

BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email editorial.bmjopen@bmj.com

BMJ Open

Investigating the Effect of Sociodemographic Factors on 30-day Hospital Readmission among Medical Patients in Toronto, Canada: a Prospective Cohort Study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-017956
Article Type:	Research
Date Submitted by the Author:	02-Jun-2017
Complete List of Authors:	Smith, Robert; University of Oxford Nuffield Department of Population Health, Cancer Epidemiology Unit Kuluski, Kerry; Bridgepoint Active Healthcare, Bridgepoint Collaboratory for Research and Innovation; University of Toronto, Institute of Health Policy, Management and Evaluation Costa, Andrew P ; McMaster University, Department of Health Research Methods, Evidence, and Impact Sinha, Samir; Mount Sinai Hospital, Department of Medicine; University of Toronto, Institute of Health Policy, Management and Evaluation Glazier, Richard; Institute for Clinical Evaluative Sciences; University of Toronto Dalla Lana School of Public Health Forster, Alan; Ottawa Hospital Research Institute; Department of Medicine in Ottawa Jeffs, Lianne; St. Michael's Hospital, Nursing Research; University of Toronto, Institute of Health Policy, Management and Evaluation
Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Health services research, Health policy, Sociology
Keywords:	GENERAL MEDICINE (see Internal Medicine), Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH, SOCIAL MEDICINE

SCHOLARONE™
Manuscripts

TITLE

Investigating the Effect of Sociodemographic Factors on 30-day Hospital Readmission among Medical Patients in Toronto, Canada: a Prospective Cohort Study

AUTHORS

Robert W. Smith, MSc

DPhil Student,

Nuffield Department of Population Health, University of Oxford

Richard Doll Building, Old Road Campus, Oxford OX3 7LF, United Kingdom

Email: robert.smith@ceu.ox.ac.uk Phone: 07491 872 778

Kerry Kuluski, MSW PhD

Assistant Professor,

Institute of Health Policy, Management and Evaluation, University of Toronto,

Toronto, Ontario, Canada

Research Scientist, Bridgepoint Collaboratory for Research and Innovation, Sinai Health System,

Toronto, Ontario, Canada

Andrew P. Costa, PhD

Assistant Professor,

Department of Health Research Methods, Evidence, and Impact, McMaster University,

Hamilton, Ontario, Canada

Samir K. Sinha, MD DPhil

Associate Professor,

Institute of Health Policy, Management and Evaluation, University of Toronto,

Director of Geriatrics, Sinai Health System and University Health Network

Toronto, Ontario, Canada

Richard H. Glazier, MD MPH

Professor, Dalla Lana School of Public Health, University of Toronto

Senior Scientist, Institute of Clinical Evaluative Sciences

Toronto, Ontario, Canada

Alan Forster, MD MSc

Professor, Department of Medicine, University of Ottawa

Senior Scientist, Ottawa Hospital Research Institute

Ottawa, Ontario, Canada

Lianne Jeffs, RN PhD

Associate Professor,

Institute of Health Policy, Management and Evaluation, University of Toronto,

Lawrence S. Bloomberg Faculty of Nursing, University of Toronto,

Toronto, Ontario, Canada

KEYWORDS:

social determinants of health; socioeconomic factors; patient readmission; risk factors;

WORD COUNT:

3591

ABSTRACT

Objective: To examine the influence of patient-level sociodemographic factors on the incidence of hospital readmission within 30 days among medical patients in a large Canadian metropolitan city.

Design: Prospective cohort study

Setting and participants: Patients admitted to the General Internal Medicine service of an urban teaching hospital in Toronto, Canada participated in a survey of sociodemographic information. Patients were not surveyed if deemed medically unstable, receiving care in medical/surgical step-down beds, or were isolated for infection control. Included in the final analysis was a diverse cohort of 1427 adult, non-palliative, patients who were discharged home.

Measures: Thirteen patient-level sociodemographic variables were examined in relation to time to unplanned all-cause readmission within 30 days. Illness-level was controlled for using Hospital Admission Risk Prediction (HARP) index score, Charlson Comorbidity Index score, and inpatient length of stay variables.

Results: Approximately 14.4% (n=205) of patients experienced readmission within 30 days. Sociodemographic factors were not significantly associated with time to readmission. Patients with HARP scores from 9 to 29, versus 0 to 2, exhibited 66% increased hazard of readmission (adjusted HR=1.66, 95% CI: 1.08-2.54, p=0.02). When HARP variables were analyzed as separate covariates, one previous admission (adjusted HR=1.78, 95% CI: 1.22-2.59, p<0.01) and at least 4 previous emergency department visits (adjusted HR=2.33, 95% CI: 1.46-4.43, p<0.01) were associated with increased hazard of readmission.

Conclusions: Patient-level sociodemographic factors did not influence the incidence of unplanned all-cause readmission within 30 days. In Canada, the studied sociodemographic factors may not be suitable variables upon which to identify high-risk patients or tailor interventions aimed at preventing readmission. Further research is needed to understand the generalizability of our findings and investigate whether contextual factors, such as access to universal health insurance coverage, can attenuate the effects of sociodemographic factors.

STRENGTHS AND LIMITATIONS

1. Our study represents the first detailed examination of patient-level sociodemographic factors in relation to hospital readmission within a general medical patient population in Canada.
2. The sample size was robust however despite this, multi-category sociodemographic variables required aggregation.
3. Survey methods reduced the likelihood of non-response from marginalized groups however, the proportion of missing data was particularly high for total family income.
4. The generalizability of these findings to other communities within and beyond Toronto, Canada remains unclear.

For peer review only

INTRODUCTION

Unplanned hospital readmissions occurring within 30 days of discharge are considered to be adverse health outcomes that are common, harmful to patients, costly to the health system, and to some degree preventable.⁽¹⁻³⁾ The causal mechanisms leading to hospital readmissions are complex and not well understood.⁽⁴⁾ Risk factors for readmission that are commonly substantiated within medical patient populations include characteristics of a person's medical condition and preexisting comorbidities; historical healthcare utilization; and characteristics of the medical care delivered in hospital and shortly after discharge.⁽⁵⁻¹⁰⁾

Several studies have examined how risk of readmission is influenced by social and demographic characteristics of people and the communities within which they live.^(1, 6-8, 11-25) Sociodemographic factors are believed to influence how individuals use healthcare by predisposing them to illness, affecting their intentions on and ability to access healthcare, and affecting their perceived and professionally evaluated need for healthcare.⁽²⁶⁾ Due in part to data availability limitations, sociodemographic factors such as age, gender/sex, and neighbourhood-level indicators of socioeconomic status have garnered the greatest attention within this literature. Few studies have examined the effects of a variety of less commonly investigated patient-level sociodemographic factors such as the following: total family income, education, housing situation, race, language, place of birth, sexual orientation, religious/spiritual affiliation, and disability. A stronger understanding of these relationships may inform the design of healthcare delivery models and health policy aimed at preventing readmissions and reducing health inequities.

Systematic collection and utilization of patient-level sociodemographic data is not a widespread practice within health systems such as Canada's.⁽²⁷⁾ In 2012, the Measuring Health Equity program was initiated by three hospitals and the public health unit in downtown Toronto, Canada to develop a standardized process for, and initiate the collection of detailed patient-level sociodemographic information.^(28, 29)

We sought to understand whether and to what degree patient-level sociodemographic factors influence the incidence of hospital readmission over a 30-day timeframe within a Canadian medical patient population.

METHODS

Study Design and Data Sources

We conducted a prospective cohort study involving 1976 patients admitted to the General Internal Medicine (GIM) service of a 442-bed academic health sciences centre in Toronto. As part of Measuring Health Equity, consenting patients were surveyed by trained research personnel and staff between June 2012 and July 2014. Survey questions (see Supplementary Materials, Table I) were translated in 11 languages and professional interpreters were available for patients who were not comfortable completing the survey in English. Five days per week, research personnel screened GIM service admitted patient lists to identify candidates for survey participation. Before the identified candidates were approached, research personnel consulted with clinical staff to ensure the patients were in stable enough condition to participate in the

1
2
3 survey. Patients were not surveyed if actively receiving care in intensive or critical care units,
4 medical/surgical step-down beds, or isolated for infection control. Approximately 75% of
5 eligible patients or their proxies consented to participate.
6
7

8 Survey data was linked to medical record data from the Canadian Institute for Health
9 Information (CIHI) Discharge Abstract Database (DAD) and National Ambulatory Care
10 Reporting System (NACRS). DAD and NACRS provided information related to characteristics
11 of each patient's inpatient admissions and emergency department visits (e.g. admission/discharge
12 dates, diagnoses, clinical service providers, discharge disposition). Primary data collection and
13 analyses were approved by the [Study Site] Research Ethics Board (REB Number: 11-0319-E).
14
15

16 **Study Cohort Derivation**

17 Figure 1 presents the cohort derivation process. We focused on adults admitted to the GIM
18 service and discharged to the community. Surveyed patients were excluded if their records
19 exhibited the following: missing patient identification numbers; missing admission, discharge,
20 and birth dates; age was under 18 years; most responsible diagnosis codes indicated palliative
21 care or chemotherapy for neoplasm; patient was not discharged to their place of residence (i.e.
22 home or non-institutional home setting with and without support services like home care); or
23 discharge disposition indicated death or patient self-sign out. These exclusion criteria are
24 consistent with those used by CIHI to calculate 30-day medical readmission rates and derive the
25 Hospital Admission Risk Prediction (HARP) index study cohort.^(7, 30) However, we did not
26 exclude patients whose primary reason for admission was related to obstetric or mental health
27 conditions, and those who received surgical interventions during their index admission. Few
28 patients within the sample exhibited these characteristics, and it was hypothesized that their
29 inclusion would better reflect the clinically diverse patient population served on medical units.
30 Also, these patients were assessed by physicians, and their diagnoses were deemed appropriate
31 for care on the GIM service as opposed to solely obstetric, psychiatric, or surgical units. The
32 final sample size was 1427.
33
34
35
36

37 **Outcome Variable**

38 The outcome variable was time to first unplanned, all-cause readmission to any acute care
39 hospital within the Toronto Central Local Health Integration Network region. Approximately 1.2
40 million people reside in this region. The observation window extended 30 days following the
41 index discharge date. The patient was the unit of analysis. Only subsequent admissions that were
42 classified as urgent/emergent (i.e. unplanned, non-elective) were considered. To align with prior
43 research, we considered subsequent admissions readmissions including when the discharge
44 disposition of this subsequent encounter indicated death.^(13, 31)
45
46
47

48 **Sociodemographic Variables & Illness-level Covariates**

49 This study analyzed the following sociodemographic factors as independent variables: gender,
50 sexual orientation, total family income; educational attainment; home ownership; race; place of
51 birth; religious/spiritual affiliation; primary spoken and reading languages; self-perceived ability
52 to speak and understand English. Self-perceived general health status and disabilities were also
53 examined as independent variables. Each variable is defined in Supplementary Materials, Table
54 I. For statistical power, sociodemographic categories were combined so to maintain at least 50
55 patients in each category. Variable aggregation was informed by previous research.^(7, 32)
56
57
58
59
60

1
2
3
4
5 HARP index score, Charlson Comorbidity Index score, and inpatient length of stay were
6 analyzed as covariates indicating illness-level and clinical complexity. The HARP index is a
7 predictive algorithm for 30-day readmission that was recently derived and validated within an
8 Ontario medical patient population.⁽⁷⁾ Weighted HARP index scores are calculated according to
9 values for the following variables: age; frequency of emergency department (ED) visits, and
10 inpatient admissions six months preceding a patient's index admission date; discharge
11 disposition; and a patient's primary diagnosis (i.e. case mix group). HARP scores can range from
12 zero (indicating low risk of readmission) to 41 (indicating high risk of readmission). Within the
13 HARP index study, the population median HARP score was nine.⁽⁷⁾ Charlson scores were
14 calculated according to the latest scoring scheme.⁽³³⁾
15
16

17 18 **Missing Data**

19 Patients were included in analyses if they did not respond to every question of the survey. Given
20 the sensitive nature of the information, it was probable that "prefer not to answer" (PNA), "do
21 not know" (DK) and complete non-responses were not missing at random. For this reason,
22 imputation was not used to manage missing data. Alternatively, PNA and DK responses were
23 aggregated into one category for each sociodemographic variable, and included in regression
24 analyses. Since it was unclear why some patients had complete non-responses recorded as
25 opposed to PNA/DK responses, these patients were not included in the regression analyses.
26
27

28 29 **Statistical Analysis**

30 Kaplan Meier product-limit failure plots were used to assess the absolute probability of
31 readmission over the 30-day observation window. Univariate and multivariable Cox regression
32 was used to examine associations between independent variables and time to readmission.
33 Patients who did not experience readmission were censored at 30 days. Hazard ratios were
34 calculated at a 95% confidence level to measure the magnitude and direction of effects. Two
35 multivariable Cox regression analyses were conducted. Adjusted model one examined the HARP
36 index score as a covariate, and model two studied the individual variables constituting the HARP
37 index as separate covariates. Akaike Information Criterion (AIC) values were calculated to
38 compare goodness of fit between multivariable models. All statistical analyses were conducted
39 using SAS software version 9.4.⁽³⁴⁾
40
41

42 43 **RESULTS**

44 Table 1 presents the descriptive characteristics of our study sample. Approximately 14.4%
45 ($n=205$) of patients experienced readmission within 30 days. One third of readmissions occurred
46 within the first 7 days. The mean time to readmission was 12.4 days ($SD=8.46$). The median age
47 of patients in this cohort was 67 years ($IQR: 50-81$). The majority identified as female ($n=771$,
48 54%), white-European ($n=988$, 69%), and heterosexual ($n=1279$, 90%). Approximately 80% of
49 patients ($n=1138$) felt most comfortable speaking with their health care provider in English.
50 Collectively however, patients within this sample comfortably spoke and read at least 28
51 different languages and identified with at least 12 racial groups. About half ($n=696$, 49%) of the
52 cohort was not born in Canada. Many patients preferred not to disclose or did not know their
53 annual total family income ($n=661$, 46%). Among those that did, the most common category
54
55
56
57
58
59
60

1
2
3 reported was income less than \$20,000 ($n=204$, 14%). The majority reported attaining at least
4 some post-secondary education ($n=808$, 57%), and living in accommodations that they did not
5 own ($n=755$, 53%).
6
7

8 Approximately half the cohort rated their general health as at least good (i.e. good, very good, or
9 excellent; $n=709$, 50%). The majority reported experiencing at least one disability ($n=781$,
10 55%). Most did not experience an ED visit ($n=989$, 69%), or inpatient admission ($n=1211$, 85%)
11 6 months prior to the index admission. The three most common diagnoses primarily responsible
12 for admission were the following: pneumonia ($n=59$, 4.1%); symptom/sign of the digestive
13 system ($n=47$, 3.3%); and heart failure ($n=43$, 3.0%). The median number of recorded
14 comorbidities was 2 (IQR: 1-3). However, relatively few patients exhibited one or more Charlson
15 comorbidities (15%, $n=208$). The median HARP score was 6 (IQR: 3-8).
16
17

18
19 None of the patient-level sociodemographic factors examined were significantly associated with
20 time to unplanned all-cause hospital readmission in unadjusted nor adjusted Cox regression
21 analyses (Table 2). In unadjusted analyses both fair (*unadjusted HR*=1.52, 95% CI: 2.09-2.12,
22 $p=0.01$) and poor (*unadjusted HR*=1.61, 95% CI: 1.14-2.27, $p=0.01$) self-perceived health were
23 associated with increased hazard of readmission. After controlling for all other variables, patients
24 reporting fair health exhibited 45% greater hazard of readmission than those reporting good, very
25 good or excellent health (adjusted *HR*=1.45, 95% CI: 1.02-2.05, $p=0.04$). Poor health was no
26 longer significantly associated. In adjusted model two, neither fair nor poor health exhibited
27 significant associations.
28
29

30
31 HARP index score was significantly associated with readmission in unadjusted and adjusted
32 analyses (Table 2). Patients within the highest HARP score quartile (score range: 9-29) exhibited
33 66% greater hazard of readmission than individuals within the lowest quartile (score range: 0-2)
34 (*adjusted HR*=1.66, 95% CI: 1.08-2.54, $p=0.02$). No significant associations were found among
35 the other HARP score quartiles. However, the global null hypothesis for adjusted model one was
36 not rejected. Therefore, the variables within this model did not predict readmission better than
37 chance. Within adjusted model two, having experienced at least four previous ED visits
38 (*adjusted HR*=2.33, CI: 1.46-4.43, $p<0.01$) or one previous admission (*adjusted HR*=1.78, CI:
39 1.22-2.59, $p<0.01$) were significantly associated with increased hazard of readmission. The null
40 hypothesis was rejected for model two and AIC values were lower (Adjusted model one:
41 $AIC=2966$; Adjusted model two: $AIC=2959$) suggesting that model two provides slightly better
42 fit to the data.
43
44
45
46

47 DISCUSSION

48
49 Our prospective study of 1427 patients admitted to the GIM service of an urban teaching hospital
50 in Toronto, Canada represents the first detailed examination of patient-level sociodemographic
51 factors in relation to hospital readmission within a general Canadian medical patient population.
52 Patient-level sociodemographic factors were not found to be significantly associated with
53 unplanned all-cause hospital readmission within 30 days. Indicators of illness-level such as fair
54 self-perceived health, HARP scores from nine to 29, and previous hospital utilization in-
55 particular were found to be significantly associated with increased hazard of readmission. The
56 results of our study are largely consistent with previous research involving medical patients.^(6, 8)
57
58
59
60

1
2
3 12-14, 17, 21, 35, 36) However, compelling insights into the relationship between sociodemographic
4 factors and 30-day hospital readmission can also be derived from contrasting findings within this
5 and broader literature. Our findings have several clinical, policy, and research implications
6 which merit discussion.
7
8

9
10 While we found that many patient-level sociodemographic factors likely are not contributors to
11 hospital readmission risk among general medical patients, some sociodemographic variables may
12 be sensitive to effect moderation by unmeasured contextual factors. Access to comprehensive
13 social safety net and universal publicly funded health insurance programs for example, may
14 attenuate associations between socioeconomic factors and readmission within nations such as
15 Canada⁽¹³⁾ and France.⁽³⁶⁾ Medicare and Medicaid programs in the United States may not
16 mitigate readmission risk associated with a patient's socioeconomic circumstances to the same
17 extent.^(12, 17) This could be attributed to differences in the adequacy of coverage and quality of
18 health and social services accessible to Medicare and Medicaid beneficiaries compared to
19 beneficiaries of universal publicly funded health insurance programs. There also exists evidence
20 for^(21, 35) and against^(8, 12, 17) race/ethnicity and primary spoken language as risk factors for
21 readmission among medical patients. Contributing to these mixed findings may be contextual
22 differences across study sites related to the cultural competence of care providers, and the
23 availability of interpreters and translated patient education materials.
24
25
26

27
28 It remains possible that sociodemographic factors may also vary in their effects on recovery and
29 disease self-management depending a person's specific medical condition. Indeed, studies
30 analyzing patients hospitalized for heart failure and pneumonia, tend to substantiate lower
31 socioeconomic status and black race as risk factors for readmission.⁽¹¹⁾ Such patterns are not
32 apparent within general medical patient populations.
33

34
35 Consistent with previous research, ED visits and hospital admissions preceding the index
36 admission were the strongest indicators of increased risk of readmission.^(5, 8, 12) Inconsistent with
37 previous research, individuals with fair but not poor self-perceived health were at increased risk
38 of readmission.^(12, 36) This finding is likely attributed to residual confounding and or
39 measurement error given that poor perceived health was no longer significantly associated after
40 adjusting for illness-level covariates, and fair perceived health was no longer associated after
41 adjusting for HARP index constituent variables. Confounding and measurement error may also
42 explain why disability score was not significantly associated while measures of functional
43 limitation and disability have been in previous studies.^(14, 37, 38)
44
45

46
47 Approximately one third of readmissions observed in this study took place within seven days of
48 discharge. Readmissions occurring within seven days are believed to be more likely preventable
49 and perpetuated by factors within the control of hospital care providers.⁽³⁹⁾ This study's results
50 suggest that the key ingredients to preventing hospital readmissions may not vary substantially
51 according to patients' sociodemographic circumstances. Continued effort may thus be warranted
52 among clinicians and healthcare administrators to improve the quality of standardized
53 transitional care processes from hospital to home. Such care processes include how patients are
54 prepared in hospital for post-discharge disease self-management, how patient readiness for
55 discharge is assessed, and the planning and coordination of timely follow-up care with primary
56 care and other service providers in the community.⁽⁴⁰⁻⁴³⁾
57
58
59
60

1
2
3 A criticism of policies aimed at incentivizing quality improvement and reducing readmission
4 rates in the United States is that hospitals serving more socially disadvantaged patient
5 populations are disproportionately penalized for readmission rates above their expected target.⁽⁴⁴⁾
6 Within a Canadian context, patient-level sociodemographic factors may not explain a significant
7 degree of variation in 30-day medical readmission rates within and between regions. Health
8 system administrators thus need to exercise caution when considering the adjustment of quality
9 standards by sociodemographic characteristics. In the absence of empirical and conceptual
10 evidence of independent association between a specific sociodemographic variable and a quality
11 indicator, genuine differences in the quality of care can be obscured and become more difficult to
12 remediate.⁽⁴⁵⁾
13
14
15

