

**Disparities in Health Outcomes Among Seniors Without a Family Physician in the North West Local Health Integration Network: A Retrospective Cohort Study**

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**Declaration**  
Dr. Alexandrea Peel, Dr. Trevor Bon, and Dr. Iris Gutmanis have no competing interests to declare.

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**Abstract**

*Background*

The relationship between having a family physician and in-hospital and post discharge health outcomes among older adults is unclear. We ascertained the proportion of seniors who did not have a family physician and were admitted to an Ontario tertiary care centre and determined the association between having/not having a family physician and in-hospital mortality and one-year post live discharge mortality and readmission.

*Methods*

This was a retrospective cohort study of community-dwelling seniors who were admitted to a medical service at Thunder Bay Regional Health Science Centre. Regression analyses adjusted for demographic factors, prior healthcare utilization, and factors associated with the index admission, were conducted to determine the association between family physician status and the study outcomes.

*Results*

Among the 12,033 hospitalized seniors admitted between April 1, 2004 and March 31, 2013, 40.7% lacked a family physician. Among those without a family physician, 8.0% (390/4,899) died during the index admission and 15.8% (714/4,509) died in the subsequent year. Adjusted regression models showed that not having a family physician was significantly associated with in-hospital mortality (odds ratio (95% confidence interval): 1.59 (1.34-1.85)). Regression models of all-cause one-year mortality and readmission also suggested that lack of a family physician was associated with detrimental health outcomes (hazard ratio: 1.14 (1.03-1.26); sub-distribution hazard ratio: 1.17 (1.10-1.24) respectively).

*Interpretation*

Elders without family physicians were disadvantaged during their hospital admission as well as in the subsequent year. Additional interventions aimed at increasing the proportion of hospitalized seniors connected with a family physician are warranted.

**Key words:** family physician, seniors, in-hospital mortality, one-year post discharge readmission, one-year post discharge mortality

## Introduction

While access to family physicians is a concern to many Ontarians<sup>1,2</sup>, this issue is particularly salient to residents of the North West Local Health Integration Network. The multiple health benefits of having a family physician are well documented. For example, those who have a family physician have lower rates of emergency department use<sup>3</sup> and are more likely to report that they received routine monitoring of health issues or check-ups.<sup>2</sup> Yet, an estimated 16.2% of residents in this health region do not have a family physician compared to 6.2% of Ontarians.<sup>4</sup> Further, only 23.8% of this population indicated that they accessed primary care within 48 hours of illness, compared to 43.6% of Ontarians.<sup>4</sup> The vast geography also poses access challenges. Although 46.0% of the North West Local Health Integration Network's residents reside in Thunder Bay, 34.2% live in rural areas while 19.8% live in small and medium sized population centres scattered across 47% of Ontario's land mass.<sup>4</sup> Consequently, some people need to travel hundreds of kilometres by land, water, and air to access healthcare services.<sup>4</sup> Even more troubling is the fact that between February 2009 and March 2017 among the 1,325 people with high healthcare needs who did not have a family physician and were registered with Health Care Connect (an Ontario Ministry of Health and Long-Term Care program designed to help Ontarians without a primary healthcare provider find one<sup>5</sup>), only 782 (59.0%) were able to find a family physician compared to 87.7% of Ontarians in the remainder of the province.<sup>6</sup>

Access to a family physician is important to everyone, but notably among seniors who are more likely to have multiple chronic health conditions.<sup>7</sup> Furthermore, elders without family physicians may be disadvantaged both during a hospital admission and post discharge. Older adults without a family physician may not have received optimal healthcare prior to hospitalization. As well, during hospitalization, they may be put on medications requiring ongoing titration and may undergo tests that require follow-up by a community-based primary care provider. Hospital-based healthcare providers at the Thunder Bay Regional Health Science Centre, the sole tertiary care hospital in the North West Local Health Integration Network, have noted these and other challenges when admitting, caring for, and discharging seniors without a family physician. This study sought to ascertain the proportion of seniors admitted to tertiary care for medical reasons who did not have a family physician and to assess their differential risk of in-hospital mortality after accounting for demographic and health-related factors. To see if any disadvantage persisted,

the association between having/not having a family physician and one-year post live discharge mortality and readmission was examined.

