 2 Adjusted + hospital experience			Unadjusted			Model 1 Adjusted		
	Odds ratio	95% confidence interval		Odds ratio	95% confidence interval		Odds ratio	95% confidence interval		Odds ratio	95% confidence interval		Odds ratio	95% confidence interval	
		from	to		from	to		from	to		from	to		from	to
Socio-demographic															
Sex															
Men†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Women	0.97	0.64	1.48	0.99	0.64	1.51	0.81	0.50	1.31	1.13*	1.01	1.27	1.38*	1.15	1.66
Household income															
Not lowest†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Lowest	1.70*	1.10	2.62	0.85	0.55	1.32	1.20	0.75	1.92	0.71*	0.62	0.80	0.89	0.75	1.06
Marital status															
With partner†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
No partner	1.69*	1.14	2.51	2.12*	1.37	3.29	1.54*	1.00	2.36	0.86*	0.76	0.98	0.92	0.77	1.09
Health															
End of life															
Alive full 365 days†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Died	5.05*	3.14	8.10	2.26*	1.29	3.96	4.09*	2.20	7.60	0.04*	0.03	0.06	0.07*	0.04	0.11
Incontinence															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	1.14	0.71	1.85	1.50	0.98	2.29	0.91	0.52	1.57	0.42*	0.36	0.50	0.79*	0.64	0.97
Mental health condition															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	1.50	0.96	2.34	1.13	0.64	2.01	1.21	0.74	1.97	0.69*	0.59	0.81	1.00	0.75	1.33
Heart disease															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	1.59*	1.03	2.43	1.06	0.71	1.57	0.99	0.64	1.54	0.38*	0.33	0.45	0.60*	0.50	0.72
Diabetes															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	1.37	0.92	2.05	0.83	0.57	1.20	0.87	0.52	1.47	0.50*	0.43	0.58	0.73*	0.60	0.89
Neurological condition															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	3.23*	1.85	5.65	2.17*	1.25	3.74	2.51*	1.15	5.47	0.45*	0.35	0.59	0.83	0.62	1.12
Chronic obstructive pulmonary disease															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	1.89*	1.08	3.31	0.92	0.44	1.91	1.31	0.65	2.61	0.36*	0.30	0.43	0.54*	0.42	0.70
Health behaviour															
Body mass index (corrected)															
Underweight	1.09	0.37	3.26	0.30*	0.11	0.80	0.60	0.16	2.20	0.43*	0.26	0.73	0.51*	0.27	0.95
Normal/Overweight†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Obese	0.92	0.59	1.44	0.85	0.55	1.31	0.82	0.50	1.34	0.67*	0.59	0.76	0.77*	0.62	0.96
Physical activity															
Active†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Inactive	2.74*	1.71	4.42	2.19*	1.39	3.45	2.52*	1.38	4.61	0.71*	0.64	0.80	0.89*	0.74	1.06
Hospital experience															
Charlson comorbidity index score															
0†	1.00	…	…	…	…	…	1.00	…	…	…	…	…	…	…	…
1	2.26*	1.39	3.65	…	…	…	2.13*	1.16	3.90	…	…	…	…	…	…
Discharged to long-term care															
No†	1.00	…	…	…	…	…	1.00	…	…	…	…	…	…	…	…
Yes	13.93*	4.90	39.66	…	…	…	13.14*	3.36	51.45	…	…	…	…	…	…

… not applicable
* significantly different from reference category (p < 0.05)
† reference category
Note: Missing category for body mass index included in models, but not shown.
Source: 2007 to 2009 Canadian Community Health Surveys linked to 2006/2007 to 2009/2010 Discharge Abstract Database and 2007 to 2010 Canadian Mortality Database.

Table 6
Unadjusted and adjusted odds relating selected characteristics to high hospital use or not hospitalized versus non-high use during one-year period, household population aged 75 or older, Canada excluding Quebec and territories, 2007 to 2009