16 The detailed patient-level nature of sociodemographic data that were analyzed are noteworthy
17 strengths of this study. Patient-level data is ideal for studying health inequalities and discerning
18 inequity.⁽²⁷⁾ As opposed to geocoded neighbourhood-level sociodemographic data, patient-level
19 data is less vulnerable to measurement error arising from misclassification. However, the use of
20 this patient-level data for research and health system performance measurement has several
21 limitations.
22
23

24 Within healthcare settings, people tend to be less comfortable sharing information that more
25 sensitive such as income, education, and sexual orientation.⁽²⁷⁾ We too observed increased
26 proportions of PNA and DK responses among these variables. Differing proportions of missing
27 data across sociodemographic variables may have increased risk of type two error within
28 multivariable model results. Since the hazard ratio confidence intervals were relatively consistent
29 in range across variables, we do not believe type two error likely accounts for differences in
30 results between the factors examined.
31
32
33

34 Due to the paucity of patient-level sociodemographic data collected within health systems, the
35 degree to which the sociodemographic characteristics of this sample is reflective of medical
36 patients cared for at other hospitals in Toronto, Ontario, other provinces, and nations remains
37 unclear. Our results may thus be vulnerable to non-response, response, and recall bias. However,
38 data collection and analysis methods helped reduce the likelihood of traditionally disadvantaged
39 populations being excluded from this study. First, multi-lingual surveyors and interpreters were
40 available to administer the survey with patients who were unable to participate in English.
41 Research staff were also specially trained in the administration of surveys for sensitive
42 information. To prevent people who were uncomfortable or unable to respond to certain
43 questions from being excluded during multivariable regression analyses, PNA and DK responses
44 were aggregated into a single category and modeled.
45
46
47

48 Most multi-category sociodemographic variables were aggregated to maintain statistical power.
49 A limitation of categorical variable aggregation is that this method can conflate and prevent the
50 detection of true effects observed within less frequently selected categories.⁽⁴⁶⁾ Particularly
51 within diverse nations such as Canada, sociodemographic variable aggregation poses a limitation
52 for researchers and health system administrators to identify and monitor health inequities.
53
54

55 Future research is needed to discern which, and within what contexts sociodemographic factors
56 affect hospital readmission risk. This research should aspire to mixed methodologies examining
57 how sociodemographic factors intersect among themselves and with other clinical factors to
58
59
60

1
2
3 influence recovery during and shortly after hospitalization. Larger medical patient cohorts may
4 facilitate stratified analyses by specific clinical conditions and reduce the need to aggregate
5 sociodemographic groups. To optimize the utility of patient-level sociodemographic data
6 collection for identifying and addressing health inequities, further work is needed to develop
7 efficient health system-wide collection methods which also minimize risk of sampling, response,
8 and non-response bias.
9
10

11 **Conclusion**

12 To conclude, our study suggests that patient-level sociodemographic factors may not influence
13 risk of 30-day readmission among medical patients in Canada. While attentiveness to patients'
14 sociodemographic circumstances is an important component of patient-centered care, the key
15 ingredients to interventions aimed at preventing adverse post-discharge outcomes may not vary
16 substantially according to patients' sociodemographic circumstances. Future research should
17 examine the generalizability of our findings within and beyond Toronto, Canada and investigate
18 whether contextual factors, such as access to universal health insurance coverage, attenuate the
19 effects of sociodemographic factors.
20
21
22
23

24 **CONTRIBUTORSHIP STATEMENT**

25
26
27 RWS was responsible for study design, data analysis, interpretation of results, and manuscript
28 production. LJ, KK, AJ, SS advised RWS on study design and analysis. RWS and SS facilitated
29 data acquisition. All authors contributed to data interpretation, critically revised the manuscript,
30 approved the final submission and act as guarantors of this work.
31
32

33 **FUNDING DECLARATION**

34
35 RWS received funding through the Canadian Institutes of Health Research Canada Graduate
36 Scholarship, Mount Sinai Hospital Department of Medicine Graduate Studentship, and through
37 grant funding awarded to LJ from the Ontario Ministry of Health and Long Term Care. RG was
38 supported as a Clinician Scientist in the Department of Family and Community Medicine at the
39 University of Toronto and at St. Michael's Hospital. No conflicting interests to declare.
40
41

42 **DATA SHARING STATEMENT**

43
44 No additional data available.
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

TABLES AND FIGURES

Table 1. Characteristics of the analysis cohort and observed readmissions.

<i>Sociodemographic Characteristics</i>	% of patients <i>Overall</i> <i>n=1427</i>	Unplanned all-cause readmission within 30 days, % of patients	
		No <i>n=1222</i> (85.6%)	Yes <i>n=205</i> (14.4%)
Age			
Median (IQR)	67 (50-81)	68 (51-82)	67 (49-88)
18-64	45.1%	44.8%	46.3%
65-84	36.6%	36.5%	37.1%
85+	18.4%	18.7%	16.6%
Gender			
Female	54.0%	53.8%	55.6%
Male	43.5%	43.8%	42.0%
Transgender/PNA/DK	2.1%	2.1%	2.1%
Sexual Orientation			
Heterosexual	89.6%	89.5%	90.2%
Not Heterosexual	4.3%	4.6%	2.9%
PNA/DK	5.7%	5.5%	6.8%
Race			
White-European	69.2%	68.8%	71.7%
Asian	11.1%	10.9%	12.2%
Black	5.5%	5.9%	3.4%
Not Asian/Black/White	10.7%	10.9%	9.3%
PNA/DK	3.2%	3.1%	3.4%
Religious/Spiritual Affiliation			
Affiliation	75.1%	74.7%	77.6%
No Affiliation	19.8%	20.0%	18.0%
PNA/DK	4.7%	4.8%	4.4%
Place of Birth			
Canada	49.5%	49.6%	48.8%
Not Canada	48.8%	48.5%	50.2%
PNA	1.4%	1.5%	1.0%
Primary Spoken Language			
English	79.7%	80.5%	75.1%
Non-English	18.3%	17.4%	23.4%
PNA/DK	1.6%	1.7%	1.5%
Primary Reading Language			
English	80.7%	81.2%	78.0%
Not English	17.4%	16.9%	20.5%
PNA/DK	1.5%	1.5%	1.5%
Self-Perceived Ability to Speak/Understand English			
Well	86.1%	86.3%	85.4%
Not Well	11.2%	11.0%	12.2%
PNA/DK	2.3%	2.3%	2.0%
Highest Level of Education			
Some high school	18.5%	18.4%	19.0%
High school diploma	18.9%	18.7%	20.5%
At least some post-secondary	56.6%	57.4%	52.2%
Other/PNA/DK	5.5%	5.1%	7.8%
Home Ownership			
Home owner	43.9%	43.5%	45.9%
Not home owner	52.9%	53.2%	51.2%
PNA/DK	2.9%	2.9%	2.9%
Total Family Income Group			
1 - \$19,999 and less	14.3%	14.2%	14.6%
2 - \$20,000-\$39,999	12.4%	12.7%	10.7%
3 - \$40,000-\$59,999	7.6%	7.5%	8.3%
4 - \$60,000-\$99,999	8.1%	8.2%	7.8%

5 - \$100,000 and over	10.9%	10.7%	11.7%
PNA/DK	46.3%	46.2%	46.9%
Disability Score			
0	38.3%	38.5%	36.6%
1	37.8%	37.7%	38.0%
2+	17.0%	16.7%	18.5%
PNA/DK	6.6%	6.7%	6.9%
Health & Illness-related Characteristics			
Self-Perceived General Health			
Good	49.7%	51.3%	40.0%
Fair	24.6%	23.8%	29.3%
Poor	21.1%	20.2%	26.3%
PNA/DK	4.2%	4.3%	4.0%
Inpatient Admissions Previous 6 Months			
0	84.9%	86.5%	75.1%
1	11.4%	10.1%	19.0%
2	2.2%	2.2%	2.4%
3+	1.5%	1.1%	3.4%
Emergency Department Visits Previous 6 Months			
0	69.3%	71.3%	57.6%
1	17.3%	16.8%	20.5%
2	5.3%	4.8%	8.3%
3	2.4%	2.5%	1.5%
4+	5.7%	4.6%	12.2%
Case Mix Group of Most Responsible Diagnosis			
Heart Failure without Cardiac Catheterization	3.0%	2.7%	4.9%
Chronic Obstructive Pulmonary Disease	2.7%	3.0%	1.0%
Inflammatory Bowel Disease	2.7%	2.8%	2.0%
Diabetes	1.8%	2.0%	0.5%
Gastrointestinal Obstruction	0.8%	0.8%	1.0%
Cirrhosis/Alcoholic Hepatitis	0.8%	0.7%	1.5%
All Other CMGs	88.1%	87.9%	89.3%
Charlson Score			
> 0	14.6%	13.8%	19.0%
Index Admission Length of Stay			
Median (IQR)	5 (3-8)	5 (3-8)	5 (3-8)
Discharge Disposition			
Home without services	65.1%	66.0%	59.5%
Home with services	34.9%	34.0%	40.5%
HARP Index Score			
Median (IQR)	6 (3-8)	5 (3-7)	6 (3-10)
Quartile 1 – Score: 0-2	22.0%	22.7%	17.6%
Quartile 2 – Score: 3-5	27.8%	29.0%	21.0%
Quartile 3 – Score: 6-8	27.1%	27.0%	27.8%
Quartile 4 – Score: 9-29	23.1%	21.3%	33.7%

Notes:

- PNA: Prefer not to answer; DK: Do not know
- Disability score: total number of self-reported physical, sensory, learning, and developmental disabilities and/or those related to chronic illness, mental health, or drug or alcohol dependence.

Table 2. Results of unadjusted and adjusted Cox regression analyses examining associations between independent variables and 30-day unplanned all-cause readmission.

	Unadjusted models		Adjusted Model 1		Adjusted Model 2	
	Unadjusted Hazard Ratio (95%CI)	p value	Adjusted Hazard Ratio (95%CI)	p value	Adjusted Hazard Ratio (95%CI)	p value
Age						
18-64	Reference		--	--	Reference	
65-84	0.97 (0.72-1.32)	0.86	--	--	0.83 (0.59-1.17)	0.28
85+	0.86 (0.58-1.28)	0.46	--	--	0.71 (0.45-1.12)	0.14
Gender[‡]						
Female	Reference		Reference		Reference	
Male	0.93 (0.70-1.23)	0.60	0.97 (0.72-1.29)	0.82	0.98 (0.73-1.31)	0.88
Transgender/PNA/DK	1.15 (0.47-2.81)	0.76	1.86 (0.51-6.82)	0.35	2.00 (0.55-7.21)	0.29
Sexual Orientation[‡]						
Heterosexual	Reference		Reference		Reference	
Not Heterosexual	0.66 (0.30-1.50)	0.32	0.71 (0.31-1.62)	0.41	0.58 (0.25-1.36)	0.21
PNA/DK	1.22 (0.71-2.10)	0.48	0.97 (0.48-1.95)	0.94	0.95 (0.47-1.91)	0.88
Race						
White-European	Reference		Reference		Reference	
Asian	1.08 (0.70-1.64)	0.73	1.02 (0.64-1.63)	0.92	0.87 (0.54-1.41)	0.58
Black	0.57 (0.27-1.22)	0.15	0.64 (0.29-1.41)	0.27	0.54 (0.24-1.20)	0.13
Not Asian/Black/White	0.83 (0.52-1.35)	0.46	0.87 (0.53-1.41)	0.57	0.84 (0.51-1.38)	0.50
PNA/DK	1.04 (0.49-2.22)	0.92	1.22 (0.48-3.13)	0.68	1.47 (0.58-3.74)	0.42
Religious/Spiritual Affiliation[‡]						
Affiliation	Reference		Reference		Reference	
No Affiliation	0.89 (0.62-1.27)	0.51	0.96 (0.66-1.39)	0.81	0.95 (0.65-1.39)	0.80
PNA/DK	0.89 (0.45-1.74)	0.73	0.91 (0.42-1.97)	0.80	0.94 (0.43-2.07)	0.89
Place of Birth						
Canada	Reference		Reference		Reference	
Not Canada	1.04 (0.79-1.36)	0.80	0.93 (0.66-1.31)	0.67	0.98 (0.69-1.40)	0.92
PNA/DK	0.68 (0.17-2.73)	0.59	0.29 (0.02-3.42)	0.32	0.17 (0.01-2.30)	0.18
Primary Spoken Language[‡]						
English	Reference		Reference		Reference	
Non-English	1.39 (1.00-1.92)	0.05	1.29 (0.86-1.93)	0.23	1.29 (0.86-1.93)	0.23
PNA/DK	0.93 (0.30-2.18)	0.90	0.99 (0.18-5.36)	0.99	0.99 (0.18-5.36)	0.99
Primary Reading Language[‡]						
English	Reference		--	--	--	--
Not English	1.24 (0.88-1.74)	0.22	--	--	--	--
PNA/DK	0.98 (0.31-3.06)	0.97	--	--	--	--
Self-Perceived Ability to Speak/Understand English[†]						
Well	Reference		--	--	--	--
Not Well	1.11 (0.73-1.69)	0.63	--	--	--	--
PNA/DK	0.89 (0.33-2.39)	0.81	--	--	--	--
Highest Level of Education[†]						
Some high school	1.13 (0.78-1.63)	0.52	0.98 (0.65-1.48)	0.93	1.08 (0.71-1.64)	0.72
High school diploma	1.19 (0.83-1.69)	0.35	1.15 (0.79-1.67)	0.46	1.23 (0.84-1.80)	0.28
At least some post-secondary	Reference		Reference		Reference	
Other/PNA/DK	1.61(0.95-2.73)	0.07	1.57 (0.85-2.91)	0.15	1.72 (0.92-3.23)	0.09
Home Ownership[‡]						
Home owner	Reference		Reference		Reference	
Not home owner	0.92 (0.70-1.22)	0.58	0.99 (0.73-1.34)	0.96	1.00 (0.73-1.37)	0.99
PNA/DK	0.96 (0.42-2.19)	0.92	0.88 (0.29-2.67)	0.83	0.93 (0.31-2.81)	0.89
Total Family Income Group						
1 - \$19,999 and less	0.94 (0.55-1.61)	0.83	0.73 (0.40-1.33)	0.31	0.70 (0.38-1.29)	0.26
2 - \$20,000-\$39,999	0.79 (0.44-1.40)	0.41	0.70 (0.38-1.29)	0.25	0.78 (0.42-1.45)	0.43
3 - \$40,000-\$59,999	1.01 (0.54-1.87)	0.99	0.96 (0.50-1.81)	0.89	0.94 (0.49-1.80)	0.86
4 - \$60,000-\$99,999	0.89 (0.47-1.67)	0.71	0.87 (0.46-1.65)	0.67	0.93 (0.49-1.76)	0.82
5 - \$100,000 and over	Reference		Reference		Reference	
PNA/DK	0.94 (0.60-1.46)	0.77	0.77 (0.47-1.26)	0.30	0.82 (0.50-1.34)	0.42

Disability Score^{a‡}						
0	Reference		Reference		Reference	
1	1.06 (0.78-1.46)	0.70	0.91 (0.65-1.28)	0.58	0.97 (0.69-1.37)	0.88
2+	1.16 (0.79-1.72)	0.45	0.99 (0.64-1.53)	0.97	1.20 (0.77-1.85)	0.42
PNA/DK	1.07 (0.60-1.89)	0.82	0.91 (0.48-1.72)	0.76	1.00 (0.53-1.90)	0.99
Self-Perceived General Health[†]						
Good	Reference		Reference		Reference	
Fair	1.52 (1.09-2.12)	0.01	1.45 (1.02-2.05)	0.04	1.39 (0.98-1.98)	0.07
Poor	1.61 (1.14-2.27)	0.01	1.15 (0.91-2.00)	0.13	1.15 (0.77-1.72)	0.49
PNA/DK	1.28 (0.65-2.56)	0.48	1.35 (0.51-2.56)	0.74	1.02 (0.46-2.27)	0.97
Inpatient Admissions Previous 6 Months						
0	Reference		--	--	Reference	
1	2.01 (1.41-2.85)	<0.01	--	--	1.78 (1.22-2.59)	<0.01
2	1.23 (0.50-2.99)	0.65	--	--	1.03 (0.41-2.58)	0.65
3+	2.96 (1.39-6.32)	0.01	--	--	2.06 (0.93-4.58)	0.08
Emergency Department Visits Previous 6 Months						
0	Reference		--	--	Reference	
1	1.44 (1.01-2.04)	0.04	--	--	1.41 (0.98-2.04)	0.06
2	1.98 (1.19-3.29)	0.01	--	--	1.62 (0.95-3.29)	0.08
3	0.73 (0.23-2.30)	0.59	--	--	0.63 (0.20-2.30)	0.59
4+	2.88 (1.89-4.43)	<0.01	--	--	2.33 (1.46-4.43)	<0.01
Case Mix Group of Most Responsible Diagnosis						
Heart Failure without Cardiac Catheterization	1.63 (0.86-3.08)	0.13	--	--	1.70 (0.87-3.31)	0.12
Chronic Obstructive Pulmonary Disease	0.34 (0.08-1.36)	0.13	--	--	0.36 (0.09-1.49)	0.16
Inflammatory Bowel Disease	0.70 (0.26-1.90)	0.49	--	--	0.86 (0.31-2.38)	0.77
Diabetes	0.25 (0.04-1.79)	0.17	--	--	0.24 (0.03-1.78)	0.16
Gastrointestinal Obstruction	1.09 (0.27-4.41)	0.90	--	--	1.33 (0.32-5.54)	0.69
Cirrhosis/Alcoholic Hepatitis	1.78 (0.57-5.58)	0.32	--	--	1.49 (0.45-4.94)	0.52
All Other CMGs	Reference		--	--	Reference	
Charlson Score						
0	Reference		Reference		Reference	
1+	1.39 (0.98-1.97)	0.07	1.30 (0.90-1.87)	0.16	1.34 (0.92-1.94)	0.13
Length of Stay						
Median (IQR)	1.01 (1.00-1.02)	0.18	1.00 (0.99-1.01)	0.70	1.01 (0.99-1.02)	0.39
Discharge Disposition						
Home without services	Reference		--	--	Reference	
Home with services	1.28 (0.97-1.70)	0.08	--	--	1.07 (0.78-1.48)	0.67
HARP Index Score						
Quartile 1 – Score: 0-2	Reference		Reference		--	--
Quartile 2 – Score: 3-5	0.94 (0.61-1.47)	0.79	0.89 (0.57-1.40)	0.61	--	--
Quartile 3 – Score: 6-8	1.30 (0.86-1.98)	0.22	1.17 (0.76-1.81)	0.48	--	--
Quartile 4 – Score: 9-29	1.90 (1.27-2.84)	<0.01	1.66 (1.08-2.54)	0.02	--	--

Notes:

- $n=1427$ observations were analyzed in each univariate model and $n=1420$ in multivariable models unless otherwise indicated; $† n=1421$ observations used within univariate model; $‡ n=1422$ observations used within univariate model
- Primary reading language and English proficiency exhibited evidence of multicollinearity and were thus not included in multivariable analyses.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

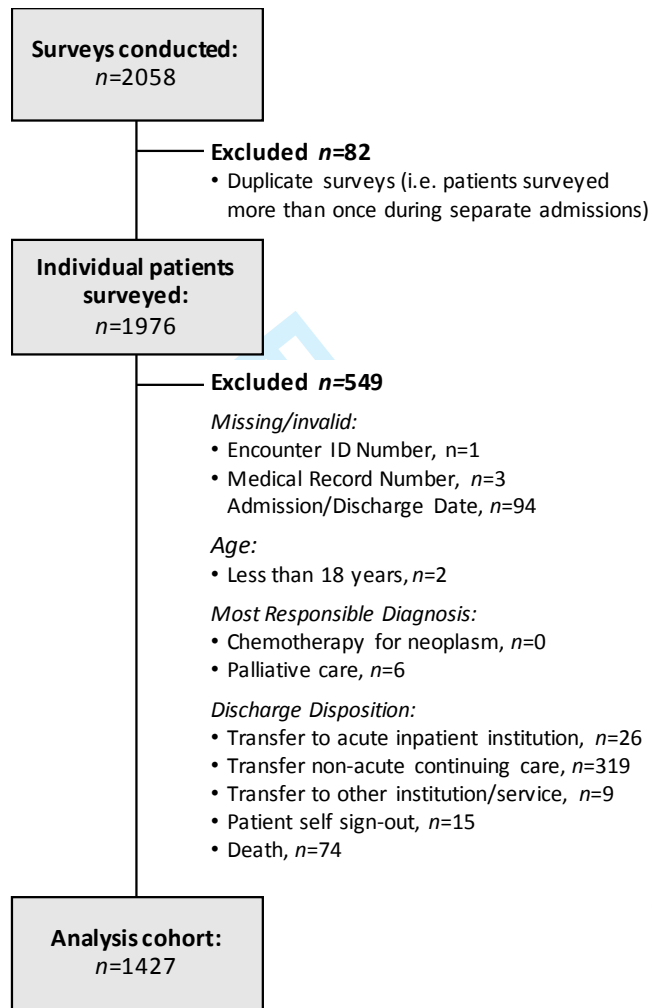


Figure 1. Cohort derivation procedures and final sample size.