**Methods**

*Study cohort*

A retrospective cohort of adults 65 or more years of age who, at the time of their index admission, were living in a private residence and had been admitted to a medical service at Thunder Bay Regional Health Science Centre, was created by data analysts from the Institute for Clinical Evaluative Sciences. Given that most long-term care home residents receive care from an onsite physician, eligibility was restricted to seniors whose primary residence was non-institutional. Those admitted for surgical and psychiatric reasons were also excluded as reasons underpinning their mortality and readmission differ from those of medical patients.<sup>8,9</sup>

First, all patients discharged from Thunder Bay Regional Health Science Centre between April 1, 2004 and March 31, 2013 were identified using the Canadian Institute for Health Information’s Discharge Abstract Database. The confidential Institute for Clinical Evaluative Sciences number assigned to each Ontario resident eligible for healthcare<sup>10</sup> and then applied to all held databases<sup>11</sup> was used to link patient information across datasets. Individuals could only appear once in the study database and the first date of hospital discharge during the study timeframe was the index case discharge date. Next, those who had resided in a long-term care home in the 30 days prior to the index admission were excluded from the study data file. Identification of this subset was based on information from the Discharge Abstract Database (not admitted from long-term care), the Ontario Health Insurance Plan Claims database (no codes indicating “nursing home” or “health facility” residency), the Ontario Drug Benefit Claims database (the absence of a long-term care home flag), and the Continuing Care Reporting System: Long-Term Care database (no discharge from long-term care).

*Exposure variable*

Those who had been rostered with a family physician on the index admission date according to the comprehensive Client Agency Program Enrolment database were considered as having a family physician. This includes patients who received healthcare from solo practitioners, as well as those rostered with family physicians working within a number of primary healthcare models including: Primary Care Networks; Family Health Networks; Family Health Groups; Family

Health Networks; Family Health Organizations; Health Service Organizations; Group Health Associations; Patient Care Groups; Family Health Teams; the Group Health Centre; and through the Rural and Northern Group Physician Agreement.

### *Study covariates*

Factors thought to potentially influence the association between physician status and the study outcomes were included in the analyses. Baseline demographic characteristics (age, sex, Local Health Integration Network of patient residence, postal code) were obtained from the Registered Persons Database. The Postal Code Conversion File<sup>12</sup> was used to determine income and rural/urban status. Income was divided into quintiles (for details see Appendix A). Date of admission and discharge, admitting service, admitted from and discharged to locations, and number of intensive care unit days, were obtained from the Discharge Abstract Database. The three admission categories used were based on Discharge Abstract Database admission categories (urgent: with a life-threatening condition or unexpected health problems requiring immediate assessment and treatment; elective: scheduled to come to the hospital in advance)<sup>13</sup> and whether the patient had been transferred to Thunder Bay Regional Health Science Centre from another acute care hospital. Length of stay was based on the full index admission episode of care (from date of admission to Thunder Bay Regional Health Science Centre to the date of discharge either directly from tertiary care or, for those who were immediately transferred to a different acute care hospital following tertiary care discharge, from their local hospital (for details see Appendix A)). Healthcare utilization was based on information in the Ontario Health Insurance Plan database (all physician visits in the year prior to the index admission) and the National Ambulatory Care Reporting System database (all emergency department visits in the year prior to the index admission).