| | High use versus non-high use | | | | | | | | | Not hospitalized versus non-high use | | | | | |
| | Unadjusted | | | Model 1 Adjusted | | | Model 2 Adjusted + hospital experience | | | Unadjusted | | | Model 1 Adjusted | | |
Characteristics	Odds ratio	95% confidence interval from	to	Odds ratio	95% confidence interval from	to	Odds ratio	95% confidence interval from	to	Odds ratio	95% confidence interval from	to	Odds ratio	95% confidence interval from	to
Socio-demographic															
Sex															
Men†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Female	1.18	0.85	1.64	0.86	0.54	1.38	0.86	0.56	1.32	1.25*	1.09	1.44	1.16*	1.02	1.31
Household income															
Not lowest†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Lowest	1.25	0.92	1.72	1.10	0.67	1.81	0.76	0.52	1.12	0.80*	0.71	0.91	0.91	0.77	1.08
Marital status															
With partner†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
No partner	1.67*	1.20	2.32	1.72*	1.13	2.63	2.04*	1.33	3.13	0.94	0.82	1.07	0.95	0.82	1.09
Health															
End of life															
Alive full 365 days†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Died	2.85*	1.87	4.34	4.59*	2.55	8.25	2.83*	1.66	4.83	0.08*	0.05	0.11	0.05*	0.03	0.08
Incontinence															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	1.65*	1.10	2.47	0.91	0.51	1.64	1.37	0.89	2.11	0.72*	0.61	0.85	0.50*	0.40	0.61
Mental health condition															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	1.52*	1.00	2.32	1.06	0.69	1.63	0.86	0.46	1.61	0.82	0.65	1.03	0.87	0.73	1.04
Heart disease															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	1.20	0.84	1.72	1.03	0.65	1.62	1.07	0.73	1.58	0.51*	0.44	0.60	0.51*	0.43	0.61
Diabetes															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	0.91	0.58	1.43	1.29	0.83	1.99	0.81	0.52	1.26	0.72*	0.60	0.85	0.67*	0.55	0.81
Neurological condition															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	2.61*	1.62	4.20	1.21	0.56	2.62	1.69*	1.01	2.81	0.73*	0.59	0.92	0.80	0.54	1.18
Chronic obstructive pulmonary disease															
No†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Yes	1.18	0.73	1.89	1.19	0.70	2.02	0.99	0.49	2.00	0.51*	0.40	0.64	0.58*	0.47	0.72
Health behaviour															
Body mass index (corrected)															
Underweight	0.88	0.30	2.56	0.69	0.22	2.21	0.64	0.23	1.78	0.53*	0.33	0.87	0.47*	0.27	0.81
Normal/Overweight†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Obese	0.85	0.57	1.26	0.73	0.46	1.15	1.03	0.67	1.59	0.79*	0.65	0.96	0.81*	0.70	0.94
Physical activity															
Active†	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…	1.00	…	…
Inactive	2.62*	1.79	3.84	2.81*	1.66	4.76	2.26*	1.45	3.52	0.77*	0.66	0.91	0.81*	0.72	0.92
Hospital experience															
Charlson comorbidity index score															
0†	1.00	…	…	…	…	…	1.00	…	…	…	…	…	…	…	…
1	2.06*	1.46	2.92	…	…	…	1.40	0.91	2.17	…	…	…	…	…	…
Discharged to long-term care															
No†	1.00	…	…	…	…	…	1.00	…	…	…	…	…	…	…	…
Yes	5.58*	3.55	8.75	…	…	…	7.15*	4.20	12.16	…	…	…	…	…	…

… not applicable
* significantly different from reference category (p < 0.05)
† reference category
Note: Missing category for body mass index included in models, but not shown.
Source: 2007 to 2009 Canadian Community Health Surveys linked to 2006/2007 to 2009/2010 Discharge Abstract Database and 2007 to 2010 Canadian Mortality Database.

Statistics Canada, Catalogue no. 82-003-X • Health Reports, Vol. 28, no. 9, pp. 3-16, September 2017
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Table 7

Top five diagnostic categories, by age group and hospital user category, household population aged 50 or older, Canada excluding Quebec and territories, 2007 to 2009