view only

REFERENCES

1. Canadian Institute for Health Information. All-Cause Readmission to Acute Care and Return to the Emergency Department. Ottawa, Canada: Canadian Institute for Health Information; 2012.
2. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among Patients in the Medicare Fee-for-Service Program. *The New England journal of medicine*. 2009;360(14):1418-28.
3. van Walraven C, Jennings A, Taljaard M, Dhalla I, English S, Mulpuru S, et al. Incidence of potentially avoidable urgent readmissions and their relation to all-cause urgent readmissions. *Canadian Medical Association Journal*. 2011;183(14):E1067-72.
4. Dharmarajan K, Krumholz HM. Risk after hospitalization: We have a lot to learn. *Journal of Hospital Medicine*. 2015;10(2):135-6.
5. van Walraven C, Dhalla IA, Bell C, Etchells E, Stiell IG, Zarnke K, et al. Derivation and validation of an index to predict early death or unplanned readmission after discharge from hospital to the community. *Canadian Medical Association Journal*. 2010;182(6):551-7.
6. van Walraven C, Wong J, Forster AJ. LACE+ index: extension of a validated index to predict early death or urgent readmission after hospital discharge using administrative data. *Open Medicine*. 2012;6(3):80-90.
7. Canadian Institute for Health Information, Health Quality Ontario. Early identification of people at-risk of hospitalization: Hospital Admission Risk Prediction (HARP)—a new tool for supporting providers and patients. Toronto, Canada: Queen's Printer of Ontario; 2013.
8. Donzé J, Aujesky D, Williams D, Schnipper JL. Potentially Avoidable 30-Day Hospital Readmissions in Medical Patients: Derivation and Validation of a Prediction Model. *JAMA Internal Medicine*. 2013;173(8):632-8.
9. O'Connor M, Murtaugh CM, Shah S, Barrón-Vaya Y, Bowles KH, Peng TR, et al. Patient Characteristics Predicting Readmission Among Individuals Hospitalized for Heart Failure. *Medical Care Research and Review*. 2015:1-38.
10. Kansagara D, Englander H, Salanitro A, Kagan D, Theobald C, Freeman M, et al. Risk prediction models for hospital readmission: A systematic review. *JAMA*. 2011;306(15):1688-98.
11. Calvillo-King L, Arnold D, Eubank KJ, Lo M, Yunyongying P, Stieglitz H, et al. Impact of social factors on risk of readmission or mortality in pneumonia and heart failure: systematic review. *J Gen Intern Med*. 2013;28.
12. Hasan O, Meltzer DO, Shaykevich SA, Bell CM, Kaboli PJ, Auerbach AD, et al. Hospital Readmission in General Medicine Patients: A Prediction Model. *Journal of General Internal Medicine*. 2010;25(3):211-9.
13. van Walraven C, Wong J, Forster AJ. Influence of neighborhood household income on early death or urgent hospital readmission. *Journal of Hospital Medicine*. 2013;8:261-6.
14. Garcia-Perez L, Linertova R, Lorenzo-Riera A, Vazquez-Diaz JR, Duque-Gonzalez B, Sarria-Santamera A. Risk factors for hospital readmissions in elderly patients: a systematic review. *QJM*. 2011;104(8):639-51.
15. Mudge AM, Kasper K, Clair A, Redfern H, Bell JJ, Barras MA, et al. Recurrent readmissions in medical patients: A prospective study. *Journal of Hospital Medicine*. 2011;6:61-7.

16. Fleming LM, Gavin M, Piatkowski G, Chang JD, Mukamal KJ. Derivation and Validation of a 30-Day Heart Failure Readmission Model. *The American Journal of Cardiology*. 2014;114(9):1379-82.
17. Hu J, Gonsahn MD, Nerenz DR. Socioeconomic Status And Readmissions: Evidence From An Urban Teaching Hospital. *Health Aff*. 2014;33(5):778-85.
18. Mather JF, Fortunato GJ, Ash JL, Davis MJ, Kumar A. Prediction of pneumonia 30-day readmissions: a single-center attempt to increase model performance. *Respiratory Care*. 2014;59(2):199-208.
19. Coventry PA, Gemmell I, Todd CJ. Psychosocial risk factors for hospital readmission in COPD patients on early discharge services: A cohort study. *BMC Pulmonary Medicine*. 2011(11):49.
20. McGregor MJ, Reid RJ, Schulzer M, Fitzgerald JM, Levy AR, Cox MB. Socioeconomic status and hospital utilization among younger adult pneumonia admissions at a Canadian hospital. *BMC Health Services Research*. 2006;6(152):1-10.
21. Karliner LS, Kim SE, Meltzer DO, Auerbach AD. Influence of language barriers on outcomes of hospital care for general medicine inpatients. *Journal of Hospital Medicine*. 2010;5(5):276-82.
22. Peterson PN, Campagna EJ, Maravi M, Allen LA, Bull S, Steiner JF, et al. Acculturation and Outcomes among Patients with Heart Failure. *Circulation: Heart Failure*. 2012;5(2):160-6.
23. Watson AJ, O'Rourke J, Jethwani K, Cami A, Stern TA, Kvedar JC, et al. Linking electronic health record-extracted psychosocial data in real-time to risk of readmission for heart failure. *Psychosomatics*. 2011;52(4):319-27.
24. Ketterer MW, Draus C, McCord J, Mossallam U, Hudson M. Behavioral Factors and Hospital Admissions/Readmissions in Patients With CHF. *Psychosomatics*. 2014;55(1):45-50.
25. van Oeffelen AM, Agyemang C, Stronks K, Bots ML, Vaartjes I. Prognosis after a first hospitalisation for acute myocardial infarction and congestive heart failure by country of birth. *Heart*. 2014;100(18):1436-43.
26. Andersen RM, Davidson PL. Chapter 1: Improving Access to Care in America--Individual and Contextual Indicators. In: Andersen RM, Rice TH, Kominski GF, editors. *Changing the US health care system: key issues in health services policy and management*. 3rd. San Francisco: Jossey-Bass; 2007. p. 3-31.
27. Kirst M, Shankardass K, Bomze S, Lofters A, Quiñonez C. Sociodemographic data collection for health equity measurement: a mixed methods study examining public opinions. *International Journal for Equity in Health*. 2013;12(1):1-10.
28. Wray R, Agic B, Bennett-AbuAyyash C, Kane K, Lam R, Mohamed A, et al. We ask because we care: The Tri-Hospital + TPH Health Equity Data Collection Research Project Report. Toronto, Canada; 2013.
29. Measuring Health Equity: Mount Sinai Hospital and Toronto Central Local Health Integration Network; 2016 [Available from: <http://torontohealthequity.ca/>].
30. Canadian Institute for Health Information. Technical Note: 30-Day Adult Medical Readmission Rate: Canadian Institute for Health Information; 2015 [Available from: <https://www.cihi.ca/en/health-system-performance/performance-reporting/indicators/technical-note-30-day-adult-medical>].

31. Barnett ML, Hsu J, McWilliams M. Patient Characteristics and Differences in Hospital Readmission Rates. *JAMA Intern Med.* 2015.
32. Fitzpatrick T, Rosella LC, Calzavara A, Petch J, Pinto AD, Manson H, et al. Looking Beyond Income and Education: Socioeconomic Status Gradients Among Future High-Cost Users of Health Care. *American Journal of Preventative Medicine.* 2015;49(2):161-71.
33. Quan H, Li B, Couris CM, Fushimi K, Graham P, Hider P, et al. Updating and Validating the Charlson Comorbidity Index and Score for Risk Adjustment in Hospital Discharge Abstracts Using Data From 6 Countries. *American Journal of Epidemiology.* 2011;173(6):676-82.
34. SAS Institute Inc. SAS Version 9.4. Cary, NC: SAS Institute Inc.; 2012.
35. Allaudeen N, Vidyarthi A, Maselli J, Auerbach A. Redefining readmission risk factors for general medicine patients. *Journal of Hospital Medicine.* 2011;6:54-60.
36. Lanièce I, Couturier P, Dramé M, Gavazzi G, Lehman S, Jolly D, et al. Incidence and main factors associated with early unplanned hospital readmission among French medical inpatients aged 75 and over admitted through emergency units. *Age and Ageing.* 2008;37(4):416-22.
37. Kahlon S, Pederson J, Majumdar SR, Belga S, Lau D, Fradette M, et al. Association between frailty and 30-day outcomes after discharge from hospital. *Canadian Medical Association Journal.* 2015.
38. Greysen S, Stijacic Cenzer I, Auerbach AD, Covinsky KE. Functional Impairment and Hospital Readmission in Medicare Seniors. *JAMA Internal Medicine.* 2015;175(4):559-65.
39. Joynt KE, Jha AK. Thirty-Day Readmissions — Truth and Consequences. *New England Journal of Medicine.* 2012;366(15):1366-9.
40. Greysen SR, Harrison JD, Kripalani S, Vasilevskis E, Robinson E, Metlay J, et al. Understanding patient-centred readmission factors: a multi-site, mixed-methods study. *BMJ Quality & Safety.* 2016.
41. Jeffs L, Dhalla I, Cardoso R, Bell CM. The perspectives of patients, family members and healthcare professionals on readmissions: preventable or inevitable? *Journal of Interprofessional Care.* 2014;28(6):507-12.
42. Jackson C, Shahsahebi M, Wedlake T, DuBard CA. Timeliness of Outpatient Follow-up: An Evidence-Based Approach for Planning After Hospital Discharge. *The Annals of Family Medicine.* 2015;13(2):115-22.
43. Hernandez AF, Greiner MA, Fonarow GC, Hammill BG, Heidenreich PA, Yancy CW, et al. Relationship Between Early Physician Follow-up and 30-Day Readmission Among Medicare Beneficiaries Hospitalized for Heart Failure. *JAMA.* 2010;303(17):1716-22.
44. National Academies of Sciences Engineering and Medicine. Accounting for Social Risk Factors in Medicare Payment: Identifying Social Risk Factors. Washington, DC: The National Academies Press; 2016.
45. National Quality Forum. Risk adjustment for socioeconomic status or other sociodemographic factors. Washington, DC: National Quality Forum; 2014.
46. Rodney P, Copeland E. The health status of black Canadians: Do aggregate racial and ethnic variables hide health disparities? *J Health Care Poor Underserved.* 2009;20.
47. Meddings J, Reichert H, Smith SN, Iwashyna TJ, Langa KM, Hofer TP, et al. The Impact of Disability and Social Determinants of Health on Condition-Specific Readmissions beyond Medicare Risk Adjustments: A Cohort Study. *J Gen Intern Med.* 2017;32(1):71–80.

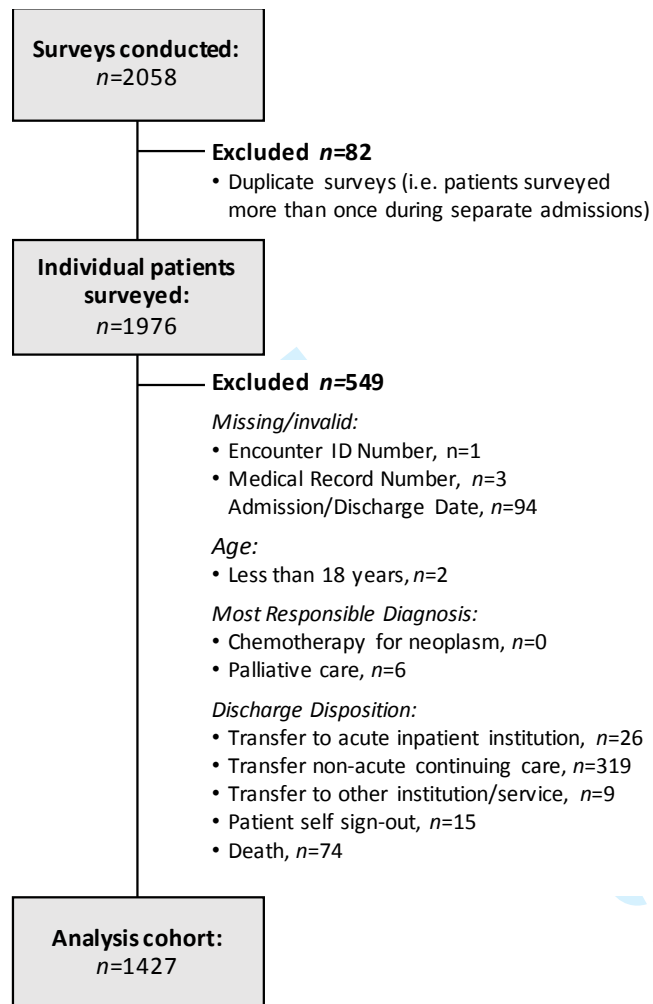


Figure 1. Cohort derivation procedures and final sample size.

Table 1. Source survey questions, definition and structure of independent variables and covariates.

Variable	Definition	Data Source	Survey Question	Survey Response Options	Aggregated Groups
Age	The number of years between date of birth and index admission date.	CIHI-DAD	N/A	N/A	18-64 years 65-84 years 85+ years
Gender	Self-identified gender.	Patient/Proxy	What is your gender?	Female Male Trans Intersex Prefer not to answer Do not know	Female Male Trans/Prefer not to answer/Do not know
Sexual Orientation	Self-identified sexual orientation.	Patient/Proxy	What is your sexual orientation?	Heterosexual ("straight") Gay Lesbian Bisexual Two-Spirit Queer Questioning Prefer not to answer Do not know	Heterosexual ("straight") Not Heterosexual Prefer not to answer/ Do not know
Race	Self-identified race.	Patient/Proxy	Which of the following best describes your race?	Aboriginal (e.g., Inuit, First Nations Non-status Indian, Métis, Aboriginal person from outside Canada) Asian - East (e.g., Chinese, Japanese, Korean) Asian - South (e.g., Indian, Pakistani, Sri Lankan, Indo-Caribbean) Asian - South East (e.g., Malaysian, Filipino, Vietnamese) Black - Africa (e.g., Ghanaian, Kenyan, Somali) Black - North America Black - Caribbean Region (e.g., Barbadian, Jamaican) Latin American (e.g., Argentinan, Chilean, Salvadorean) Middle Eastern (e.g., Egyptian, Iranian, Lebanese) Mixed heritage: _____ White/ European (e.g., English, Italian, Portuguese, Russian) Other(s): _____ Prefer not to answer Do not know	White-European Asian Black Not Asian/Black/White Prefer not to answer/ Do not know
Religious/Spiritual Affiliation	Self-reported affiliation with religious/spiritual community.	Patient/Proxy	What is your religious or spiritual affiliation?	I do not have a religious or spiritual affiliation Animism or Shamanism Atheism Baha'i Faith Buddhism Christianity Christian Orthodox Protestant Roman Catholic Christian, <i>not included elsewhere on this list</i> Confucianism Hinduism Jainism Judaism Islam Native Spirituality Rastafarianism Sikhism Spiritual Unitarianism Wicca Zoroastrianism	Affiliated Not Affiliated Prefer not to answer/ Do not know

BMJ Open: first published as 10.1136/bmjopen-2017-017956 on 12 December 2017. Downloaded from http://bmjopen.bmj.com/ on April 17, 2024 by guest. Protected by copyright.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Place of Birth	Self-reported birth place (Canada vs. Not Canada)	Patient/ Proxy	Were you born in Canada?	Yes No Prefer not to answer Do not know	Yes No Prefer not to answer/ Do not know
Primary Spoken Language	Self-reported preferred language to speak with health care providers.	Patient/ Proxy	What language would you feel most comfortable speaking in with your health care provider?	American Sign Language Arabic Bengali Chinese (Cantonese) Chinese (Mandarin) Cree Dari English French German Greek Gujarati Hebrew Hindi Hungarian Italian Korean Ojibwe Oji-Cree Farsi (Persian) Polish Portuguese Punjabi Russian Spanish Somali Tagalog Tamil Urdu Vietnamese Other (Please specify) Prefer not to answer Do not know	English Not English Prefer not to answer/ Do not know
Primary Reading Language	Self-reported preferred language within which to read health information.	Patient/ Proxy	In what language would you prefer to read health care information?	American Sign Language Arabic Bengali Braille Chinese (Cantonese) Chinese (Mandarin) Cree Dari English French German Greek Gujarati Hebrew Hindi Hungarian Italian Korean Ojibwe Oji-Cree Farsi (Persian) Polish Portuguese Punjabi Russian Spanish Somali Tagalog Tamil Urdu Vietnamese Other (Please specify) Prefer not to answer	English Not English Prefer not to answer/ Do not know

For peer review

				Do not know	
Self-perceived ability to speak/understand English	Self-evaluated ability to speak/understand English	Patient/Proxy	How would you rate your ability to speak and understand English?	Very well Well Not well Not at all Unsure Prefer not to answer Do not know	Well Not Well Prefer not to answer/ Do not know
Highest Level of Education	Self-reported highest achieved education level.	Patient/Proxy	What is the highest level of education you have completed?	Some grade school (grade 1-8) Some high school High school graduate Some College/University education College degree Undergraduate (university) Degree Postgraduate Degree Other: _____ Prefer not to answer Do not know	Some High School High School Diploma At least some post-secondary Other Prefer not to answer/ Do not know
Home Ownership	Self-reported housing situation.	Patient/Proxy	What type of housing do you live in?	Renting Own Living with family or friends Temporary housing (e.g. shelter, hostel) or homeless Correctional facility Other: _____ Prefer not to answer Do not know	Home owner Not home owner Prefer not to answer/ Do not know
Total Family Income	Self-reported total family income before taxes.	Patient/Proxy	What was your total family income before taxes last year?	Less than \$10,000 \$10,000 to \$19,999 \$20,000 to \$29,999 \$30,000 to \$39,999 \$40,000 to \$49,999 \$50,000 to \$59,999 \$60,000 to \$79,999 \$80,000 to \$99,999 \$100,000 to \$149,999 \$150,000 or more Prefer not to answer Do not know	Less than \$20,000 \$20,000 to \$39,999 \$40,000 to \$59,999 \$60,000 to \$99,999 At least \$100,000 Prefer not to answer/ Do not know
Disability Score	Total number of self-reported disabilities.	Patient/Proxy	Do you have any of the following disabilities? <i>Check all that apply</i>	No disabilities Chronic illness Developmental disability Learning disability Mental health disability Physical disability Sensory disability (i.e. hearing or vision loss) Drug or alcohol dependence Other: _____ Prefer not to answer Do not know	0 1 2+
Self-perceived General Health	Self-evaluated general health status.	Patient/Proxy	In general, would you say your health is:	Excellent Very good Good Fair Poor Prefer not to answer Do not know	Good Fair Poor Prefer not to answer/ Do not know
Inpatient Admissions Previous 6 Months	Number of hospital admissions 183 days preceding the index admission date.	CIHI-DAD	N/A	N/A	0 1 2 3+
ED Visits Previous 6 Months	Number of emergency department visits 183 days	CIHI-NACRS	N/A	N/A	0 1 2 3

BMJ Open: first published as 10.1136/bmjopen-2017-017956 on 12 December 2017. Downloaded from http://bmjopen.bmj.com/ on April 17, 2024 by guest. Protected by copyright.

	preceding the index admission date.				4+
Case Mix Group of Most Responsible Diagnosis	Case Mix Group (CMG) under which the index admission primary diagnosis code (most responsible diagnosis) is categorized under. Specified CMGs are associated with increased risk of 30-day readmission.	CIHI-DAD	N/A	N/A	All Other CMGs Chronic Obstructive Pulmonary Disease Congestive Heart Failure without Cardiac Catheterization Inflammatory Bowel Disease Gastrointestinal Obstruction Cirrhosis/Alcoholic Hepatitis Diabetes
Charlson Comorbidity Index Score	Total weighted score associated with the number and type of Charlson comorbidities.	CIHI-DAD	N/A	N/A	0 1+
Length of Stay	Number of days between index admission date and discharge disposition date.	CIHI-DAD	N/A	N/A	N/A
Discharge Disposition	Location to which patient was discharged.	CIHI-DAD	N/A	N/A	Home or home setting without services Home or home setting with services

STROBE Checklist of items included in the manuscript entitled:

Investigating the Effect of Sociodemographic Factors on 30-day Hospital Readmission among Medical Patients in Toronto, Canada: a Prospective Cohort Study

	Item No	Recommendation	Addressed in Manuscript?
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	pp.1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	pp.2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	pp.4
Objectives	3	State specific objectives, including any prespecified hypotheses	pp.4
Methods			
Study design	4	Present key elements of study design early in the paper	pp.4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	pp.4-5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	pp.4-5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	pp.5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	pp.4-5
Bias	9	Describe any efforts to address potential sources of bias	pp.4,9
Study size	10	Explain how the study size was arrived at	pp.5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	pp.5-6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	pp.6
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	pp.6
		(d) If applicable, explain how loss to follow-up was addressed	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	pp.15
		(b) Give reasons for non-participation at each stage	pp.15
		(c) Consider use of a flow diagram	pp.15
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	pp.6-7, 11-12

		(b) Indicate number of participants with missing data for each variable of interest	pp.11-12
		(c) Summarise follow-up time (eg, average and total amount)	pp.6
Outcome data	15*	Report numbers of outcome events or summary measures over time	pp.6
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	pp.7, 13-14
		(b) Report category boundaries when continuous variables were categorized	pp.7
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	pp.7-8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	pp.9-10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	pp.8-10
Generalisability	21	Discuss the generalisability (external validity) of the study results	pp.9-10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	pp.10

*Give information separately for exposed and unexposed groups.