The Charlson Comorbidity Index<sup>14</sup> score was calculated using the methodology initially described by Deyo et al<sup>15</sup>, who used International Classification of Diseases, Ninth Revision codes from administrative data, and subsequently adapted for use with administrative data using International Classification of Diseases, Tenth Revision codes by Quan et al<sup>16</sup>, Sundararajan et al<sup>17</sup>, and the Institute for Clinical Evaluative Sciences (personal communication). Information on comorbidities was based on information in the Discharge Abstract Database in the two years prior to the index admission date and on the adjusted diagnostic groups based on information in

the Discharge Abstract Database, National Ambulatory Care Reporting System, and Ontario Health Insurance Plan databases.

*Outcome measures*

Discharge disposition from the index admission as recorded in the Discharge Abstract Database and date of death from the Registered Persons Database were used to identify in-hospital deaths. The Registered Persons Database was also used to determine date of death for those who were discharged alive from the index admission. Hospital admission and discharge dates, obtained from the Discharge Abstract Database, were recorded for all hospitalizations following live index discharge (used to calculate days to all-cause readmission).

*Statistical analysis*

All statistical analyses were conducted in SAS software, version 9.5 (SAS Institute). For all statistical tests, an alpha error of  $p \leq 0.05$  was considered significant for two-sided hypotheses. Standardized differences with a threshold of  $0.10^{18}$  were used to compare the distributions associated with baseline covariates between those with and those without a family physician. Multivariable logistic regression was used to examine the adjusted association between family physician status and in-hospital mortality. Although data that measure follow-up time (in this case, from index admission discharge to time of death/first readmission in the year following live discharge) can be analyzed using either the Kaplan-Meier method or the Cox proportional hazards model, the latter was selected as this approach allows for the difference between survival times of those with/without a family physician to be tested while accounting for other factors.<sup>19</sup> As Cox proportional hazards models do not take into account complex situations where individuals may be at risk for more than one cause of failure<sup>20</sup> (in this case both re-hospitalization and death), a competing risk proportional hazards model was generated to identify factors associated with one-year post live discharge re-hospitalization. For all regression models, diagnostics were generated to ensure model assumptions were met.

*Ethics approval*

The study was approved by the Thunder Bay Regional Health Science Centre Research Ethics Board.

## Results

Among the 12,033 seniors admitted to a medical service at Thunder Bay Regional Health Science Centre during the study period, 4,899 (40.7%) lacked a family physician, 5,666 (47.1%) were male (without/with family physician: 50.2% vs. 45.0%, standardized difference (SDiff)=0.11), and 2,019 (16.8%) lived in rural areas (without/with: 21.7% vs. 13.4%; SDiff=0.22) suggesting possible access challenges (Table 1).

### *In-hospital mortality*

Seven hundred and forty-six people (6.2%) died during the index admission (without/with family physician: 8.0% vs. 5.0%; SDiff=0.12). In models of in-hospital mortality adjusted for age, sex, income, rurality, past medical history, and index admission experience, the odds ratio (OR) associated with not having a family physician was 1.56 (95% confidence interval (CI): 1.33-1.83) (Table 2). Sex, age, rurality, admission to the intensive care unit, and increasing comorbidity were also significantly associated with significantly increased odds of in-hospital mortality. Model diagnostics supported the regression model (likelihood ratio test chi-square: 935.523, 18 df,  $p<0.001$ ; Wald chi-square: 816.57, 18 df,  $p<0.001$ ; C-statistic: 0.814; Hosmer and Lemeshow Goodness-of-fit Chi-square: 25.138, 8df,  $p<0.0015$ ).

### *One-year post discharge mortality and readmission*

Analyses of one-year post discharge mortality and readmission were conditional on having survived the index hospitalization. Among the 11,287 seniors who were discharged alive, 1,613 (14.3%) died in the year following discharge from the index admission (without/with family physician: 15.8% vs. 13.3% (SDiff: 0.07). The Hazard Ratio (HR) associated with no family physician was 1.14 (95% CI: 1.04-1.26) in adjusted models of one-year post discharge mortality (Table 2). Although model diagnostics indicated the model fit the study data (likelihood ratio test chi-square: 1060.631, 18 df,  $p<0.001$ ; Wald chi-square: 1060.608, 18 df,  $p<0.001$ ), that the proportional hazards assumption was supported, and there was no evidence of collinearity, the C-statistic was only 0.595 suggesting a relatively poor model.