Age group and hospital user category	Most responsible diagnostic category (ICD-10 chapter)	Number 000s	%	95% confidence level from	to	Most frequent ICD-10 subcategory: plain language description
50 to 74						
High users						
	Neoplasms (2)	7.3	21.7[E]	11.2	37.9	Malignant neoplasm of bronchus and lung (C34): lung cancer
	Diseases of circulatory system (9)	6.3	18.6[E]	12.6	26.4	Acute myocardial infarction (I21): heart attack
	Diseases of respiratory system (10)	3.8	11.2[E]	7.3	16.9	Other chronic obstructive pulmonary disorder (J44)
	Diseases of digestive system (11)	3.2	9.6[E]	6.2	14.6	Inguinal hernia repair (K40): hernia repair
	Injury, poisoning, other consequences of external causes (19)	2.9	8.7[E]	5.1	14.4	Fracture of femur (S72): broken leg
Non-high users						
	Diseases of circulatory system (9)	76.3	18.3	16.3	20.6	Acute myocardial infarction (I21): heart attack
	Diseases of musculoskeletal system and connective tissue (13)	62.9	15.1	13.0	17.5	Arthrosis of knee (M17): knee replacement
	Diseases of digestive system (11)	55.8	13.4	11.7	15.3	Cholethiasis (K80): gall bladder attack
	Neoplasms (2)	50.5	12.1	10.5	13.9	Neoplasm of the breast (C50): breast cancer
	Diseases of genitourinary system (14)	33.3	8.0	6.3	10.1	Female genital prolapse (N81): pelvic floor disorder
75 or older						
High users						
	Diseases of circulatory system (9)	7.7	21.3	16.0	27.8	Acute myocardial infarction (I21): heart attack
	Injury, poisoning, other consequences of external causes (19)	4.1	11.5[E]	8.1	16.2	Fracture of femur (S72): broken leg
	Symptoms, signs, abnormal clinical and laboratory findings, not elsewhere classified (18)	3.3	9.1[E]	5.5	14.5	Pain in throat and chest (R07)
	Diseases of respiratory system (10)	3.2	8.9[E]	5.1	15.1	Other chronic obstructive pulmonary disorder (J44)
	Neoplasms (2)	3.0	8.4[E]	5.3	13.1	Malignant neoplasm of prostate (C61): prostate cancer
Non-high users						
	Diseases of circulatory system (9)	43.9	21.6	19.0	24.5	Acute myocardial infarction (I21): heart attack
	Diseases of digestive system (11)	23.0	11.3	9.5	13.4	Cholethiasis (K80): gall bladder attack
	Diseases of respiratory system (10)	22.7	11.2	9.4	13.3	Other chronic obstructive pulmonary disorder (J44)
	Injury, poisoning, other consequences of external causes (19)	18.5	9.1	7.5	11.0	Fracture of femur (S72): broken leg
	Diseases of musculoskeletal system and connective tissue (13)	18.1	8.9	7.3	10.9	Arthrosis of knee (M17): knee replacement

[E] use with caution
Source: 2007 to 2009 Canadian Community Health Surveys linked to 2006/2007 to 2009/2010 Discharge Abstract Database and 2007 to 2010 Canadian Mortality Database.

Physical *inactivity* was more common among high users than among non-high users and less common among people who were not hospitalized.

No statistically significant differences across BMI categories were apparent between high users and non-high users. However, significantly lower percentages of 50- to 74-year-olds who were not hospitalized were underweight (0.8%) or obese (28.3%). These associations were not found at age 75 or older.

In both age groups, the prevalence of hospital stays with a serious comorbidity (Charlson comorbidity index score = 1) was greater among high users than non-high users. And at age 75 or older, discharge to long-term care was more common among high users than non-high users (19.7% versus 4.2%).

Of course, socio-demographic characteristics, poor health and health behaviour are not independent. When relationships among these factors were taken into account, some of the associations indicating increased odds of high use versus non-high use were no longer significant (Tables 5 and 6). For other associations, the effect size was changed (usually reduced). Nonetheless, the odds of high use remained elevated among people who did not have a partner (Model 2, Tables 5 and 6). Similarly, end of life, a neurological condition, physical inactivity, a non-zero Charlson score (ages 50 to 74), and discharge to long-

term care remained strongly associated with high use.

When hospital use versus no hospitalization was examined in multivariate models, many associations persisted, albeit with some attenuation. In particular, being female continued to be protective against hospitalization, while end-of-life, incontinence, heart disease, diabetes, chronic obstructive pulmonary disease, weight extremes, and inactivity each increased the risk.

Leading diagnoses

At ages 50 to 74, the five leading causes of hospitalization for high users were neoplasms, circulatory diseases, respiratory diseases, digestive diseases, and injuries (Table 7). For non-high users, musculoskeletal/connective tissue diseases and genitourinary diseases ranked among the top five, supplanting respiratory diseases and injuries. As well, the rank order of causes differed between the two groups.

At age 75 or older, the five leading causes of hospitalization for high users were circulatory diseases, injuries, unspecified symptoms and signs, respiratory diseases, and neoplasms. Among non-high users, the leading causes were similar, except that digestive diseases and musculoskeletal/connective tissue diseases replaced neoplasms and unspecified symptoms and signs. Again, the relative ranking of causes differed between the two groups.

Discussion

The present analysis supports earlier research reporting that a small fraction of the population accounts for a large share of health care costs and resources.[3-8,10-14] High users made up 0.5% of the population aged 50 to 74 and 2.6% of those aged 75 or older, but they accumulated about half of all hospital days (45.6% and 56.1%, respectively) recorded for people of these ages, and each patient averaged two months in hospital during the year.