BMJ Open

Investigating the Effect of Sociodemographic Factors on 30-day Hospital Readmission among Medical Patients in Toronto, Canada: a Prospective Cohort Study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-017956.R1
Article Type:	Research
Date Submitted by the Author:	31-Jul-2017
Complete List of Authors:	Smith, Robert; University of Oxford Nuffield Department of Population Health, Cancer Epidemiology Unit Kuluski, Kerry; Bridgepoint Active Healthcare, Bridgepoint Collaboratory for Research and Innovation; University of Toronto, Institute of Health Policy, Management and Evaluation Costa, Andrew P ; McMaster University, Department of Health Research Methods, Evidence, and Impact Sinha, Samir; Mount Sinai Hospital, Department of Medicine; University of Toronto, Institute of Health Policy, Management and Evaluation Glazier, Richard; Institute for Clinical Evaluative Sciences; University of Toronto Dalla Lana School of Public Health Forster, Alan; Ottawa Hospital Research Institute; Department of Medicine in Ottawa Jefferies, Lianne; St. Michael's Hospital, Nursing Research; University of Toronto, Institute of Health Policy, Management and Evaluation
Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Health services research, Health policy, Sociology
Keywords:	GENERAL MEDICINE (see Internal Medicine), Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH, SOCIAL MEDICINE

SCHOLARONE™
Manuscripts

TITLE

Investigating the Effect of Sociodemographic Factors on 30-day Hospital Readmission among Medical Patients in Toronto, Canada: a Prospective Cohort Study

AUTHORS

Robert W. Smith, MSc

DPhil Student,

Nuffield Department of Population Health, University of Oxford

Richard Doll Building, Old Road Campus, Oxford OX3 7LF, United Kingdom

Email: robert.smith@ndph.ox.ac.uk Phone: 07491 872 778

Kerry Kuluski, MSW PhD

Assistant Professor,

Institute of Health Policy, Management and Evaluation, University of Toronto,

Toronto, Ontario, Canada

Research Scientist, Bridgepoint Collaboratory for Research and Innovation, Sinai Health System,

Toronto, Ontario, Canada

Andrew P. Costa, PhD

Assistant Professor,

Department of Health Research Methods, Evidence, and Impact, McMaster University,

Hamilton, Ontario, Canada

Samir K. Sinha, MD DPhil

Associate Professor,

Institute of Health Policy, Management and Evaluation, University of Toronto,

Director of Geriatrics, Sinai Health System and University Health Network

Toronto, Ontario, Canada

Richard H. Glazier, MD MPH

Professor, Dalla Lana School of Public Health, University of Toronto

Senior Scientist, Institute of Clinical Evaluative Sciences

Toronto, Ontario, Canada

Alan Forster, MD MSc

Professor, Department of Medicine, University of Ottawa

Senior Scientist, Ottawa Hospital Research Institute

Ottawa, Ontario, Canada

Lianne Jeffs, RN PhD

Associate Professor,

Institute of Health Policy, Management and Evaluation, University of Toronto,

Lawrence S. Bloomberg Faculty of Nursing, University of Toronto,

Toronto, Ontario, Canada

KEYWORDS:

General medicine; Quality in health care; Public Health; Social Medicine;

WORD COUNT:

3935

ABSTRACT

Objective: To examine the influence of patient-level sociodemographic factors on the incidence of hospital readmission within 30 days among medical patients in a large Canadian metropolitan city.

Design: Prospective cohort study

Setting and participants: Patients admitted to the General Internal Medicine service of an urban teaching hospital in Toronto, Canada participated in a survey of sociodemographic information. Patients were not surveyed if deemed medically unstable, receiving care in medical/surgical step-down beds, or were isolated for infection control. Included in the final analysis was a diverse cohort of 1427 adult, non-palliative, patients who were discharged home.

Measures: Thirteen patient-level sociodemographic variables were examined in relation to time to unplanned all-cause readmission within 30 days. Illness-level was controlled for using Hospital Admission Risk Prediction (HARP) index score, Charlson Comorbidity Index score, and inpatient length of stay variables.

Results: Approximately 14.4% (n=205) of patients experienced readmission within 30 days. Sociodemographic factors were not significantly associated with time to readmission. Patients with HARP scores from 9 to 29, versus 0 to 2, exhibited 66% increased hazard of readmission (adjusted HR=1.66, 95% CI: 1.08-2.54, p=0.02). When HARP variables were analyzed as separate covariates, one previous admission (adjusted HR=1.78, 95% CI: 1.22-2.59, p<0.01) and at least 4 previous emergency department visits (adjusted HR=2.33, 95% CI: 1.46-4.43, p<0.01) were associated with increased hazard of readmission.

Conclusions: Patient-level sociodemographic factors did not influence the incidence of unplanned all-cause readmission within 30 days. In Canada, the studied sociodemographic factors may not be suitable variables upon which to identify high-risk patients or tailor interventions aimed at preventing readmission. Further research is needed to understand the generalizability of our findings and investigate whether contextual factors, such as access to universal health insurance coverage, attenuate the effects of sociodemographic factors.

STRENGTHS AND LIMITATIONS

1. Our study represents the first detailed examination of patient-level sociodemographic factors in relation to hospital readmission within a general medical patient population in Canada.
2. The sample size was robust however despite this, multi-category sociodemographic variables required aggregation.
3. Survey methods reduced the likelihood of non-response from marginalized groups however, the proportion of missing data was particularly high for total family income.
4. The generalizability of these findings to other communities within and beyond Toronto, Canada remains unclear.

For peer review only

INTRODUCTION

Unplanned hospital readmissions occurring within 30 days of discharge are considered to be adverse health outcomes that are common, harmful to patients, costly to the health system, and to some degree preventable.⁽¹⁻³⁾ The causal mechanisms leading to hospital readmissions are complex and not well understood.⁽⁴⁾ Risk factors for readmission that are commonly substantiated within medical patient populations include characteristics of a person's medical condition and preexisting comorbidities; historical healthcare utilization; and characteristics of the medical care delivered in hospital and shortly after discharge.⁽⁵⁻¹⁰⁾

Several studies have examined how risk of readmission is influenced by social and demographic characteristics of people and the communities within which they live.^(1, 6-8, 11-25) Sociodemographic factors are believed to influence how individuals use healthcare by predisposing them to illness, affecting their intentions on and ability to access healthcare, and affecting their perceived and professionally evaluated need for healthcare.⁽²⁶⁾ Due in part to data availability limitations, sociodemographic factors such as age, gender/sex, and neighbourhood-level indicators of socioeconomic status have garnered the greatest attention within this literature. Few studies have examined the effects of a variety of less commonly investigated patient-level sociodemographic factors such as the following: total family income, education, housing situation, race, language, place of birth, sexual orientation, religious/spiritual affiliation, and disability. A stronger understanding of these relationships may inform the design of healthcare delivery models and health policy aimed at preventing readmissions and reducing health inequities.

Systematic collection and utilization of patient-level sociodemographic data is not a widespread practice within health systems such as Canada's.⁽²⁷⁾ In 2012, the Measuring Health Equity program was initiated by three hospitals and the public health unit in downtown Toronto, Canada to develop a standardized process for, and initiate the collection of detailed patient-level sociodemographic information.^(28, 29)

We sought to understand whether and to what degree patient-level sociodemographic factors influence the incidence of hospital readmission over a 30-day timeframe within a Canadian medical patient population.

METHODS

Study Design and Data Sources

We conducted a prospective cohort study involving 1976 patients admitted to the General Internal Medicine (GIM) service of a 442-bed academic health sciences centre in Toronto. As part of Measuring Health Equity, consenting patients were surveyed by trained research personnel and staff between June 2012 and July 2014. Survey questions (see Supplementary Materials, Table I) were translated in 11 languages and professional interpreters were available for patients who were not comfortable completing the survey in English. Five days per week, research personnel screened GIM service admitted patient lists to identify candidates for survey participation. Before the identified candidates were approached at the bedside, research personnel consulted with clinical staff to ensure the patients were in stable enough condition to

1
2
3 participate in the informed consent process and survey. Patients were not surveyed if actively
4 receiving care in intensive or critical care units, medical/surgical step-down beds, or isolated for
5 infection control. Among those who were approached by research staff, we estimate that 75% of
6 eligible patients or their proxies provided written informed consent to participate. This estimated
7 response rate was calculated as of July 2013. Due to inconsistencies in survey administration
8 from July 2013 a final response rate for the sampled population was not attainable.

9
10
11 Survey data was linked to medical record data from the Canadian Institute for Health
12 Information (CIHI) Discharge Abstract Database (DAD) and National Ambulatory Care
13 Reporting System (NACRS). DAD and NACRS provided information related to characteristics
14 of each patient's inpatient admissions and emergency department visits (e.g. admission/discharge
15 dates, diagnoses, clinical service providers, discharge disposition). Primary data collection and
16 analyses were approved by the Mount Sinai Hospital Research Ethics Board (REB Number: 11-
17 0319-E).
18
19

20 21 **Study Cohort Derivation**

22 Figure 1 presents the cohort derivation process. We focused on adults admitted to the GIM
23 service and discharged to the community. Surveyed patients were excluded if their records
24 exhibited the following: missing patient identification numbers; missing admission, discharge,
25 and birth dates; age was under 18 years; most responsible diagnosis codes indicated palliative
26 care or chemotherapy for neoplasm; patient was not discharged to their place of residence (i.e.
27 home or non-institutional home setting with and without support services like home care); or
28 discharge disposition indicated death or patient self-sign out. These exclusion criteria are
29 consistent with those used by CIHI to calculate 30-day medical readmission rates and derive the
30 Hospital Admission Risk Prediction (HARP) index study cohort.^(7, 30) However, we did not
31 exclude patients whose primary reason for admission was related to obstetric or mental health
32 conditions, and those who received surgical interventions during their index admission. Few
33 patients within the sample exhibited these characteristics, and it was hypothesized that their
34 inclusion would better reflect the clinically diverse patient population served on medical units.
35 Also, these patients were assessed by physicians, and their diagnoses were deemed appropriate
36 for care on the GIM service as opposed to solely obstetric, psychiatric, or surgical units. The
37 final sample size was 1427 patients.
38
39
40
41

42 **Outcome Variable**

43 The outcome variable was time to first unplanned, all-cause readmission to any acute care
44 hospital within the Toronto Central Local Health Integration Network region. Approximately 1.2
45 million people reside in this region. The observation window extended 30 days following the
46 index discharge date. The patient was the unit of analysis. Only subsequent admissions that were
47 classified as urgent/emergent (i.e. unplanned, non-elective) were considered. To align with prior
48 research, we considered subsequent admissions readmissions including when the discharge
49 disposition of this subsequent encounter indicated death.^(13, 31)
50
51
52

53 **Sociodemographic Variables & Covariates**

54 Variable selection was guided by an extensive review of previous observational studies
55 examining risk factors for readmission among medical patients, and Andersen's Behavioural
56 Model.^(26, 32) Andersen's Behavioural Model is a framework conceptualizing healthcare
57 utilization as a function of the following factors: an individual's sociodemographic
58
59
60

1
2
3 characteristics and health behaviours; contextual characteristics of the communities where they
4 live (e.g. policies governing the organization of, and access to healthcare and social welfare
5 programs); and the medical care processes and health outcomes experienced upon accessing
6 care. Andersen's Behavioural Model was chosen for its relevance to the comprehensive study of
7 sociodemographic, behavioural, health-related, and contextual determinants of healthcare
8 utilization. Due to the patient-level nature of the available data, our study focused on individual
9 characteristics. These predisposing, enabling, and need factors are posited to influence how
10 individuals use healthcare by predisposing them to illness, affecting their intentions on and
11 ability to access healthcare, and affecting their perceived and professionally evaluated need for
12 healthcare.⁽²⁶⁾
13
14
15

16
17 The following independent variables were conceptualized as predisposing factors: gender, sexual
18 orientation, race, place of birth, religious/spiritual affiliation, primary spoken and reading
19 languages, self-perceived ability to speak and understand English, educational attainment, home
20 ownership status. Sexual orientation was the only variable for which no previous medical
21 readmission studies could be identified. This variable was included because of recent data from
22 the Canadian Community Health Survey indicating potential differences in access to regular
23 medical care and healthcare seeking behavior among those who identify as homosexual and
24 bisexual compared to heterosexual.⁽³³⁾ Total family income was conceptualized as an enabling
25 factor. Self-perceived health status and disabilities were conceptualized as need factors. Self-
26 reported disabilities were analyzed as a disability score variable representing the total number of
27 physical, sensory, learning, and developmental disabilities and or disability related to chronic
28 illness, mental health, or drug or alcohol dependence. Each variable is defined in Supplementary
29 Materials, Table I. For statistical power, sociodemographic categories were combined to
30 maintain at least 50 patients in each category. Variable aggregation was informed by previous
31 research.^(7, 34)
32
33
34

35
36 The HARP index score, Charlson Comorbidity Index score, and inpatient length of stay
37 covariates were conceptualized as need factors indicating illness-level and clinical complexity.
38 The HARP index is a predictive algorithm for 30-day readmission that was recently derived and
39 validated within an Ontario medical patient population.⁽⁷⁾ Weighted HARP index scores are
40 calculated according to values for the following variables: age; frequency of emergency
41 department (ED) visits, and inpatient admissions six months preceding a patient's index
42 admission date; discharge disposition; and a patient's primary diagnosis (i.e. case mix group).
43 HARP scores can range from zero (indicating low risk of readmission) to 41 (indicating high risk
44 of readmission). Within the HARP index study, the population median HARP score was nine.⁽⁷⁾
45 Charlson scores were calculated according to the latest scoring scheme.⁽³⁵⁾
46
47
48

49 **Missing Data**

50 Patients were included in analyses if they did not respond to every question of the survey. Given
51 the sensitive nature of the information, it was probable that "prefer not to answer" (PNA), "do
52 not know" (DK) and complete non-responses were not missing at random. For this reason,
53 imputation was not used to manage missing data. Alternatively, PNA and DK responses were
54 aggregated into one category for each sociodemographic variable, and included in regression
55 analyses. Since it was unclear why some patients had complete non-responses recorded as
56 opposed to PNA/DK responses, these patients were not included in the regression analyses.
57
58
59
60

Statistical Analysis

Kaplan Meier product-limit failure plots were used to assess the absolute probability of readmission over the 30-day observation window. Univariate and multivariable Cox regression was used to examine associations between independent variables and time to readmission. Patients who did not experience readmission were censored at 30 days. The proportional hazards assumption was assessed by modeling time-dependent covariates for each independent variable and covariate. This assumption was satisfied. Primary reading language and English proficiency exhibited evidence of multicollinearity and were thus not included in multivariable analyses. Hazard ratios were calculated at a 95% confidence level to measure the magnitude and direction of effects. Two multivariable Cox regression analyses were conducted. Anticipating a 14% to 15% readmission rate within this cohort, we estimated that each multivariable model had adequate statistical power to examine 19 to 21 variables. Adjusted model one examined the HARP index score as a covariate, and model two studied the individual variables constituting the HARP index as separate covariates. Akaike Information Criterion (AIC) values were calculated to compare goodness of fit between multivariable models. All statistical analyses were conducted using SAS software version 9.4.⁽³⁶⁾

RESULTS

Table 1 presents the descriptive characteristics of our study sample. Approximately 14.4% ($n=205$) of patients experienced readmission within 30 days. One third of readmissions occurred within the first 7 days. The mean time to readmission was 12.4 days ($SD=8.46$). The median age of patients in this cohort was 67 years ($IQR: 50-81$). The majority identified as female ($n=771$, 54%), white-European ($n=988$, 69%), and heterosexual ($n=1279$, 90%). Approximately 80% of patients ($n=1138$) felt most comfortable speaking with their health care provider in English. Collectively however, patients within this sample comfortably spoke and read at least 28 different languages and identified with at least 12 racial groups. About half ($n=696$, 49%) of the cohort was not born in Canada. Many patients preferred not to disclose or did not know their annual total family income ($n=661$, 46%). Among those that did, the most common category reported was income less than \$20,000 ($n=204$, 14%). The majority reported attaining at least some post-secondary education ($n=808$, 57%), and living in accommodations that they did not own ($n=755$, 53%).

Approximately half the cohort rated their general health as at least good (i.e. good, very good, or excellent; $n=709$, 50%). The majority reported experiencing at least one disability ($n=781$, 55%). Most did not experience an ED visit ($n=989$, 69%), or inpatient admission ($n=1211$, 85%) 6 months prior to the index admission. The three most common diagnoses primarily responsible for admission were the following: pneumonia ($n=59$, 4.1%); symptom/sign of the digestive system ($n=47$, 3.3%); and heart failure ($n=43$, 3.0%). The median number of recorded comorbidities was 2 ($IQR: 1-3$). However, relatively few patients exhibited one or more Charlson comorbidities (15%, $n=208$). The median HARP score was 6 ($IQR: 3-8$).

None of the patient-level sociodemographic factors examined were significantly associated with time to unplanned all-cause hospital readmission in unadjusted nor adjusted Cox regression analyses (Table 2). In unadjusted analyses both fair (*unadjusted HR*=1.52, 95% *CI*: 2.09-2.12,

1
2
3 $p=0.01$) and poor (*unadjusted HR*=1.61, 95% *CI*: 1.14-2.27, $p=0.01$) self-perceived health were
4 associated with increased hazard of readmission. After controlling for all other variables, patients
5 reporting fair health exhibited 45% greater hazard of readmission than those reporting good, very
6 good or excellent health (*adjusted HR*=1.45, 95% *CI*: 1.02-2.05, $p=0.04$). Poor health was no
7 longer significantly associated. In adjusted model two, neither fair nor poor health exhibited
8 significant associations.
9

10
11 HARP index score was significantly associated with readmission in unadjusted and adjusted
12 analyses (Table 2). Patients within the highest HARP score quartile (score range: 9-29) exhibited
13 66% greater hazard of readmission than individuals within the lowest quartile (score range: 0-2)
14 (*adjusted HR*=1.66, 95% *CI*: 1.08-2.54, $p=0.02$). No significant associations were found among
15 the other HARP score quartiles. However, the global null hypothesis for adjusted model one was
16 not rejected. Therefore, the variables within this model did not predict readmission better than
17 chance. Within adjusted model two, having experienced at least four previous ED visits
18 (*adjusted HR*=2.33, *CI*: 1.46-4.43, $p<0.01$) or one previous admission (*adjusted HR*=1.78, *CI*:
19 1.22-2.59, $p<0.01$) were significantly associated with increased hazard of readmission. The null
20 hypothesis was rejected for model two and AIC values were lower (Adjusted model one:
21 *AIC*=2966; Adjusted model two: *AIC*=2959) suggesting that model two provides slightly better
22 fit to the data.
23
24
25
26
27

28 DISCUSSION

29
30 Our prospective study of 1427 patients admitted to the GIM service of an urban teaching hospital
31 in Toronto, Canada represents the first detailed examination of patient-level sociodemographic
32 factors in relation to hospital readmission within a general Canadian medical patient population.
33 Patient-level sociodemographic factors were not found to be significantly associated with
34 unplanned all-cause hospital readmission within 30 days. Indicators of illness-level such as fair
35 self-perceived health, HARP scores from nine to 29, and previous hospital utilization in-
36 particular were found to be significantly associated with increased hazard of readmission. The
37 results of our study are largely consistent with previous research involving medical patients.<sup>(6, 8,
38 12-14, 17, 21, 37, 38)</sup> However, compelling insights into the relationship between sociodemographic
39 factors and 30-day hospital readmission can also be derived from contrasting findings within this
40 and broader literature. Our findings have several clinical, policy, and research implications
41 which merit discussion.
42
43
44

45 While we found that many patient-level sociodemographic factors likely are not contributors to
46 hospital readmission risk among general medical patients, some sociodemographic variables may
47 be sensitive to effect moderation by unmeasured contextual factors. Access to comprehensive
48 social safety net and universal publicly funded health insurance programs for example, may
49 attenuate associations between socioeconomic factors and readmission within nations such as
50 Canada⁽¹³⁾ and France.⁽³⁸⁾ Medicare and Medicaid programs in the United States may not
51 mitigate readmission risk associated with a patient's socioeconomic circumstances to the same
52 extent.^(12, 17) This could be attributed to differences in the adequacy of coverage and quality of
53 health and social services accessible to Medicare and Medicaid beneficiaries compared to
54 beneficiaries of universal publicly funded health insurance programs. There also exists evidence
55 for^(21, 37) and against^(8, 12, 17) race/ethnicity and primary spoken language as risk factors for
56
57
58
59
60