Almost 5,000 people (44.1%) were readmitted at least once in the year following index discharge (without/with family physician: 48.0% vs. 41.5%; SDiff:0.13). The adjusted sub-distribution hazard ratio (SHR) associated with readmission to hospital for those with no family physician was 1.17 (95% CI: 1.10-1.24). Further, elective admissions were more likely to be readmitted

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than urgent admissions. Model diagnostics indicate that the proportional hazards assumption was supported (no interaction between time and family physician status).

**Interpretation**

Just over 40% of North West Local Health Integration Network seniors who were admitted to the sole regional tertiary care centre did not have a family physician. Although data on the proportion of older adults living without a family physician who require tertiary care is lacking for other Ontario centres, the observed proportion is certainly high.

Similar to other studies of seniors admitted for medical issues (8.4%<sup>21</sup> and 6.2%<sup>22</sup>), 6.2% of seniors admitted to Thunder Bay Regional Health Science Centre for medical reasons died during the index admission. As well, both the proportion of seniors readmitted within 12 months following live index discharge and the proportion who died post discharge were similar to proportions reported in other studies (44.1% vs. 40.7%<sup>23</sup> and 14.3% vs. 12.9%<sup>24</sup>, respectively). Among elders without a family physician, the odds of in-hospital mortality increased by 56 percent. Regression models of one-year mortality and readmission also suggested that lack of a family physician was associated with detrimental health outcomes (hazard ratio: 1.14 (1.03-1.26); sub-distribution hazard ratio: 1.17 (1.10-1.24) respectively).

While some studies have established the importance of continuity of primary care on health<sup>25,26</sup> and others have identified characteristics associated with individuals without a family physician<sup>27,28</sup>, no studies quantifying the association between family physician status and in-hospital mortality among Canadian seniors were found. Further, only two studies that examined the association between family physician status and health status post acute care discharge were located. In 2002, van Walraven et al<sup>29</sup> found that three-month readmission risk increased among those (mean age: 65.7 years) who were admitted to another Ontario tertiary care hospital for an acute medical illness and who had a family physician. However, in 2010 van Walraven et al<sup>30</sup> found no association between physician status and 30-day mortality or unplanned readmission among adults (mean age: 61.3 years) admitted to either a medical or a surgical service at 11 different Ontario hospitals. Although study inclusion criteria, covariates, and time to outcome differed by study, the association between family physician status and post live discharge outcomes may be relatively small and mediated/modified by a number of factors.

While other investigators have also noted that individuals with chronic health conditions but no family physician have higher healthcare utilization<sup>31</sup>, in this study the OR, HR and SHR increased with the number of comorbidities; however, the dose-response relationship was less pronounced in the one-year readmission model. Although comorbidity has been identified as a significant predictor of in-hospital mortality<sup>21</sup> and one-year mortality<sup>32</sup>, the findings have been inconsistent<sup>22</sup>. Some of this inconsistency may be due to how scores are determined. While most investigators have used an additive approach to the calculation of Charlson Comorbidity Index scores and subsequently used categorized or continuous scores, Mehta and coworkers suggest a multiplicative approach be used for score calculation<sup>33</sup>. Thus, the reported OR, HR and SRH values associated with comorbidity scores need to be interpreted with caution.

Conceptually, while urgent compared to elective admission status could be considered a marker of admission acuity, it was unknown if patients transferred to Thunder Bay were more similar to those classified as urgent or elective. In all three models, those who were transferred to tertiary care experienced worse health outcomes than those classified as urgent. The reasons underpinning this finding should be investigated in future studies.