Illness, of course, is the fundamental determinant of hospitalization. By definition, high users are less healthy than

non-high users and people who are not hospitalized. High users have been shown to be more likely to report their health as fair/poor,[4,10] to have a high disease burden,[2,7,14,15,36] and to have mobility limitations or disabilities.[10,36] The linked CCHS, DAD and CMDB data reveal that factors associated with high use included end of life, a neurological condition, and higher Charlson comorbidity index scores.

The ability to determine which patients were at the end of life facilitates interpretation of the results. Few studies have controlled for vital status ascertained from records of subsequent death,[15] although some have used in-hospital death[6,9] or insurance registries.[3,7]

The association between neurological conditions and high use in the present study is well-established[3,6,12] and expected, given the accompanying cognitive and mobility impairments that can slow recovery and compromise independent living.[17,37,38]

Because the diagnostic chapters responsible for hospitalization largely depend on the age of the population studied,[3,6,12] similarities in the leading ICD chapters for which high users and non-high users were hospitalized were expected. Serious cardiovascular events such as heart attacks ranked among the top five for both groups. The leading diagnoses that were unique to non-high users were less serious, age-related conditions such as joint replacement or gallbladder removal, which require short hospital stays.

In the multivariate analyses, household income was no longer associated with high use. Hospitalization may be influenced more by "vertical equity," with sicker people, regardless of income, being admitted and staying longer, a pattern observed elsewhere.[2,15] As well, for older people, many of whom are retired, current income may not be a reliable indicator of socioeconomic status.

By contrast, this analysis substantiates the protective influence of having a partner.[6,39,40] This may reflect better social support, adherence to medication/treatment regimes, and/or timelier presentation to hospital.

Discharge to long-term care was independently associated with high hospital use. This has been cited as a major contributor to utilization and spending.[6,8,17,41] In particular, waiting times for long-term placement can prolong the hospital stays of patients who are but unable to return home.[41]

The benefits of using routinely collected national survey data include the potential for periodic updates and monitoring. Variations in factors associated with no hospitalization versus high use compared with non-high use demonstrate the value of having multiple comparison groups.[42]

Limitations

The study examined only acute care; findings are not generalizable to other types of hospitalization, such as day surgery, or to health service use overall. As well, some variables relevant to high use were not collected by each CCHS cycle, and therefore, could not be used in the analysis: medication use/adherence, disability, and food insecurity. DAD information for the study period did not reliability distinguish alternate level care from acute care.[43]

Differences in study methodology[5] and the limited generalizability of non-Canadian results to the Canadian context reduce the possibility of comparing these findings and other research.[11,36]

To increase statistical power, multiple CCHS cycles were combined, but individual hospital use varies—people in the top percentiles one year may not be in another.[3,6,12,44]

The data are cross-sectional and so permit the observation of associations between variables at only one point in time.

The CCHS relied on self- or proxy-reports, and so is subject to reporting error; no independent clinical source was available to verify response accuracy.

The results pertain to adults living in private households. Residents of long-term care institutions, a group particularly susceptible to high hospital

use, were not eligible to participate in the CCHS, although some respondents entered long-term care during the follow-up period and were included.

CCHS respondents in Quebec were excluded from the study because the DAD does not contain Quebec data. And if respondents from other provinces were hospitalized in Quebec, their hospital stays were not captured. Additionally, after 2005, Ontario mental health hospitalizations tended to be reported to the Ontario Mental Health Reporting System,[45] not to the DAD.

Probabilistic linkage was used to match hospital and survey records; the possibility of false links or missed links exists.

Conclusion

This is the first national, population-based study of community-dwelling users of acute care hospital services. The analysis demonstrates the value of linking hospital and death data to large population health surveys and thereby examining a broad set of risk factors. The results provide a comprehensive picture of factors associated with high hospital use among Canadians aged 50 or older. End-of-life, neurological conditions, and discharge to long-term care were predictive of high use; having a partner and being active were protective. A better understanding of high users' characteristics can inform programs aimed at identifying people at risk of high use and develop strategies to reduce time in hospital. ∎

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Appendix

Table A
Collection details of 2007, 2008 and 2009 Canadian Community Health Surveys

Cycle	Sample size	Response rates (%)	Collection dates	Proxy respondents (%)
2007	65,946	77.6	January 2, 2007 to January 8, 2008	2.2
2008	66,013	75.2	January 2, 2008 to December 29, 2008	2.3
2009	61,679	73.2	January 2, 2009 to January 2, 2010	2.0
Average (2007 to 2009)	64,546	75.3	January 2, 2007 to January 2, 2010	2.2

Figure A
Creation of analysis file