1
2
3 readmission among medical patients. Contributing to these mixed findings may be contextual
4 differences across study sites related to the cultural competence of care providers, and the
5 availability of interpreters and translated patient education materials.
6
7

8 It remains possible that sociodemographic factors may also vary in their effects on recovery and
9 disease self-management depending a person's specific medical condition. Indeed, studies
10 analyzing patients hospitalized for heart failure and pneumonia, tend to substantiate lower
11 socioeconomic status and black race as risk factors for readmission.⁽¹¹⁾ Such patterns are not
12 apparent within general medical patient populations.
13
14

15 Consistent with previous research, ED visits and hospital admissions preceding the index
16 admission were the strongest indicators of increased risk of readmission.^(5, 8, 12) Inconsistent with
17 previous research, individuals with fair but not poor self-perceived health were at increased risk
18 of readmission.^(12, 38) This finding is likely attributed to residual confounding and or
19 measurement error given that poor perceived health was no longer significantly associated after
20 adjusting for illness-level covariates, and fair perceived health was no longer associated after
21 adjusting for HARP index constituent variables. Confounding and measurement error may also
22 explain why disability score was not significantly associated while measures of functional
23 limitation and disability have been in previous studies.^(14, 39, 40)
24
25
26

27 Approximately one third of readmissions observed in this study took place within seven days of
28 discharge. Readmissions occurring within seven days are believed to be more likely preventable
29 and perpetuated by factors within the control of hospital care providers.⁽⁴¹⁾ This study's results
30 suggest that the key ingredients to preventing hospital readmissions may not vary substantially
31 according to patients' sociodemographic circumstances. Continued effort may thus be warranted
32 among clinicians and healthcare administrators to improve the quality of standardized
33 transitional care processes from hospital to home. Such care processes include how patients are
34 prepared in hospital for post-discharge disease self-management, how patient readiness for
35 discharge is assessed, and the planning and coordination of timely follow-up care with primary
36 care and other service providers in the community.⁽⁴²⁻⁴⁵⁾
37
38
39

40 A criticism of policies aimed at incentivizing quality improvement and reducing readmission
41 rates in the United States is that hospitals serving more socially disadvantaged patient
42 populations are disproportionately penalized for readmission rates above their expected target.⁽⁴⁶⁾
43 Within a Canadian context, patient-level sociodemographic factors may not explain a significant
44 degree of variation in 30-day medical readmission rates within and between regions. Health
45 system administrators thus need to exercise caution when considering the adjustment of quality
46 standards by sociodemographic characteristics. In the absence of empirical and conceptual
47 evidence of independent association between a specific sociodemographic variable and a quality
48 indicator, genuine differences in the quality of care can be obscured and become more difficult to
49 remediate.⁽⁴⁷⁾
50
51
52

53 The detailed patient-level nature of sociodemographic data that were analyzed are noteworthy
54 strengths of this study. Patient-level data is ideal for studying health inequalities and discerning
55 inequity.⁽²⁷⁾ As opposed to geocoded neighbourhood-level sociodemographic data, patient-level
56 data is less vulnerable to measurement error arising from misclassification. However, limitations
57
58
59
60

1
2
3 associated with the collection and analysis of patient-level data within our study merit
4 consideration.
5
6

7 Based on early survey records we estimated that 75% of patients approached by research staff
8 participated in the Measuring Health Equity survey. However, the exact number and nature of
9 patients who declined was not available. Affecting the generalizability of our findings may be
10 non-response, response, and recall bias. Post-hoc descriptive analyses of previous population-
11 based studies involving medical patients from Canada,⁽¹³⁾ and Mount Sinai Hospital admissions
12 data suggest that the clinical characteristics of our sample were largely reflective of medical
13 patients discharged home at Mount Sinai Hospital and hospitals within the province of Ontario,
14 Canada. Due to the paucity of patient-level sociodemographic data collected within health
15 systems, the degree to which the sociodemographic characteristics of this sample is reflective of
16 medical patients cared for within and beyond hospitals in Toronto also remains unclear.
17 However, data collection and analysis methods helped reduce the likelihood of traditionally
18 disadvantaged populations being excluded from this study. First, multi-lingual surveyors and
19 interpreters were available to administer the survey with patients who were unable to participate
20 in English. Research staff were also specially trained in the administration of surveys for
21 sensitive information. To prevent people who were uncomfortable or unable to respond to certain
22 questions from being excluded during multivariable regression analyses, PNA and DK responses
23 were aggregated into a single category and modeled.
24
25
26
27

28 Within healthcare settings, people tend to be less comfortable sharing sensitive information such
29 as income, education, and sexual orientation.⁽²⁷⁾ We too observed increased proportions of PNA
30 and DK responses among these variables. Differing proportions of missing data across
31 sociodemographic variables may have increased risk of type two error within multivariable
32 model results. Caution should thus be exercised when interpreting our results particularly in
33 relation to income within this sample. However, since the hazard ratio confidence intervals were
34 relatively consistent in range across variables, we do not believe type two error likely accounts
35 for differences in results between the factors examined.
36
37
38

39 Most multi-category sociodemographic variables were aggregated to maintain statistical power.
40 A limitation of categorical variable aggregation is that this method can conflate and prevent the
41 detection of true effects observed within less frequently selected categories.⁽⁴⁸⁾ Particularly
42 within diverse nations such as Canada, sociodemographic variable aggregation poses a limitation
43 for researchers and health system administrators to identify and monitor health inequities.
44
45

46 Future research is needed to assess the generalizability of these findings, and discern which, and
47 within what contexts sociodemographic factors affect hospital readmission risk. This research
48 should aspire to mixed methodologies examining how sociodemographic factors intersect among
49 themselves and with other clinical factors to influence recovery during and shortly after
50 hospitalization. Larger medical patient cohorts may facilitate stratified analyses by specific
51 clinical conditions and reduce the need to aggregate sociodemographic groups. To optimize the
52 utility of patient-level sociodemographic data collection for identifying and addressing health
53 inequities, further work is needed to develop efficient health system-wide collection methods
54 which also minimize risk of sampling, response, and non-response bias.
55
56
57
58
59
60

Conclusion

Our study suggests that many sociodemographic factors may not influence risk of 30-day readmission among medical patients in Canada. While attentiveness to patients' sociodemographic circumstances is an important component of patient-centered care, the key ingredients to interventions aimed at preventing readmissions may not vary substantially according to patients' sociodemographic characteristics. Future research should examine the generalizability of our findings within and beyond Toronto, Canada and investigate whether contextual factors, such as access to universal health insurance coverage, attenuate the effects of sociodemographic factors.

CONTRIBUTORSHIP STATEMENT

RWS was responsible for study design, data analysis, interpretation of results, and manuscript production. LJ, KK, AJ, SS advised RWS on study design and analysis. RWS and SS facilitated data acquisition. All authors contributed to data interpretation, critically revised the manuscript, approved the final submission and act as guarantors of this work.

FUNDING DECLARATION

RWS received funding through the Canadian Institutes of Health Research Canada Graduate Scholarship, Mount Sinai Hospital Department of Medicine Graduate Studentship, and through grant funding awarded to LJ from the Ontario Ministry of Health and Long Term Care. RG was supported as a Clinician Scientist in the Department of Family and Community Medicine at the University of Toronto and at St. Michael's Hospital. No conflicting interests to declare.

DATA SHARING STATEMENT

No additional data available.

TABLES

Table 1. Characteristics of the analysis cohort and observed readmissions.

<i>Sociodemographic Characteristics</i>	% of patients <i>Overall</i> <i>n=1427</i>	Unplanned all-cause readmission within 30 days, % of patients	
		No <i>n=1222</i> (85.6%)	Yes <i>n=205</i> (14.4%)
Age			
Median (IQR)	67 (50-81)	68 (51-82)	67 (49-88)
18-64	45.1%	44.8%	46.3%
65-84	36.6%	36.5%	37.1%
85+	18.4%	18.7%	16.6%
Gender			
Female	54.0%	53.8%	55.6%
Male	43.5%	43.8%	42.0%
Transgender/PNA/DK	2.1%	2.1%	2.1%
Sexual Orientation			
Heterosexual	89.6%	89.5%	90.2%
Not Heterosexual	4.3%	4.6%	2.9%
PNA/DK	5.7%	5.5%	6.8%
Race			
White-European	69.2%	68.8%	71.7%
Asian	11.1%	10.9%	12.2%
Black	5.5%	5.9%	3.4%
Not Asian/Black/White	10.7%	10.9%	9.3%
PNA/DK	3.2%	3.1%	3.4%
Religious/Spiritual Affiliation			
Affiliation	75.1%	74.7%	77.6%
No Affiliation	19.8%	20.0%	18.0%
PNA/DK	4.7%	4.8%	4.4%
Place of Birth			
Canada	49.5%	49.6%	48.8%
Not Canada	48.8%	48.5%	50.2%
PNA	1.4%	1.5%	1.0%
Primary Spoken Language			
English	79.7%	80.5%	75.1%
Non-English	18.3%	17.4%	23.4%
PNA/DK	1.6%	1.7%	1.5%
Primary Reading Language			
English	80.7%	81.2%	78.0%
Not English	17.4%	16.9%	20.5%
PNA/DK	1.5%	1.5%	1.5%
Self-Perceived Ability to Speak/Understand English			
Well	86.1%	86.3%	85.4%
Not Well	11.2%	11.0%	12.2%
PNA/DK	2.3%	2.3%	2.0%
Highest Level of Education			
Some high school	18.5%	18.4%	19.0%
High school diploma	18.9%	18.7%	20.5%
At least some post-secondary	56.6%	57.4%	52.2%
Other/PNA/DK	5.5%	5.1%	7.8%
Home Ownership			
Home owner	43.9%	43.5%	45.9%
Not home owner	52.9%	53.2%	51.2%
PNA/DK	2.9%	2.9%	2.9%
Total Family Income Group			
1 - \$19,999 and less	14.3%	14.2%	14.6%
2 - \$20,000-\$39,999	12.4%	12.7%	10.7%
3 - \$40,000-\$59,999	7.6%	7.5%	8.3%
4 - \$60,000-\$99,999	8.1%	8.2%	7.8%

5 - \$100,000 and over	10.9%	10.7%	11.7%
PNA/DK	46.3%	46.2%	46.9%
Disability Score			
0	38.3%	38.5%	36.6%
1	37.8%	37.7%	38.0%
2+	17.0%	16.7%	18.5%
PNA/DK	6.6%	6.7%	6.9%
Health & Illness-related Characteristics			
Self-Perceived General Health			
Good	49.7%	51.3%	40.0%
Fair	24.6%	23.8%	29.3%
Poor	21.1%	20.2%	26.3%
PNA/DK	4.2%	4.3%	4.0%
Inpatient Admissions Previous 6 Months			
0	84.9%	86.5%	75.1%
1	11.4%	10.1%	19.0%
2	2.2%	2.2%	2.4%
3+	1.5%	1.1%	3.4%
Emergency Department Visits Previous 6 Months			
0	69.3%	71.3%	57.6%
1	17.3%	16.8%	20.5%
2	5.3%	4.8%	8.3%
3	2.4%	2.5%	1.5%
4+	5.7%	4.6%	12.2%
Case Mix Group of Most Responsible Diagnosis			
Heart Failure without Cardiac Catheterization	3.0%	2.7%	4.9%
Chronic Obstructive Pulmonary Disease	2.7%	3.0%	1.0%
Inflammatory Bowel Disease	2.7%	2.8%	2.0%
Diabetes	1.8%	2.0%	0.5%
Gastrointestinal Obstruction	0.8%	0.8%	1.0%
Cirrhosis/Alcoholic Hepatitis	0.8%	0.7%	1.5%
All Other CMGs	88.1%	87.9%	89.3%
Charlson Score			
> 0	14.6%	13.8%	19.0%
Index Admission Length of Stay			
Median (IQR)	5 (3-8)	5 (3-8)	5 (3-8)
Discharge Disposition			
Home without services	65.1%	66.0%	59.5%
Home with services	34.9%	34.0%	40.5%
HARP Index Score			
Median (IQR)	6 (3-8)	5 (3-7)	6 (3-10)
Quartile 1 – Score: 0-2	22.0%	22.7%	17.6%
Quartile 2 – Score: 3-5	27.8%	29.0%	21.0%
Quartile 3 – Score: 6-8	27.1%	27.0%	27.8%
Quartile 4 – Score: 9-29	23.1%	21.3%	33.7%

Notes:

PNA: Prefer not to answer; DK: Do not know

Table 2. Results of unadjusted and adjusted Cox regression analyses examining associations between independent variables and 30-day unplanned all-cause readmission.

	Unadjusted models		Adjusted Model 1		Adjusted Model 2	
	Unadjusted Hazard Ratio (95%CI)	p value	Adjusted Hazard Ratio (95%CI)	p value	Adjusted Hazard Ratio (95%CI)	p value
Age						
18-64	Reference		--	--	Reference	
65-84	0.97 (0.72-1.32)	0.86	--	--	0.83 (0.59-1.17)	0.28
85+	0.86 (0.58-1.28)	0.46	--	--	0.71 (0.45-1.12)	0.14
Gender[‡]						
Female	Reference		Reference		Reference	
Male	0.93 (0.70-1.23)	0.60	0.97 (0.72-1.29)	0.82	0.98 (0.73-1.31)	0.88
Transgender/PNA/DK	1.15 (0.47-2.81)	0.76	1.86 (0.51-6.82)	0.35	2.00 (0.55-7.21)	0.29
Sexual Orientation[‡]						
Heterosexual	Reference		Reference		Reference	
Not Heterosexual	0.66 (0.30-1.50)	0.32	0.71 (0.31-1.62)	0.41	0.58 (0.25-1.36)	0.21
PNA/DK	1.22 (0.71-2.10)	0.48	0.97 (0.48-1.95)	0.94	0.95 (0.47-1.91)	0.88
Race						
White-European	Reference		Reference		Reference	
Asian	1.08 (0.70-1.64)	0.73	1.02 (0.64-1.63)	0.92	0.87 (0.54-1.41)	0.58
Black	0.57 (0.27-1.22)	0.15	0.64 (0.29-1.41)	0.27	0.54 (0.24-1.20)	0.13
Not Asian/Black/White	0.83 (0.52-1.35)	0.46	0.87 (0.53-1.41)	0.57	0.84 (0.51-1.38)	0.50
PNA/DK	1.04 (0.49-2.22)	0.92	1.22 (0.48-3.13)	0.68	1.47 (0.58-3.74)	0.42
Religious/Spiritual Affiliation[‡]						
Affiliation	Reference		Reference		Reference	
No Affiliation	0.89 (0.62-1.27)	0.51	0.96 (0.66-1.39)	0.81	0.95 (0.65-1.39)	0.80
PNA/DK	0.89 (0.45-1.74)	0.73	0.91 (0.42-1.97)	0.80	0.94 (0.43-2.07)	0.89
Place of Birth						
Canada	Reference		Reference		Reference	
Not Canada	1.04 (0.79-1.36)	0.80	0.93 (0.66-1.31)	0.67	0.98 (0.69-1.40)	0.92
PNA/DK	0.68 (0.17-2.73)	0.59	0.29 (0.02-3.42)	0.32	0.17 (0.01-2.30)	0.18
Primary Spoken Language[‡]						
English	Reference		Reference		Reference	
Non-English	1.39 (1.00-1.92)	0.05	1.29 (0.86-1.93)	0.23	1.29 (0.86-1.93)	0.23
PNA/DK	0.93 (0.30-2.18)	0.90	0.99 (0.18-5.36)	0.99	0.99 (0.18-5.36)	0.99
Primary Reading Language[‡]						
English	Reference		--	--	--	--
Not English	1.24 (0.88-1.74)	0.22	--	--	--	--
PNA/DK	0.98 (0.31-3.06)	0.97	--	--	--	--
Self-Perceived Ability to Speak/Understand English[†]						
Well	Reference		--	--	--	--
Not Well	1.11 (0.73-1.69)	0.63	--	--	--	--
PNA/DK	0.89 (0.33-2.39)	0.81	--	--	--	--
Highest Level of Education[†]						
Some high school	1.13 (0.78-1.63)	0.52	0.98 (0.65-1.48)	0.93	1.08 (0.71-1.64)	0.72
High school diploma	1.19 (0.83-1.69)	0.35	1.15 (0.79-1.67)	0.46	1.23 (0.84-1.80)	0.28
At least some post-secondary	Reference		Reference		Reference	
Other/PNA/DK	1.61(0.95-2.73)	0.07	1.57 (0.85-2.91)	0.15	1.72 (0.92-3.23)	0.09
Home Ownership[‡]						
Home owner	Reference		Reference		Reference	
Not home owner	0.92 (0.70-1.22)	0.58	0.99 (0.73-1.34)	0.96	1.00 (0.73-1.37)	0.99
PNA/DK	0.96 (0.42-2.19)	0.92	0.88 (0.29-2.67)	0.83	0.93 (0.31-2.81)	0.89
Total Family Income Group						
1 - \$19,999 and less	0.94 (0.55-1.61)	0.83	0.73 (0.40-1.33)	0.31	0.70 (0.38-1.29)	0.26
2 - \$20,000-\$39,999	0.79 (0.44-1.40)	0.41	0.70 (0.38-1.29)	0.25	0.78 (0.42-1.45)	0.43
3 - \$40,000-\$59,999	1.01 (0.54-1.87)	0.99	0.96 (0.50-1.81)	0.89	0.94 (0.49-1.80)	0.86
4 - \$60,000-\$99,999	0.89 (0.47-1.67)	0.71	0.87 (0.46-1.65)	0.67	0.93 (0.49-1.76)	0.82
5 - \$100,000 and over	Reference		Reference		Reference	
PNA/DK	0.94 (0.60-1.46)	0.77	0.77 (0.47-1.26)	0.30	0.82 (0.50-1.34)	0.42

Disability Score^{a†}						
0	Reference		Reference		Reference	
1	1.06 (0.78-1.46)	0.70	0.91 (0.65-1.28)	0.58	0.97 (0.69-1.37)	0.88
2+	1.16 (0.79-1.72)	0.45	0.99 (0.64-1.53)	0.97	1.20 (0.77-1.85)	0.42
PNA/DK	1.07 (0.60-1.89)	0.82	0.91 (0.48-1.72)	0.76	1.00 (0.53-1.90)	0.99
Self-Perceived General Health[†]						
Good	Reference		Reference		Reference	
Fair	1.52 (1.09-2.12)	0.01	1.45 (1.02-2.05)	0.04	1.39 (0.98-1.98)	0.07
Poor	1.61 (1.14-2.27)	0.01	1.15 (0.91-2.00)	0.13	1.15 (0.77-1.72)	0.49
PNA/DK	1.28 (0.65-2.56)	0.48	1.35 (0.51-2.56)	0.74	1.02 (0.46-2.27)	0.97
Inpatient Admissions Previous 6 Months						
0	Reference		--	--	Reference	
1	2.01 (1.41-2.85)	<0.01	--	--	1.78 (1.22-2.59)	<0.01
2	1.23 (0.50-2.99)	0.65	--	--	1.03 (0.41-2.58)	0.65
3+	2.96 (1.39-6.32)	0.01	--	--	2.06 (0.93-4.58)	0.08
Emergency Department Visits Previous 6 Months						
0	Reference		--	--	Reference	
1	1.44 (1.01-2.04)	0.04	--	--	1.41 (0.98-2.04)	0.06
2	1.98 (1.19-3.29)	0.01	--	--	1.62 (0.95-3.29)	0.08
3	0.73 (0.23-2.30)	0.59	--	--	0.63 (0.20-2.30)	0.59
4+	2.88 (1.89-4.43)	<0.01	--	--	2.33 (1.46-4.43)	<0.01
Case Mix Group of Most Responsible Diagnosis						
Heart Failure without Cardiac Catheterization	1.63 (0.86-3.08)	0.13	--	--	1.70 (0.87-3.31)	0.12
Chronic Obstructive Pulmonary Disease	0.34 (0.08-1.36)	0.13	--	--	0.36 (0.09-1.49)	0.16
Inflammatory Bowel Disease	0.70 (0.26-1.90)	0.49	--	--	0.86 (0.31-2.38)	0.77
Diabetes	0.25 (0.04-1.79)	0.17	--	--	0.24 (0.03-1.78)	0.16
Gastrointestinal Obstruction	1.09 (0.27-4.41)	0.90	--	--	1.33 (0.32-5.54)	0.69
Cirrhosis/Alcoholic Hepatitis	1.78 (0.57-5.58)	0.32	--	--	1.49 (0.45-4.94)	0.52
All Other CMGs	Reference		--	--	Reference	
Charlson Score						
0	Reference		Reference		Reference	
1+	1.39 (0.98-1.97)	0.07	1.30 (0.90-1.87)	0.16	1.34 (0.92-1.94)	0.13
Length of Stay						
Median (IQR)	1.01 (1.00-1.02)	0.18	1.00 (0.99-1.01)	0.70	1.01 (0.99-1.02)	0.39
Discharge Disposition						
Home without services	Reference		--	--	Reference	
Home with services	1.28 (0.97-1.70)	0.08	--	--	1.07 (0.78-1.48)	0.67
HARP Index Score						
Quartile 1 – Score: 0-2	Reference		Reference		--	--
Quartile 2 – Score: 3-5	0.94 (0.61-1.47)	0.79	0.89 (0.57-1.40)	0.61	--	--
Quartile 3 – Score: 6-8	1.30 (0.86-1.98)	0.22	1.17 (0.76-1.81)	0.48	--	--
Quartile 4 – Score: 9-29	1.90 (1.27-2.84)	<0.01	1.66 (1.08-2.54)	0.02	--	--

Notes:

- $n=1427$ observations were analyzed in each univariate model and $n=1420$ in multivariable models unless otherwise indicated; † $n=1421$ observations used within univariate model; ‡ $n=1422$ observations used within univariate model
- Primary reading language and English proficiency exhibited evidence of multicollinearity and were thus not included in multivariable analyses.