### *Limitations*

This study has several limitations. First, findings were only adjusted for some factors known to impact mortality and recidivism following a medical admission. For example, although body mass index has been linked to in-hospital<sup>34,35</sup> and post discharge mortality<sup>24</sup>, as height was not captured in any of the databases used to create the inception cohort, this factor was not included as a study covariate. Further, as currently there are no culturally relevant, consistent, and inclusive Indigenous identifiers in the population data sets that were used for this study<sup>36</sup>, study findings were not adjusted for ethnocultural identity, a factor known to be associated with the prevalence of several chronic health issues (e.g., diabetes<sup>37</sup>) as well as access to urgent medical care.<sup>38,39</sup> This omission may have led to increased risk estimates associated with family physician status. Future studies could also include other factors such as a measure of why physicians might limit the number of elderly patients in their practices (e.g., medical complexity<sup>40</sup>), in addition to self-identified ethnocultural identity and height.

Although rurality and income status were included in regression models, possible direct, indirect, or multiplicative impacts of other social determinants of health (e.g., food and housing) on the

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study outcomes were not measured. Furthermore, the rural/urban dichotomy used in this study may have been too simplistic. Future studies could determine if Rurality Index of Ontario<sup>41</sup> scores have a direct effect on the study outcomes or interact with family physician status. Finally, the unique characteristics of the North West Local Health Integration Network may limit the generalizability of the study’s findings to other regions in Ontario and Canada. That said, the current study demonstrates the urgency for similar investigations in other jurisdictions, as national policies have recognized the importance of equitable and accessible care for older adults.<sup>42</sup>

*Conclusion*

In conclusion, 40.7% of older adults admitted for medical reasons to Thunder Bay Regional Health Science Centre did not have a family physician. Those without a family physician experienced poorer health outcomes both during admission and in the subsequent year. Study findings support the need for further interventions designed to increase seniors’ access to family physicians both prior to hospitalization and post discharge.

## Appendix A

### Quintile of Adjusted Income per Person Equivalent

Quintile of adjusted income per person equivalent was calculated using information from the 2006 census. Neighbourhood income per person equivalent is a household size-adjusted measure of household income, based on 2006 census summary data at the dissemination area level, and using person-equivalents implied by the 2006 low income cut-offs. Note that the 2001 single person equivalents were 1.00 for 1 person, 1.25 for 2 persons, 1.55 for 3 persons, 1.95 for 4 or 5 persons, and 2.44 for 6 or more persons sharing the same household (regardless of age). For a description of how income per person equivalent was calculated previously based on 1991 census summary data and single-person equivalents from the 1991 low income cut offs, see Ng et al<sup>43</sup>.

Within each census metropolitan area, census agglomeration, or provincial residual area not in any census metropolitan area or census agglomeration, the dissemination area average income per person equivalent was used to rank all dissemination areas, and then the population was divided into approximate fifths, thus creating community-specific income quintiles based on the income per person equivalent. The quintiles were defined within each area in order to better reflect the relative nature of this measure, to minimize the effect on household welfare of large differences in housing costs, and to ensure that each census metropolitan area or census agglomeration would have about an equal percentage of the population in each income quintile. The first income quintile is associated with the lowest income.

Definitions for the terms census metropolitan area<sup>44</sup>, census agglomeration<sup>44</sup> and dissemination area<sup>45</sup> are provided by Statistics Canada.

*A census metropolitan area (CMA) or a census agglomeration (CA) is formed by one or more adjacent municipalities centred on a population centre (known as the core).*

*A CMA must have a total population of at least 100,000 of which 50,000 or more must live in the core. A CA must have a core population of at least 10,000. To be included in the CMA or CA, other adjacent municipalities must have a high degree of integration with the core, as measured by commuting flows derived from previous census place of work data.*

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*A dissemination area (DA) is a small, relatively stable geographic unit composed of one or more adjacent dissemination blocks. It is the smallest standard geographic area for which all census data are disseminated. DAs cover all the territory of Canada.*

*Small area composed of one or more neighbouring dissemination blocks, with a population of 400 to 700 persons. All of Canada is divided into dissemination areas.*

**Episode of care**

Episode of care, constructed from information in the Discharge Abstract Database, is based on transfers between two different institutions using both the timing between admissions and transfer flags on either record.

The following situations are defined as a transfer:

- 1. any admissions within six hours of the previous discharge;
- 2. any admissions within 12 hours of the previous discharge where either:
  - a. the "institution from" number matches the "institution to" number, OR
  - b. the "institution from" type OR the "institution to" type equals 1 (acute care);
- 3. any admissions within 48 hours of the previous discharge where:
  - a. the "institution from" number matches the "institution to" number.

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Table 1: Baseline characteristics of cohort participants

	Without family physician (n=4,899 or 40.7%)	With family physician (n=7,134 or 59.3%)	SDiff	Total population (n=12,033)
<b>Demographic factors</b>				
Age in years:				
- mean (SD)	76.96 (7.62)	77.25 (7.63)	0.04	77.1 (7.6)
- median (IQR)	77 (71-82)	77 (71-83)	0.04	77 (71-83)
Sex: male: n (%)	2,459 (50.2%)	3,207 (45.0%)	0.11	5,666 (47.1%)
Rural: n (%)	1,061 (21.7%)	958 (13.4%)	0.22	2,019 (16.8%)
Income quintile: n (%)				
- 1 (lowest)	1,334 (27.2%)	1,653 (23.2%)	0.09	2,987 (24.8%)
- 2	925 (18.9%)	1,388 (19.5%)	0.01	2,313 (19.2%)
- 3	1,037 (21.2%)	1,601 (22.4%)	0.03	2,638 (21.9%)
- 4	855 (17.5%)	1,425 (20.0%)	0.06	2,280 (18.9%)
- 5 (highest)	700 (14.3%)	1,032 (14.5%)	0.01	1,732 (14.4%)
- missing	48 (1.0%)	35 (0.5%)	0.06	83 (0.7%)
Patient LHIN: North West LHIN	4,785 (97.7%)	6,992 (98.0%)	0.02	11,777 (97.9%)
<b>Past medical history</b>				
Charlson Comorbidity Index score: n (%)				
- 0	1,641 (33.5%)	2,739 (38.4%)	0.10	4,380 (36.4%)
- 1	1,349 (27.5%)	1,874 (26.3%)	0.03	3,223 (26.8%)
- 2	771 (15.7%)	1,106 (15.5%)	0.01	1,877 (15.6%)
- 3+	1,138 (23.2%)	1,415 (19.8%)	0.08	2,553 (21.2%)
Emergency department visits in the year before index admission:				
- mean (SD)	1.73 (3.15)	1.42 (2.72)	0.11	1.55 (2.91)
- median (IQR)	1 (0-2)	1 (0-2)	0.10	1 (0-2)
All physician visits in the year prior to index admission:				
- mean (SD)	20.37 (21.55)	19.67 (16.30)	0.04	19.96 (18.62)
- median (IQR)	15 (6-27)	16 (9-25)	0.11	15 (8-26)

<b>During index admission</b>				
Admission category of index admission: n (%)				
- Elective	96 (2.0%)	147 (2.1%)	0.01	243 (2.0%)
- Urgent	3,664 (74.8%)	5,596 (78.4%)	0.09	9,260 (77.0%)
- Transfer	1,139 (23.2%)	1,391 (19.5%)	0.09	2,530 (21.0%)
Length of stay of index admission (# of days):				
- mean (SD)	10.7 (18.0)	9.89 (17.3)	0.05	10.2 (17.6)
- median (IQR)	6 (3-12)	6 (3-11)	0.10	6 (3.12)
ICU stay during index admission: n (%)	559 (11.4%)	758 (10.6%)	0.03	1,317 (10.9%)
<b>Outcomes</b>				
In-hospital mortality: n (%)	390 (8.0%)	356 (5.0%)	0.12	746 (6.2%)
Mortality, one-year post discharge: n (%)	714/4,509 (15.8%)	899/6,778 (13.3%)	0.07	1,613/11,287 (14.3%)
Readmission, one-year post discharge: n (%)	2,164/4,509 (48.0%)	2,816/6,778 (41.5%)	0.13	4,980/11,287 (44.1%)