FIGURES:

Figure 1. Cohort derivation procedures and final sample size.

REFERENCES

1. Canadian Institute for Health Information. All-Cause Readmission to Acute Care and Return to the Emergency Department. Ottawa, Canada: Canadian Institute for Health Information; 2012.
2. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among Patients in the Medicare Fee-for-Service Program. *The New England journal of medicine*. 2009;360(14):1418-28.
3. van Walraven C, Jennings A, Taljaard M, Dhalla I, English S, Mulpuru S, et al. Incidence of potentially avoidable urgent readmissions and their relation to all-cause urgent readmissions. *Canadian Medical Association Journal*. 2011;183(14):E1067-72.
4. Dharmarajan K, Krumholz HM. Risk after hospitalization: We have a lot to learn. *Journal of Hospital Medicine*. 2015;10(2):135-6.
5. van Walraven C, Dhalla IA, Bell C, Etchells E, Stiell IG, Zarnke K, et al. Derivation and validation of an index to predict early death or unplanned readmission after discharge from hospital to the community. *Canadian Medical Association Journal*. 2010;182(6):551-7.
6. van Walraven C, Wong J, Forster AJ. LACE+ index: extension of a validated index to predict early death or urgent readmission after hospital discharge using administrative data. *Open Medicine*. 2012;6(3):80-90.
7. Canadian Institute for Health Information, Health Quality Ontario. Early identification of people at-risk of hospitalization: Hospital Admission Risk Prediction (HARP)—a new tool for supporting providers and patients. Toronto, Canada: Queen's Printer of Ontario; 2013.
8. Donzé J, Aujesky D, Williams D, Schnipper JL. Potentially Avoidable 30-Day Hospital Readmissions in Medical Patients: Derivation and Validation of a Prediction Model. *JAMA Internal Medicine*. 2013;173(8):632-8.
9. O'Connor M, Murtaugh CM, Shah S, Barrón-Vaya Y, Bowles KH, Peng TR, et al. Patient Characteristics Predicting Readmission Among Individuals Hospitalized for Heart Failure. *Medical Care Research and Review*. 2015:1-38.
10. Kansagara D, Englander H, Salanitro A, Kagan D, Theobald C, Freeman M, et al. Risk prediction models for hospital readmission: A systematic review. *JAMA*. 2011;306(15):1688-98.
11. Calvillo-King L, Arnold D, Eubank KJ, Lo M, Yunyongying P, Stieglitz H, et al. Impact of social factors on risk of readmission or mortality in pneumonia and heart failure: systematic review. *J Gen Intern Med*. 2013;28.
12. Hasan O, Meltzer DO, Shaykevich SA, Bell CM, Kaboli PJ, Auerbach AD, et al. Hospital Readmission in General Medicine Patients: A Prediction Model. *Journal of General Internal Medicine*. 2010;25(3):211-9.
13. van Walraven C, Wong J, Forster AJ. Influence of neighborhood household income on early death or urgent hospital readmission. *Journal of Hospital Medicine*. 2013;8:261-6.
14. Garcia-Perez L, Linertova R, Lorenzo-Riera A, Vazquez-Diaz JR, Duque-Gonzalez B, Sarria-Santamera A. Risk factors for hospital readmissions in elderly patients: a systematic review. *QJM*. 2011;104(8):639-51.
15. Mudge AM, Kasper K, Clair A, Redfern H, Bell JJ, Barras MA, et al. Recurrent readmissions in medical patients: A prospective study. *Journal of Hospital Medicine*. 2011;6:61-7.

16. Fleming LM, Gavin M, Piatkowski G, Chang JD, Mukamal KJ. Derivation and Validation of a 30-Day Heart Failure Readmission Model. *The American Journal of Cardiology*. 2014;114(9):1379-82.
17. Hu J, Gonsahn MD, Nerenz DR. Socioeconomic Status And Readmissions: Evidence From An Urban Teaching Hospital. *Health Aff*. 2014;33(5):778-85.
18. Mather JF, Fortunato GJ, Ash JL, Davis MJ, Kumar A. Prediction of pneumonia 30-day readmissions: a single-center attempt to increase model performance. *Respiratory Care*. 2014;59(2):199-208.
19. Coventry PA, Gemmell I, Todd CJ. Psychosocial risk factors for hospital readmission in COPD patients on early discharge services: A cohort study. *BMC Pulmonary Medicine*. 2011(11):49.
20. McGregor MJ, Reid RJ, Schulzer M, Fitzgerald JM, Levy AR, Cox MB. Socioeconomic status and hospital utilization among younger adult pneumonia admissions at a Canadian hospital. *BMC Health Services Research*. 2006;6(152):1-10.
21. Karliner LS, Kim SE, Meltzer DO, Auerbach AD. Influence of language barriers on outcomes of hospital care for general medicine inpatients. *Journal of Hospital Medicine*. 2010;5(5):276-82.
22. Peterson PN, Campagna EJ, Maravi M, Allen LA, Bull S, Steiner JF, et al. Acculturation and Outcomes among Patients with Heart Failure. *Circulation: Heart Failure*. 2012;5(2):160-6.
23. Watson AJ, O'Rourke J, Jethwani K, Cami A, Stern TA, Kvedar JC, et al. Linking electronic health record-extracted psychosocial data in real-time to risk of readmission for heart failure. *Psychosomatics*. 2011;52(4):319-27.
24. Ketterer MW, Draus C, McCord J, Mossallam U, Hudson M. Behavioral Factors and Hospital Admissions/Readmissions in Patients With CHF. *Psychosomatics*. 2014;55(1):45-50.
25. van Oeffelen AM, Agyemang C, Stronks K, Bots ML, Vaartjes I. Prognosis after a first hospitalisation for acute myocardial infarction and congestive heart failure by country of birth. *Heart*. 2014;100(18):1436-43.
26. Andersen RM, Davidson PL. Chapter 1: Improving Access to Care in America--Individual and Contextual Indicators. In: Andersen RM, Rice TH, Kominski GF, editors. *Changing the US health care system: key issues in health services policy and management*. 3rd. San Francisco: Jossey-Bass; 2007. p. 3-31.
27. Kirst M, Shankardass K, Bomze S, Lofters A, Quiñonez C. Sociodemographic data collection for health equity measurement: a mixed methods study examining public opinions. *International Journal for Equity in Health*. 2013;12(1):1-10.
28. Wray R, Agic B, Bennett-AbuAyyash C, Kanee K, Lam R, Mohamed A, et al. *We ask because we care: The Tri-Hospital + TPH Health Equity Data Collection Research Project Report*. Toronto, Canada; 2013.
29. *Measuring Health Equity: Mount Sinai Hospital and Toronto Central Local Health Integration Network*; 2016 [Available from: <http://torontohealthequity.ca/>].
30. Canadian Institute for Health Information. *Technical Note: 30-Day Adult Medical Readmission Rate*: Canadian Institute for Health Information; 2015 [Available from: <https://www.cihi.ca/en/health-system-performance/performance-reporting/indicators/technical-note-30-day-adult-medical>].

- 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
 - 9
 - 10
 - 11
 - 12
 - 13
 - 14
 - 15
 - 16
 - 17
 - 18
 - 19
 - 20
 - 21
 - 22
 - 23
 - 24
 - 25
 - 26
 - 27
 - 28
 - 29
 - 30
 - 31
 - 32
 - 33
 - 34
 - 35
 - 36
 - 37
 - 38
 - 39
 - 40
 - 41
 - 42
 - 43
 - 44
 - 45
 - 46
 - 47
 - 48
 - 49
 - 50
 - 51
 - 52
 - 53
 - 54
 - 55
 - 56
 - 57
 - 58
 - 59
 - 60
31. Barnett ML, Hsu J, McWilliams M. Patient Characteristics and Differences in Hospital Readmission Rates. *JAMA Intern Med.* 2015.
32. Smith RW. Patient-level Social Determinants of Unplanned Hospital Readmission among General Internal Medicine Patients. University of Toronto; 2016.
33. Statistics Canada. Same-sex couples and sexual orientation. The Daily: By the numbers. 2016. [Available from: http://www.statcan.gc.ca/eng/dai/smr08/2015/smr08_203_2015].
34. Fitzpatrick T, Rosella LC, Calzavara A, Petch J, Pinto AD, Manson H, et al. Looking Beyond Income and Education: Socioeconomic Status Gradients Among Future High-Cost Users of Health Care. *American Journal of Preventative Medicine.* 2015;49(2):161-71.
35. Quan H, Li B, Couris CM, Fushimi K, Graham P, Hider P, et al. Updating and Validating the Charlson Comorbidity Index and Score for Risk Adjustment in Hospital Discharge Abstracts Using Data From 6 Countries. *American Journal of Epidemiology.* 2011;173(6):676-82.
36. SAS Institute Inc. SAS Version 9.4. Cary, NC: SAS Institute Inc.; 2012.
37. Allaudeen N, Vidyarthi A, Maselli J, Auerbach A. Redefining readmission risk factors for general medicine patients. *Journal of Hospital Medicine.* 2011;6:54-60.
38. Lanièce I, Couturier P, Dramé M, Gavazzi G, Lehman S, Jolly D, et al. Incidence and main factors associated with early unplanned hospital readmission among French medical inpatients aged 75 and over admitted through emergency units. *Age and Ageing.* 2008;37(4):416-22.
39. Kahlon S, Pederson J, Majumdar SR, Belga S, Lau D, Fradette M, et al. Association between frailty and 30-day outcomes after discharge from hospital. *Canadian Medical Association Journal.* 2015.
40. Greysen S, Stijacic Cenzer I, Auerbach AD, Covinsky KE. Functional Impairment and Hospital Readmission in Medicare Seniors. *JAMA Internal Medicine.* 2015;175(4):559-65.
41. Joynt KE, Jha AK. Thirty-Day Readmissions — Truth and Consequences. *New England Journal of Medicine.* 2012;366(15):1366-9.
42. Greysen SR, Harrison JD, Kripalani S, Vasilevskis E, Robinson E, Metlay J, et al. Understanding patient-centred readmission factors: a multi-site, mixed-methods study. *BMJ Quality & Safety.* 2016.
43. Jeffs L, Dhalla I, Cardoso R, Bell CM. The perspectives of patients, family members and healthcare professionals on readmissions: preventable or inevitable? *Journal of Interprofessional Care.* 2014;28(6):507-12.
44. Jackson C, Shahsahebi M, Wedlake T, DuBard CA. Timeliness of Outpatient Follow-up: An Evidence-Based Approach for Planning After Hospital Discharge. *The Annals of Family Medicine.* 2015;13(2):115-22.
45. Hernandez AF, Greiner MA, Fonarow GC, Hammill BG, Heidenreich PA, Yancy CW, et al. Relationship Between Early Physician Follow-up and 30-Day Readmission Among Medicare Beneficiaries Hospitalized for Heart Failure. *JAMA.* 2010;303(17):1716-22.
46. National Academies of Sciences Engineering and Medicine. Accounting for Social Risk Factors in Medicare Payment: Identifying Social Risk Factors. Washington, DC: The National Academies Press; 2016.
47. National Quality Forum. Risk adjustment for socioeconomic status or other sociodemographic factors. Washington, DC: National Quality Forum; 2014.
48. Rodney P, Copeland E. The health status of black Canadians: Do aggregate racial and ethnic variables hide health disparities? *J Health Care Poor Underserved.* 2009;20.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

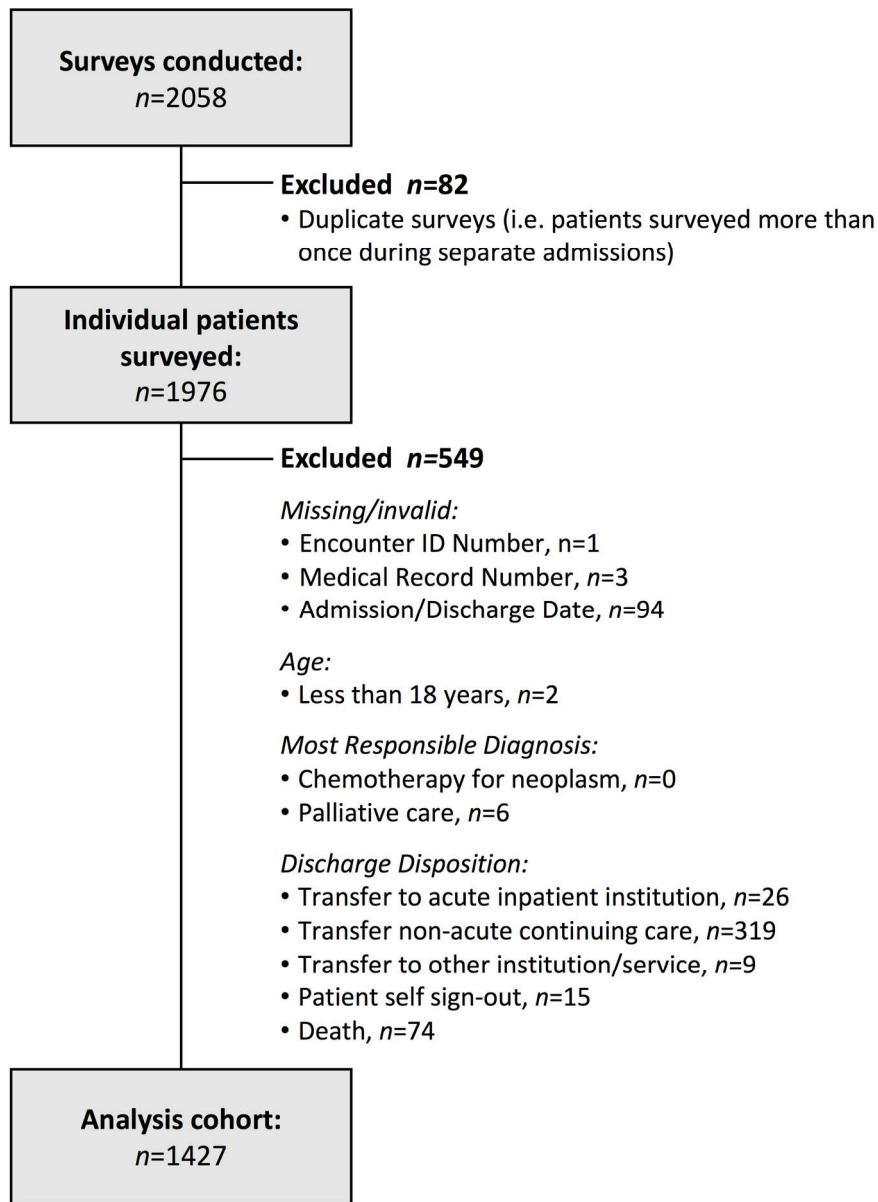


Figure 1. Cohort derivation procedures and final sample size.!! +

167x225mm (300 x 300 DPI)

Table 1. Source survey questions, definition and structure of independent variables and covariates.

Variable	Definition	Data Source	Survey Question	Survey Response Options	Aggregated Groups
Age	The number of years between date of birth and index admission date.	CIHI-DAD	N/A	N/A	18-64 years 65-84 years 85+ years
Gender	Self-identified gender.	Patient/Proxy	What is your gender?	Female Male Trans Intersex Prefer not to answer Do not know	Female Male Trans/Prefer not to answer/Do not know
Sexual Orientation	Self-identified sexual orientation.	Patient/Proxy	What is your sexual orientation?	Heterosexual ("straight") Gay Lesbian Bisexual Two-Spirit Queer Questioning Prefer not to answer Do not know	Heterosexual ("straight") Not Heterosexual Prefer not to answer/Do not know
Race	Self-identified race.	Patient/Proxy	Which of the following best describes your race?	Aboriginal (e.g., Inuit, First Nations Non-status Indian, Métis, Aboriginal person from outside Canada) Asian - East (e.g., Chinese, Japanese, Korean) Asian - South (e.g., Indian, Pakistani, Sri Lankan, Indo-Caribbean) Asian - South East (e.g., Malaysian, Filipino, Vietnamese) Black - Africa (e.g., Ghanaian, Kenyan, Somali) Black - North America Black - Caribbean Region (e.g., Barbadian, Jamaican) Latin American (e.g., Argentinian, Chilean, Salvadorean) Middle Eastern (e.g., Egyptian, Iranian, Lebanese) Mixed heritage: _____ White/ European (e.g., English, Italian, Portuguese, Russian) Other(s): _____ Prefer not to answer Do not know	White-European Asian Black Not Asian/Black/White Prefer not to answer/Do not know
Religious/Spiritual Affiliation	Self-reported affiliation with religious/spiritual community.	Patient/Proxy	What is your religious or spiritual affiliation?	I do not have a religious or spiritual affiliation Animism or Shamanism Atheism Baha'i Faith Buddhism Christianity Christian Orthodox Protestant Roman Catholic Christian, <i>not included elsewhere on this list</i> Confucianism Hinduism Jainism Judaism Islam Native Spirituality Rastafarianism Sikhism Spiritual Unitarianism Wicca Zoroastrianism	Affiliated Not Affiliated Prefer not to answer/Do not know

				Other: _____	
				Prefer not to answer	
				Do not know	
Place of Birth	Self-reported birth place (Canada vs. Not Canada)	Patient/ Proxy	Were you born in Canada?	Yes No Prefer not to answer Do not know	Yes No Prefer not to answer/ Do not know
Primary Spoken Language	Self-reported preferred language to speak with health care providers.	Patient/ Proxy	What language would you feel most comfortable speaking in with your health care provider?	American Sign Language Arabic Bengali Chinese (Cantonese) Chinese (Mandarin) Cree Dari English French German Greek Gujarati Hebrew Hindi Hungarian Italian Korean Ojibwe Oji-Cree Farsi (Persian) Polish Portuguese Punjabi Russian Spanish Somali Tagalog Tamil Urdu Vietnamese Other (Please specify) Prefer not to answer Do not know	English Not English Prefer not to answer/ Do not know
Primary Reading Language	Self-reported preferred language within which to read health information.	Patient/ Proxy	In what language would you prefer to read health care information?	American Sign Language Arabic Bengali Braille Chinese (Cantonese) Chinese (Mandarin) Cree Dari English French German Greek Gujarati Hebrew Hindi Hungarian Italian Korean Ojibwe Oji-Cree Farsi (Persian) Polish Portuguese Punjabi Russian Spanish Somali Tagalog Tamil Urdu Vietnamese Other (Please specify) Prefer not to answer	English Not English Prefer not to answer/ Do not know