**Note:** LHIN: Local Health Integration Network; n: number; SD: Standard deviation; IQR: Interquartile range; ICU: Intensive Care unit; %: percent; IQR: interquartile range; SDiff: Standardized Difference

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**Table 2: Multivariable regression models of in-hospital mortality, one-year mortality, and one-year readmission to acute care**

	In-hospital mortality (n=12,033)	One-year post d/c mortality* (n=11,287)	One-year post d/c readmission^ (n=11,287)
Variable	OR (95% CI)	HR (95% CI)	SHR (95% CI)
Without vs. with family physician (ref)	1.56 (1.33-1.83)	1.14 (1.04-1.26)	1.17 (1.10-1.24)
Age (years)	1.04 (1.03-1.05)	1.04 (1.04-1.05)	1.02 (1.01-1.02)
Gender: male vs. female (ref)	1.31 (1.11-1.54)	1.14 (1.03-1.26)	1.07 (1.01-1.14)
Income quintile: 2 vs. 1 (ref: lowest)	1.05 (0.82-1.34)	1.02 (0.89-1.18)	0.94 (0.87-1.03)
Income quintile: 3 vs. 1	1.14 (0.90-1.44)	1.02 (0.88-1.17)	0.95 (0.87-1.03)
Income quintile: 4 vs. 1	1.11 (0.87-1.43)	0.97 (0.83-1.1)	0.95 (0.87-1.03)
Income quintile: 5 (highest) vs. 1	1.09 (0.84-1.42)	0.89 (0.75-1.05)	0.88 (0.80-0.97)
Income quintile: missing vs. 1	0.75 (0.32-1.77)	1.05 (0.60-1.85)	0.86 (0.61-1.21)
Charlson score: 1 vs. 0 (ref)	2.50 (1.89-3.32)	1.59 (1.35-1.87)	1.19 (1.10-1.28)
Charlson score: 2 vs. 0	3.06 (2.27-4.14)	2.83 (2.40-3.34)	1.55 (1.43-1.69)
Charlson score: 3 or more vs. 0	7.06 (5.41-9.22)	5.46 (4.72-6.31)	1.94 (1.79-2.10)
Number of physician visits in the year prior to the index admission	0.998 (0.994-1.002)	1.003 (1.001-1.005)	1.008 (1.007-1.009)
Number of ED visits in the year prior to the index admission	1.01 (0.99-1.03)	0.99 (0.97-1.01)	1.010 (1.002-1.018)
Length of stay of index admission	1.002 (1.000-1.005)	1.004 (1.002-1.005)	0.998 (0.997-1.000)
Admission category of index admission: elective vs. urgent (ref)	0.28 (0.09-0.92)	0.90 (0.59-1.39)	3.29 (2.69-4.02)
Admission category of index admission: transfer vs. urgent	1.14 (0.94-1.39)	1.34 (1.19-1.51)	1.12 (1.04-1.21)
ICU: yes vs. no (ref)	5.62 (4.73-6.68)	0.80 (0.67-0.95)	0.83 (0.75-0.92)
Rural: yes vs. no (ref)	1.41 (1.14-1.76)	0.91 (0.78-1.05)	1.17 (1.08-1.28)

**Note:** OR: odds ratio; HR: Hazard ratio; 95% CI: 95% confidence interval; SHR: sub-distribution hazard ratio; d/c: discharge; ED: emergency department; ICU: Intensive Care Unit; ref: reference category; \*: Cox proportional hazards regression model is conditional

on having survived the index hospitalization;  $\wedge$ :sub-distribution hazard ratios are from a competing risk proportional hazards regression model.

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