For peer review

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

				Do not know	
Self-perceived ability to speak/understand English	Self-evaluated ability to speak/understand English	Patient/Proxy	How would you rate your ability to speak and understand English?	Very well Well Not well Not at all Unsure Prefer not to answer Do not know	Well Not Well Prefer not to answer/ Do not know
Highest Level of Education	Self-reported highest achieved education level.	Patient/Proxy	What is the highest level of education you have completed?	Some grade school (grade 1-8) Some high school High school graduate Some College/University education College degree Undergraduate (university) Degree Postgraduate Degree Other: _____ Prefer not to answer Do not know	Some High School High School Diploma At least some post-secondary Other Prefer not to answer/ Do not know
Home Ownership	Self-reported housing situation.	Patient/Proxy	What type of housing do you live in?	Renting Own Living with family or friends Temporary housing (e.g. shelter, hostel) or homeless Correctional facility Other: _____ Prefer not to answer Do not know	Home owner Not home owner Prefer not to answer/ Do not know
Total Family Income	Self-reported total family income before taxes.	Patient/Proxy	What was your total family income before taxes last year?	Less than \$10,000 \$10,000 to \$19,999 \$20,000 to \$29,999 \$30,000 to \$39,999 \$40,000 to \$49,999 \$50,000 to \$59,999 \$60,000 to \$79,999 \$80,000 to \$99,999 \$100,000 to \$149,999 \$150,000 or more Prefer not to answer Do not know	Less than \$20,000 \$20,000 to \$39,999 \$40,000 to \$59,999 \$60,000 to \$99,999 At least \$100,000 Prefer not to answer/ Do not know
Disability Score	Total number of self-reported disabilities.	Patient/Proxy	Do you have any of the following disabilities? <i>Check all that apply</i>	No disabilities Chronic illness Developmental disability Learning disability Mental health disability Physical disability Sensory disability (i.e. hearing or vision loss) Drug or alcohol dependence Other: _____ Prefer not to answer Do not know	0 1 2+
Self-perceived General Health	Self-evaluated general health status.	Patient/Proxy	In general, would you say your health is:	Excellent Very good Good Fair Poor Prefer not to answer Do not know	Good Fair Poor Prefer not to answer/ Do not know
Inpatient Admissions Previous 6 Months	Number of hospital admissions 183 days preceding the index admission date.	CIHI-DAD	N/A	N/A	0 1 2 3+
ED Visits Previous 6 Months	Number of emergency department visits 183 days	CIHI-NACRS	N/A	N/A	0 1 2 3

	preceding the index admission date.				4+
Case Mix Group of Most Responsible Diagnosis	Case Mix Group (CMG) under which the index admission primary diagnosis code (most responsible diagnosis) is categorized under. Specified CMGs are associated with increased risk of 30-day readmission.	CIHI-DAD	N/A	N/A	All Other CMGs Chronic Obstructive Pulmonary Disease Congestive Heart Failure without Cardiac Catheterization Inflammatory Bowel Disease Gastrointestinal Obstruction Cirrhosis/Alcoholic Hepatitis Diabetes
Charlson Comorbidity Index Score	Total weighted score associated with the number and type of Charlson comorbidities.	CIHI-DAD	N/A	N/A	0 1+
Length of Stay	Number of days between index admission date and discharge disposition date.	CIHI-DAD	N/A	N/A	N/A
Discharge Disposition	Location to which patient was discharged.	CIHI-DAD	N/A	N/A	Home or home setting without services Home or home setting with services

BMJ Open: first published as 10.1136/bmjopen-2017-017956 on 12 December 2017. Downloaded from <http://bmjopen.bmj.com/> on April 17, 2024 by guest. Protected by copyright.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

STROBE Checklist of items included in the manuscript entitled:

Investigating the Effect of Sociodemographic Factors on 30-day Hospital Readmission among Medical Patients in Toronto, Canada: a Prospective Cohort Study

	Item No	Recommendation	Addressed in Manuscript?
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	pp.1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	pp.2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	pp.4
Objectives	3	State specific objectives, including any prespecified hypotheses	pp.4
Methods			
Study design	4	Present key elements of study design early in the paper	pp.4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	pp.4-5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	pp.4-5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	pp.5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	pp.4-5
Bias	9	Describe any efforts to address potential sources of bias	pp.4,9
Study size	10	Explain how the study size was arrived at	pp.5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	pp.5-6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	pp.6
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	pp.6
		(d) If applicable, explain how loss to follow-up was addressed	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	pp.15
		(b) Give reasons for non-participation at each stage	pp.15
		(c) Consider use of a flow diagram	pp.15
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	pp.6-7, 11-12

		(b) Indicate number of participants with missing data for each variable of interest	pp.11-12
		(c) Summarise follow-up time (eg, average and total amount)	pp.6
Outcome data	15*	Report numbers of outcome events or summary measures over time	pp.6
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	pp.7, 13-14
		(b) Report category boundaries when continuous variables were categorized	pp.7
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	pp.7-8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	pp.9-10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	pp.8-10
Generalisability	21	Discuss the generalisability (external validity) of the study results	pp.9-10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	pp.10

*Give information separately for exposed and unexposed groups.

BMJ Open

Investigating the Effect of Sociodemographic Factors on 30-day Hospital Readmission among Medical Patients in Toronto, Canada: a Prospective Cohort Study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-017956.R2
Article Type:	Research
Date Submitted by the Author:	10-Oct-2017
Complete List of Authors:	Smith, Robert; University of Oxford Nuffield Department of Population Health, Cancer Epidemiology Unit Kuluski, Kerry; Bridgepoint Active Healthcare, Bridgepoint Collaboratory for Research and Innovation; University of Toronto, Institute of Health Policy, Management and Evaluation Costa, Andrew P ; McMaster University, Department of Health Research Methods, Evidence, and Impact Sinha, Samir; Mount Sinai Hospital, Department of Medicine; University of Toronto, Institute of Health Policy, Management and Evaluation Glazier, Richard; Institute for Clinical Evaluative Sciences; University of Toronto Dalla Lana School of Public Health Forster, Alan; Ottawa Hospital Research Institute; Department of Medicine in Ottawa Jefferies, Lianne; St. Michael's Hospital, Nursing Research; University of Toronto, Institute of Health Policy, Management and Evaluation
Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Health services research, Health policy, Sociology
Keywords:	GENERAL MEDICINE (see Internal Medicine), Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH, SOCIAL MEDICINE

SCHOLARONE™
Manuscripts

TITLE

Investigating the Effect of Sociodemographic Factors on 30-day Hospital Readmission among Medical Patients in Toronto, Canada: a Prospective Cohort Study

AUTHORS

Robert W. Smith, MSc

DPhil Student,

Nuffield Department of Population Health, University of Oxford

Richard Doll Building, Old Road Campus, Oxford OX3 7LF, United Kingdom

Email: robert.smith@ndph.ox.ac.uk Phone: 07491 872 778

Kerry Kuluski, MSW PhD

Assistant Professor,

Institute of Health Policy, Management and Evaluation, University of Toronto,

Toronto, Ontario, Canada

Research Scientist, Bridgepoint Collaboratory for Research and Innovation, Sinai Health System,

Toronto, Ontario, Canada

Andrew P. Costa, PhD

Assistant Professor,

Department of Health Research Methods, Evidence, and Impact, McMaster University,

Hamilton, Ontario, Canada

Samir K. Sinha, MD DPhil

Associate Professor,

Department of Medicine and Institute of Health Policy, Management and Evaluation, University of Toronto,

Director of Geriatrics, Sinai Health System and University Health Network

Toronto, Ontario, Canada

Richard H. Glazier, MD MPH

Professor, Dalla Lana School of Public Health, University of Toronto

Senior Scientist, Institute of Clinical Evaluative Sciences

Toronto, Ontario, Canada

Alan Forster, MD MSc

Professor, Department of Medicine, University of Ottawa

Senior Scientist, Ottawa Hospital Research Institute

Ottawa, Ontario, Canada

Lianne Jeffs, RN PhD

Associate Professor,

Institute of Health Policy, Management and Evaluation, University of Toronto,

Lawrence S. Bloomberg Faculty of Nursing, University of Toronto,

Toronto, Ontario, Canada

KEYWORDS:

General medicine; Quality in health care; Public Health; Social Medicine;

WORD COUNT: 3145

ABSTRACT

Objective: To examine the influence of patient-level sociodemographic factors on the incidence of hospital readmission within 30 days among medical patients in a large Canadian metropolitan city.

Design: Prospective cohort study

Setting and participants: Patients admitted to the General Internal Medicine service of an urban teaching hospital in Toronto, Canada participated in a survey of sociodemographic information. Patients were not surveyed if deemed medically unstable, receiving care in medical/surgical step-down beds, or were isolated for infection control. Included in the final analysis was a diverse cohort of 1427 adult, non-palliative, patients who were discharged home.

Measures: Thirteen patient-level sociodemographic variables were examined in relation to time to unplanned all-cause readmission within 30 days. Illness-level was accounted for by the following covariates: self-perceived health status, previous hospital utilization, primary diagnosis case mix group, Charlson Comorbidity Index score, and inpatient length of stay.

Results: Approximately 14.4% (n=205) of patients experienced readmission within 30 days. Sociodemographic factors were not significantly associated with time to readmission in unadjusted and adjusted analyses. Indicators of illness-level, namely previous hospitalizations, were the strongest risk factors for readmission within this cohort. One previous admission (adjusted HR=1.78, 95% CI: 1.22-2.59, p<0.01) and at least 4 previous emergency department visits (adjusted HR=2.33, 95% CI: 1.46-4.43, p<0.01) were associated with increased hazard of readmission within 30-days.

Conclusions: Patient-level sociodemographic factors did not influence the incidence of unplanned all-cause readmission within 30 days. Further research is needed to understand the generalizability of our findings and investigate whether contextual factors, such as access to universal health insurance coverage, attenuate the effects of sociodemographic factors.

STRENGTHS AND LIMITATIONS

1. Our study represents the first detailed examination of patient-level sociodemographic factors in relation to hospital readmission within a general medical patient population in Canada.
2. The sample size was robust however despite this, multi-category sociodemographic variables required aggregation.
3. Survey methods reduced the likelihood of non-response from marginalized groups however, the proportion of missing data was particularly high for total family income.
4. The generalizability of these findings to other communities within and beyond Toronto, Canada remains unclear.

For peer review only

INTRODUCTION

Unplanned hospital readmissions occurring within 30 days of discharge are considered to be adverse health outcomes that are common, harmful to patients, costly to the health system, and to some degree preventable.⁽¹⁻³⁾ The causal mechanisms leading to hospital readmissions are complex and not well understood.⁽⁴⁾ Risk factors for readmission that are commonly substantiated within medical patient populations include characteristics of a person's medical condition and preexisting comorbidities; historical healthcare utilization; and characteristics of the medical care delivered in hospital and shortly after discharge.⁽⁵⁻¹⁰⁾

Several studies have examined how risk of readmission is influenced by social and demographic characteristics of people and the communities within which they live.^(1, 6-8, 11-25) Sociodemographic factors are believed to influence how individuals use healthcare by predisposing them to illness, affecting their intentions on and ability to access healthcare, and affecting their perceived and professionally evaluated need for healthcare.⁽²⁶⁾ Due in part to data availability limitations, sociodemographic factors such as age, gender/sex, and neighbourhood-level indicators of socioeconomic status have garnered the greatest attention within this literature. Few studies have examined the effects of a variety of less commonly investigated patient-level sociodemographic factors such as the following: total family income, education, housing situation, race, language, place of birth, sexual orientation, religious/spiritual affiliation, and disability. A stronger understanding of these relationships may inform the design of healthcare delivery models and health policy aimed at preventing readmissions and reducing health inequities.

Systematic collection and utilization of patient-level sociodemographic data is not a widespread practice within health systems such as Canada's.⁽²⁷⁾ In 2012, the Measuring Health Equity program was initiated by three downtown hospitals and the public health unit in Toronto, Canada to develop a standardized process for, and initiate the collection of detailed patient-level sociodemographic information.^(28, 29)

We sought to understand whether and to what degree patient-level sociodemographic factors influence the incidence of hospital readmission over a 30-day timeframe within an urban Canadian medical patient population.

METHODS

Study Design and Data Sources

We conducted a prospective cohort study involving 1976 patients admitted to the General Internal Medicine (GIM) service of a 442-bed academic health sciences centre in Toronto. As part of the Measuring Health Equity program, consenting patients were surveyed by trained research personnel and staff between June 2012 and July 2014. Survey questions (see Supplementary Materials, Table I) were translated in 11 languages and professional interpreters were available for patients who were not comfortable completing the survey in English. Five days per week, research personnel screened GIM service admitted patient lists to identify candidates for survey participation. Before the identified candidates were approached at the bedside, research personnel consulted with clinical staff to ensure the patients were in stable

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

enough condition to give informed consent and participate in the survey. Patients were not surveyed if actively receiving care in intensive or critical care units, medical/surgical step-down beds, or isolated for infection control purposes. Among those who were approached by research staff, we estimate that 75% of eligible patients or their proxies provided written informed consent to participate. This estimated response rate was calculated as of July 2013. Due to inconsistencies in survey administration from July 2013 a final response rate for the sampled population was not attainable.

Survey data was linked to medical record data from the Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD) and National Ambulatory Care Reporting System (NACRS). DAD and NACRS provided information related to characteristics of each patient's inpatient admissions and emergency department visits (e.g. admission/discharge dates, diagnoses, clinical service providers, discharge disposition). Primary data collection and analyses were approved by the Mount Sinai Hospital Research Ethics Board (REB Number: 11-0319-E).

Study Cohort Derivation

Figure 1 presents the cohort derivation process. We focused on adults admitted to the GIM service and discharged to the community. Surveyed patients were excluded if their records exhibited the following: missing patient identification numbers; missing admission, discharge, and birth dates; age was under 18 years; most responsible diagnosis codes indicated palliative care or chemotherapy for neoplasm; patient was not discharged to their place of residence (i.e. home or non-institutional home setting with and without support services like home care); or discharge disposition indicated death or patient self-sign out. These exclusion criteria are consistent with those used by CIHI to calculate 30-day medical readmission rates and derive the Hospital Admission Risk Prediction (HARP) index study cohort.^(7, 30) However, we did not exclude patients whose primary reason for admission was related to obstetric or mental health conditions, and those who received surgical interventions during their index admission. Few patients within the sample exhibited these characteristics, and it was hypothesized that their inclusion would better reflect the clinically diverse patient population served on medical units. Also, these patients were assessed by physicians, and their diagnoses were deemed appropriate for care on the GIM service as opposed to solely obstetric, psychiatric, or surgical units. The final sample size was 1427 patients.

Outcome Variable

The outcome variable was time to first unplanned, all-cause readmission to any acute care hospital within the Toronto Central Local Health Integration Network region. Approximately 1.2 million people reside in this region. The observation window extended 30 days following the index discharge date. The patient was the unit of analysis. Only subsequent admissions that were classified as urgent/emergent (i.e. unplanned, non-elective) were considered. To align with prior research, we considered subsequent admissions readmissions including when the discharge disposition of this subsequent encounter indicated death.⁽¹³⁾

Sociodemographic Variables & Covariates

Variable selection was guided by an extensive review of previous observational studies examining risk factors for readmission among medical patients, and Andersen's Behavioural Model.^(26, 31) The Behavioural Model is a conceptual framework for the determinants of

1
2
3 healthcare utilization. It considers contextual, individual, behavioural, and health outcome
4 factors. For example, affecting whether someone accesses hospital care may include the
5 following: contextual characteristics of the communities where they live (i.e. policies governing
6 the organization of and access to healthcare, and social welfare programs); an individual's
7 sociodemographic characteristics, health status and lifestyle; and the medical care processes and
8 health outcomes experienced upon accessing care. Andersen's latest adaptation of the
9 Behavioural Model was chosen for its relevance to the comprehensive study of
10 sociodemographic, behavioural, health-related, and contextual determinants of healthcare
11 utilization.⁽²⁶⁾ Due to the patient-level nature of the available data, our study focused on
12 individual characteristics. These predisposing, enabling, and need factors are posited to influence
13 how individuals use healthcare by predisposing them to illness, affecting their intentions on and
14 ability to access healthcare, and affecting their perceived and professionally evaluated need for
15 healthcare.⁽²⁶⁾
16
17
18
19

20 We examined patient-level sociodemographic factors as predisposing, enabling, and need
21 factors. The following independent variables were conceptualized as predisposing factors: age,
22 gender, sexual orientation, race, place of birth, religious/spiritual affiliation, primary spoken and
23 reading languages, self-perceived ability to speak and understand English, educational
24 attainment. Sexual orientation was the only variable for which no previous medical readmission
25 studies could be identified. This variable was included because of recent data from the Canadian
26 Community Health Survey indicating potential differences in access to regular medical care and
27 healthcare seeking behavior among those who identify as homosexual and bisexual compared to
28 heterosexual.⁽³²⁾ Total family income, home ownership, and discharge disposition (i.e. receipt of
29 home care services) were conceptualized as enabling factors. The following variables were
30 conceptualized as need factors: self-perceived health status and disabilities, frequency of
31 emergency department (ED) visits and inpatient admissions six months preceding a patient's
32 index admission date, primary diagnosis case mix group, Charlson Comorbidity Index score, and
33 inpatient length of stay. Self-reported disabilities were analyzed as a disability score variable
34 representing the total number of physical, sensory, learning, and developmental disabilities and
35 or disability related to chronic illness, mental health, or drug or alcohol dependence. The
36 categorical structure of previous hospitalization and primary diagnosis variables were based on a
37 readmission risk prediction algorithm recently derived and validated among medical patients in
38 Ontario, Canada.⁽⁷⁾ Charlson scores were calculated according to the latest scoring scheme.⁽³³⁾ To
39 promote comparability of results with previous research, inpatient length of stay was studied as a
40 median value.⁽¹³⁾ The structure of categorical need factor variables aggregation was informed by
41 previous research.^(7, 34) For statistical power, the categories of sociodemographic variables were
42 combined to maintain at least 50 patients in each category. Each variable is defined in-detail
43 within Supplementary Materials, Table I.
44
45
46
47
48
49

50 **Missing Data**

51 Patients were included in analyses if they did not respond to every question of the survey. Given
52 the sensitive nature of the information, it was probable that "prefer not to answer" (PNA), "do
53 not know" (DK) and complete non-responses were not missing at random. For this reason,
54 imputation was not used to manage missing data. Alternatively, PNA and DK responses were
55 aggregated into one category for each sociodemographic variable, and included in regression
56
57
58
59
60

1
2
3 analyses. Since it was unclear why some patients had complete non-responses recorded as
4 opposed to PNA/DK responses, these patients were not included in the regression analyses.
5
6

7 **Statistical Analysis**

8 Kaplan Meier product-limit failure plots were used to assess the absolute probability of
9 readmission over the 30-day observation window. Univariate and multivariable Cox regression
10 was used to examine associations between independent variables and time to readmission.
11 Patients who did not experience readmission were censored at 30 days. Hazard ratios were
12 calculated at a 95% confidence level to measure the magnitude and direction of effects. The
13 proportional hazards assumption was assessed by modeling time-dependent covariates for each
14 independent variable and covariate. This assumption was satisfied. Primary reading language and
15 English proficiency exhibited evidence of multicollinearity and were thus not included in
16 multivariable analyses. Anticipating a 14% to 15% readmission rate within this cohort, we
17 estimated that each multivariable model had adequate statistical power to examine 19 to 21
18 variables. All statistical analyses were conducted using SAS software version 9.4.⁽³⁵⁾
19
20
21
22

23 **RESULTS**

24
25
26 Table 1 presents the descriptive characteristics of our study sample. Approximately 14.4%
27 ($n=205$) of patients experienced readmission within 30 days. One third of readmissions occurred
28 within the first 7 days. The mean time to readmission was 12.4 days ($SD=8.46$).
29

30
31 The median age of patients in this cohort was 67 years ($IQR: 50-81$). The majority identified as
32 female ($n=771, 54%$), white-European ($n=988, 69%$), and heterosexual ($n=1279, 90%$).
33 Approximately 80% of patients ($n=1138$) felt most comfortable speaking with their health care
34 provider in English. Collectively however, patients within this sample comfortably spoke and
35 read at least 28 different languages and identified with at least 12 racial groups. About half
36 ($n=696, 49%$) of the cohort was not born in Canada. Many patients preferred not to disclose or
37 did not know their annual total family income ($n=661, 46%$). Among those that did, the most
38 common category reported was income less than \$20,000 ($n=204, 14%$). The majority reported
39 attaining at least some post-secondary education ($n=808, 57%$), and living in accommodations
40 that they did not own ($n=755, 53%$). Approximately half the cohort rated their general health as
41 at least good (i.e. good, very good, or excellent; $n=709, 50%$). The majority reported
42 experiencing at least one disability ($n=781, 55%$). Most did not experience an ED visit ($n=989,$
43 $69%$), or inpatient admission ($n=1211, 85%$) 6 months prior to the index admission. The three
44 most common diagnoses primarily responsible for admission were the following: pneumonia
45 ($n=59, 4.1%$); symptom/sign of the digestive system ($n=47, 3.3%$); and heart failure ($n=43,$
46 $3.0%$). The median number of recorded comorbidities was 2 ($IQR: 1-3$). However, relatively few
47 patients exhibited one or more Charlson comorbidities (15%, $n=208$).
48
49
50

51
52 Unadjusted and adjusted Cox regression analyses did not substantiate significant associations
53 between predisposing nor enabling factors and unplanned all-cause hospital readmission within
54 30 days (Table 2). Among need factors, fair (*unadjusted HR*=1.52, 95% *CI*: 2.09-2.12, $p=0.01$)
55 and poor (*unadjusted HR*=1.61, 95% *CI*: 1.14-2.27, $p=0.01$) self-perceived health were
56 associated with increased hazard of readmission in unadjusted models but were no longer
57 significantly associated after controlling for all other variables. Previous ED visits and inpatient
58
59
60

admissions were also significantly associated with readmission in unadjusted models, however remaining significant within the adjusted model, were one previous inpatient admission (*adjusted HR*=1.78, *CI*: 1.22-2.59, $p<0.01$) and at least four previous emergency department visits (*adjusted HR*=2.33, *CI*: 1.46-4.43, $p<0.01$).

DISCUSSION

Our prospective study of 1427 patients admitted to the GIM service of an urban teaching hospital in Toronto, Canada represents the first detailed examination of patient-level sociodemographic factors in relation to hospital readmission within a general Canadian medical patient population. Predisposing and enabling sociodemographic factors were not significantly associated with unplanned all-cause hospital readmission within 30 days. Need factors, namely previous hospital utilization, were significantly associated with increased hazard of readmission. Our findings are largely consistent with previous research involving medical patients.^(6, 8, 12-14, 17, 21, 36, 37) However, contrasting findings from previous research remain compelling as they may provide insight into contexts within which sociodemographic factors predispose individuals to risk of, and or enable, hospital readmissions. Our findings also have clinical, policy, and research implications which merit discussion.

Our findings support previous research suggesting that many patient-level sociodemographic factors likely do not independently influence hospital readmission risk among medical patients. It remains possible however, that sociodemographic factors vary in their effects on recovery and disease self-management depending a person's specific medical condition. Indeed, studies analyzing patients hospitalized for heart failure and pneumonia, tend to substantiate lower socioeconomic status and black race as risk factors for readmission.⁽¹¹⁾ Such patterns are not apparent among general medical patient populations. Some sociodemographic variables may also be sensitive to effect moderation by unmeasured contextual factors. According to Andersen's Behavioural Model, health care utilization is affected by contextual characteristics of the communities within which people live and the health system from which people seek care.⁽²⁶⁾ Access to comprehensive social safety net and universal publicly funded health insurance programs for example, may attenuate associations between socioeconomic enabling factors and readmission within nations such as Canada⁽¹³⁾ and France.⁽³⁷⁾ Medicare and Medicaid programs in the United States may not mitigate readmission risk associated with a patient's socioeconomic circumstances to the same extent.^(12, 17) This could be attributed to differences in the adequacy of coverage and quality of health and social services accessible to Medicare and Medicaid beneficiaries compared to beneficiaries of universal publicly funded health insurance programs. There also exists evidence for^(21, 36) and against^(8, 12, 17) predisposing factors such as race/ethnicity and primary spoken language as risk factors for readmission among medical patients. Contributing to these mixed findings may be contextual differences across study sites related to the cultural competence of care providers, and as suggested by Karliner and colleagues⁽²¹⁾ the availability of interpreters and translated patient education materials. Further research is needed understand whether and to what degree contextual factors influence readmission risk and whether they moderate the effects of predisposing and enabling factors. Much like approaches being taken in the United States⁽³⁸⁾ this research should aspire to mixed methodologies examining how sociodemographic factors intersect among themselves and with other clinical factors to influence recovery during and shortly after hospitalization.

1
2
3
4
5
6
7
8 Consistent with previous research, need factors such as ED visits and hospital admissions
9 preceding the index admission were the strongest indicators of readmission risk.^(5, 8, 12) Need
10 factors related to disability^(14, 39, 40) and comorbidity^(15, 17, 36) have previously been linked to
11 readmission among medical patients. Measurement error may account for our non-significant
12 findings in relation to these need factors and among specific levels of the previous
13 hospitalization variables.
14

15
16 A criticism of policies aimed at incentivizing quality improvement and reducing readmission
17 rates in the United States is that hospitals serving more socially disadvantaged patient
18 populations are disproportionately penalized for readmission rates above their expected target.⁽⁴¹⁾
19 Within a Canadian context, patient-level sociodemographic factors may not explain a significant
20 degree of variation in 30-day medical readmission rates within and between regions. As such,
21 many of the predisposing and enabling factors we examined may not be suitable for targeting
22 high-risk patients for intervention, nor for the risk adjustment of health system quality indicators
23 such as 30-day readmission rates. In the absence of empirical and conceptual evidence of
24 association between a specific sociodemographic variable and a quality indicator, genuine
25 differences in the quality of care can be obscured and become more difficult to remediate.⁽⁴²⁾
26
27

28
29 The detailed patient-level nature of sociodemographic data that were analyzed is a noteworthy
30 strength of this study. These data elucidated in-detail the sociodemographic diversity of medical
31 patients within Toronto, Canada. Patient-level data is ideal for studying health inequalities and
32 discerning inequity.⁽²⁷⁾ As opposed to geocoded neighbourhood-level sociodemographic data,
33 patient-level data is less vulnerable to misclassification. However, limitations associated with the
34 collection and analysis of patient-level data within our study merit consideration.
35
36

37
38 Based on early survey records we estimated that 75% of patients approached by research staff
39 participated in the Measuring Health Equity survey. However, the exact number and nature of
40 patients who declined was not available. Affecting the generalizability of our findings may be
41 non-response, response, and recall bias. Post-hoc descriptive analyses of previous population-
42 based studies involving medical patients from Canada,⁽¹³⁾ and Mount Sinai Hospital admissions
43 data suggest that the clinical characteristics of our sample were largely reflective of medical
44 patients discharged home at Mount Sinai Hospital and hospitals within the province of Ontario,
45 Canada. Due to the paucity of patient-level sociodemographic data collected within health
46 systems, the degree to which the sociodemographic characteristics of this sample is reflective of
47 medical patients cared for within and beyond hospitals in Toronto also remains unclear.
48 Therefore, assessing the generalizability of our findings represents a key opportunity for future
49 research.
50
51

52
53 Data collection and analysis methods helped reduce the likelihood of traditionally disadvantaged
54 populations being excluded from this study. First, multi-lingual surveyors and interpreters were
55 available to administer the survey with patients who were unable to participate in English.
56 Research staff were also specially trained in the administration of surveys for sensitive
57 information. To prevent people who were uncomfortable or unable to respond to certain
58
59
60

1
2
3 questions from being excluded during multivariable regression analyses, PNA and DK responses
4 were aggregated into a single category and modeled. Differing proportions of missing data across
5 sociodemographic variables may have increased risk of type two error within multivariable
6 model results. Caution should thus be exercised when interpreting our results particularly in
7 relation to income within this sample. However, since the hazard ratio confidence intervals were
8 relatively consistent in range across variables, we do not believe type two error likely accounts
9 for differences in results between the factors examined.
10
11

12 **Conclusion**

13
14 While attentiveness to people's sociodemographic circumstances is an important component of
15 patient-centered care, in our study, patient-level sociodemographic factors did not substantially
16 influence risk of unplanned readmission within 30 days. Need factors indicating illness-level,
17 namely frequency of previous hospitalization, were however associated with readmission. These
18 findings are important as clinicians consider among whom and how to intervene to prevent
19 readmissions, and as health system administrators consider how to measure readmissions to
20 promote quality improvement. Future research should examine the generalizability of our
21 findings within and beyond Toronto, Canada and investigate whether contextual factors, such as
22 access to universal health insurance coverage, attenuate the effects of sociodemographic factors.
23
24
25
26
27

28 **CONTRIBUTORSHIP STATEMENT**

29
30 RWS was responsible for study design, data analysis, interpretation of results, and manuscript
31 production. LJ, KK, APC, SKS advised RWS on study design and analysis. RWS and SKS
32 facilitated data acquisition. All authors contributed to data interpretation, critically revised the
33 manuscript, approved the final submission and act as guarantors of this work.
34
35

36 **FUNDING DECLARATION**

37
38 RWS received funding through the Canadian Institutes of Health Research Canada Graduate
39 Scholarship, a Mount Sinai Hospital Department of Medicine Graduate Studentship, and through
40 grant funding awarded to LJ from the Ontario Ministry of Health and Long Term Care. RG was
41 supported as a Clinician Scientist in the Department of Family and Community Medicine at the
42 University of Toronto and at St. Michael's Hospital. No conflicting interests to declare.
43
44

45 **DATA SHARING STATEMENT**

46
47 No additional data available.
48
49
50
51
52
53
54
55
56
57
58
59
60

TABLES

Table 1. Characteristics of the analysis cohort and observed readmissions.

	Overall cohort, % of patients <i>n=1427</i>	Unplanned all-cause readmission within 30 days, % of patients	
		No <i>n=1222</i> (85.6%)	Yes <i>n=205</i> (14.4%)
Individual Characteristics:			
Predisposing Factors			
Age			
Median (IQR)	67 (50-81)	68 (51-82)	67 (49-88)
18-64	45.1%	44.8%	46.3%
65-84	36.6%	36.5%	37.1%
85+	18.4%	18.7%	16.6%
Gender			
Female	54.0%	53.8%	55.6%
Male	43.5%	43.8%	42.0%
Transgender/PNA/DK	2.1%	2.1%	2.1%
Sexual Orientation			
Heterosexual	89.6%	89.5%	90.2%
Not Heterosexual	4.3%	4.6%	2.9%
PNA/DK	5.7%	5.5%	6.8%
Race			
White-European	69.2%	68.8%	71.7%
Asian	11.1%	10.9%	12.2%
Black	5.5%	5.9%	3.4%
Not Asian/Black/White	10.7%	10.9%	9.3%
PNA/DK	3.2%	3.1%	3.4%
Religious/Spiritual Affiliation			
Affiliation	75.1%	74.7%	77.6%
No Affiliation	19.8%	20.0%	18.0%
PNA/DK	4.7%	4.8%	4.4%
Place of Birth			
Canada	49.5%	49.6%	48.8%
Not Canada	48.8%	48.5%	50.2%
PNA	1.4%	1.5%	1.0%
Primary Spoken Language			
English	79.7%	80.5%	75.1%
Non-English	18.3%	17.4%	23.4%
PNA/DK	1.6%	1.7%	1.5%
Primary Reading Language			
English	80.7%	81.2%	78.0%
Not English	17.4%	16.9%	20.5%
PNA/DK	1.5%	1.5%	1.5%
Self-Perceived Ability to Speak/Understand English			
Well	86.1%	86.3%	85.4%
Not Well	11.2%	11.0%	12.2%
PNA/DK	2.3%	2.3%	2.0%
Highest Level of Education			
Some high school	18.5%	18.4%	19.0%
High school diploma	18.9%	18.7%	20.5%
At least some post-secondary	56.6%	57.4%	52.2%
Other/PNA/DK	5.5%	5.1%	7.8%
Enabling Factors			
Total Family Income Group			
1 - \$19,999 and less	14.3%	14.2%	14.6%
2 - \$20,000-\$39,999	12.4%	12.7%	10.7%
3 - \$40,000-\$59,999	7.6%	7.5%	8.3%
4 - \$60,000-\$99,999	8.1%	8.2%	7.8%
5 - \$100,000 and over	10.9%	10.7%	11.7%

PNA/DK	46.3%	46.2%	46.9%
Home Ownership			
Home owner	43.9%	43.5%	45.9%
Not home owner	52.9%	53.2%	51.2%
PNA/DK	2.9%	2.9%	2.9%
Discharge Disposition			
Home without services	65.1%	66.0%	59.5%
Home with services	34.9%	34.0%	40.5%
Need Factors			
Disability Score			
0	38.3%	38.5%	36.6%
1	37.8%	37.7%	38.0%
2+	17.0%	16.7%	18.5%
PNA/DK	6.6%	6.7%	6.9%
Self-Perceived General Health			
Good	49.7%	51.3%	40.0%
Fair	24.6%	23.8%	29.3%
Poor	21.1%	20.2%	26.3%
PNA/DK	4.2%	4.3%	4.0%
Inpatient Admissions Previous 6 Months			
0	84.9%	86.5%	75.1%
1	11.4%	10.1%	19.0%
2	2.2%	2.2%	2.4%
3+	1.5%	1.1%	3.4%
Emergency Department Visits Previous 6 Months			
0	69.3%	71.3%	57.6%
1	17.3%	16.8%	20.5%
2	5.3%	4.8%	8.3%
3	2.4%	2.5%	1.5%
4+	5.7%	4.6%	12.2%
Case Mix Group of Most Responsible Diagnosis			
Heart Failure without Cardiac Catheterization	3.0%	2.7%	4.9%
Chronic Obstructive Pulmonary Disease	2.7%	3.0%	1.0%
Inflammatory Bowel Disease	2.7%	2.8%	2.0%
Diabetes	1.8%	2.0%	0.5%
Gastrointestinal Obstruction	0.8%	0.8%	1.0%
Cirrhosis/Alcoholic Hepatitis	0.8%	0.7%	1.5%
All Other CMGs	88.1%	87.9%	89.3%
Charlson Score			
> 0	14.6%	13.8%	19.0%
Index Admission Length of Stay			
Median (IQR)	5 (3-8)	5 (3-8)	5 (3-8)

Notes:

PNA: Prefer not to answer; DK: Do not know

Table 2. Results of unadjusted and adjusted Cox regression analyses examining predisposing, enabling and need factors in relation to 30-day unplanned all-cause readmission.

Individual Characteristics	Unadjusted Hazard Ratio (95%CI)	p value	Fully Adjusted Hazard Ratio (95%CI)	p value
Predisposing Factors				
Age				
18-64	Reference		Reference	
65-84	0.97 (0.72-1.32)	0.86	0.83 (0.59-1.17)	0.28
85+	0.86 (0.58-1.28)	0.46	0.71 (0.45-1.12)	0.14
Gender[‡]				
Female	Reference		Reference	
Male	0.93 (0.70-1.23)	0.60	0.98 (0.73-1.31)	0.88
Transgender/PNA/DK	1.15 (0.47-2.81)	0.76	2.00 (0.55-7.21)	0.29
Sexual Orientation[‡]				
Heterosexual	Reference		Reference	
Not Heterosexual	0.66 (0.30-1.50)	0.32	0.58 (0.25-1.36)	0.21
PNA/DK	1.22 (0.71-2.10)	0.48	0.95 (0.47-1.91)	0.88
Race				
White-European	Reference		Reference	
Asian	1.08 (0.70-1.64)	0.73	0.87 (0.54-1.41)	0.58
Black	0.57 (0.27-1.22)	0.15	0.54 (0.24-1.20)	0.13
Not Asian/Black/White	0.83 (0.52-1.35)	0.46	0.84 (0.51-1.38)	0.50
PNA/DK	1.04 (0.49-2.22)	0.92	1.47 (0.58-3.74)	0.42
Religious/Spiritual Affiliation[‡]				
Affiliation	Reference		Reference	
No Affiliation	0.89 (0.62-1.27)	0.51	0.95 (0.65-1.39)	0.80
PNA/DK	0.89 (0.45-1.74)	0.73	0.94 (0.43-2.07)	0.89
Place of Birth				
Canada	Reference		Reference	
Not Canada	1.04 (0.79-1.36)	0.80	0.98 (0.69-1.40)	0.92
PNA/DK	0.68 (0.17-2.73)	0.59	0.17 (0.01-2.30)	0.18
Primary Spoken Language[‡]				
English	Reference		Reference	
Non-English	1.39 (1.00-1.92)	0.05	1.29 (0.86-1.93)	0.23
PNA/DK	0.93 (0.30-2.18)	0.90	0.99 (0.18-5.36)	0.99
Primary Reading Language[‡]				
English	Reference		--	--
Not English	1.24 (0.88-1.74)	0.22	--	--
PNA/DK	0.98 (0.31-3.06)	0.97	--	--
Self-Perceived Ability to Speak/Understand English[†]				
Well	Reference		--	--
Not Well	1.11 (0.73-1.69)	0.63	--	--
PNA/DK	0.89 (0.33-2.39)	0.81	--	--
Highest Level of Education[†]				
Some high school	1.13 (0.78-1.63)	0.52	1.08 (0.71-1.64)	0.72
High school diploma	1.19 (0.83-1.69)	0.35	1.23 (0.84-1.80)	0.28
At least some post-secondary	Reference		Reference	
Other/PNA/DK	1.61(0.95-2.73)	0.07	1.72 (0.92-3.23)	0.09
Enabling Factors				
Total Family Income Group				
1 - \$19,999 and less	0.94 (0.55-1.61)	0.83	0.70 (0.38-1.29)	0.26
2 - \$20,000-\$39,999	0.79 (0.44-1.40)	0.41	0.78 (0.42-1.45)	0.43
3 - \$40,000-\$59,999	1.01 (0.54-1.87)	0.99	0.94 (0.49-1.80)	0.86
4 - \$60,000-\$99,999	0.89 (0.47-1.67)	0.71	0.93 (0.49-1.76)	0.82
5 - \$100,000 and over	Reference		Reference	
PNA/DK	0.94 (0.60-1.46)	0.77	0.82 (0.50-1.34)	0.42
Home Ownership[‡]				

Home owner	Reference		Reference	
Not home owner	0.92 (0.70-1.22)	0.58	1.00 (0.73-1.37)	0.99
PNA/DK	0.96 (0.42-2.19)	0.92	0.93 (0.31-2.81)	0.89
Discharge Disposition				
Home without services	Reference		Reference	
Home with services	1.28 (0.97-1.70)	0.08	1.07 (0.78-1.48)	0.67
Need Factors				
Disability Score [‡]				
0	Reference		Reference	
1	1.06 (0.78-1.46)	0.70	0.97 (0.69-1.37)	0.88
2+	1.16 (0.79-1.72)	0.45	1.20 (0.77-1.85)	0.42
PNA/DK	1.07 (0.60-1.89)	0.82	1.00 (0.53-1.90)	0.99
Self-Perceived General Health [†]				
Good	Reference		Reference	
Fair	1.52 (1.09-2.12)	0.01	1.39 (0.98-1.98)	0.07
Poor	1.61 (1.14-2.27)	0.01	1.15 (0.77-1.72)	0.49
PNA/DK	1.28 (0.65-2.56)	0.48	1.02 (0.46-2.27)	0.97
Inpatient Admissions Previous 6 Months				
0	Reference		Reference	
1	2.01 (1.41-2.85)	<0.01	1.78 (1.22-2.59)	<0.01
2	1.23 (0.50-2.99)	0.65	1.03 (0.41-2.58)	0.65
3+	2.96 (1.39-6.32)	0.01	2.06 (0.93-4.58)	0.08
Emergency Department Visits Previous 6 Months				
0	Reference		Reference	
1	1.44 (1.01-2.04)	0.04	1.41 (0.98-2.04)	0.06
2	1.98 (1.19-3.29)	0.01	1.62 (0.95-3.29)	0.08
3	0.73 (0.23-2.30)	0.59	0.63 (0.20-2.30)	0.59
4+	2.88 (1.89-4.43)	<0.01	2.33 (1.46-4.43)	<0.01
Case Mix Group of Most Responsible Diagnosis				
Heart Failure without Cardiac Catheterization	1.63 (0.86-3.08)	0.13	1.70 (0.87-3.31)	0.12
Chronic Obstructive Pulmonary Disease	0.34 (0.08-1.36)	0.13	0.36 (0.09-1.49)	0.16
Inflammatory Bowel Disease	0.70 (0.26-1.90)	0.49	0.86 (0.31-2.38)	0.77
Diabetes	0.25 (0.04-1.79)	0.17	0.24 (0.03-1.78)	0.16
Gastrointestinal Obstruction	1.09 (0.27-4.41)	0.90	1.33 (0.32-5.54)	0.69
Cirrhosis/Alcoholic Hepatitis	1.78 (0.57-5.58)	0.32	1.49 (0.45-4.94)	0.52
All Other CMGs	Reference		Reference	
Charlson Score				
0	Reference		Reference	
1+	1.39 (0.98-1.97)	0.07	1.34 (0.92-1.94)	0.13
Inpatient Length of Stay				
Median (IQR)	1.01 (1.00-1.02)	0.18	1.01 (0.99-1.02)	0.39

Notes:

- $n=1427$ observations were analyzed in each univariate model and $n=1420$ in multivariable models unless otherwise indicated; [†] $n=1421$ observations used within univariate model; [‡] $n=1422$ observations used within univariate model
- Primary reading language and English proficiency exhibited evidence of multicollinearity and were thus not included in multivariable analyses.

FIGURES:

Figure 1. Cohort derivation procedures and final sample size.

REFERENCES

1. Canadian Institute for Health Information. All-Cause Readmission to Acute Care and Return to the Emergency Department. Ottawa, Canada: Canadian Institute for Health Information; 2012.
2. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among Patients in the Medicare Fee-for-Service Program. *The New England journal of medicine*. 2009;360(14):1418-28.
3. van Walraven C, Jennings A, Taljaard M, Dhalla I, English S, Mulpuru S, et al. Incidence of potentially avoidable urgent readmissions and their relation to all-cause urgent readmissions. *Canadian Medical Association Journal*. 2011;183(14):E1067-72.
4. Dharmarajan K, Krumholz HM. Risk after hospitalization: We have a lot to learn. *Journal of Hospital Medicine*. 2015;10(2):135-6.
5. van Walraven C, Dhalla IA, Bell C, Etchells E, Stiell IG, Zarnke K, et al. Derivation and validation of an index to predict early death or unplanned readmission after discharge from hospital to the community. *Canadian Medical Association Journal*. 2010;182(6):551-7.
6. van Walraven C, Wong J, Forster AJ. LACE+ index: extension of a validated index to predict early death or urgent readmission after hospital discharge using administrative data. *Open Medicine*. 2012;6(3):80-90.
7. Canadian Institute for Health Information, Health Quality Ontario. Early identification of people at-risk of hospitalization: Hospital Admission Risk Prediction (HARP)—a new tool for supporting providers and patients. Toronto, Canada: Queen's Printer of Ontario; 2013.
8. Donzé J, Aujesky D, Williams D, Schnipper JL. Potentially Avoidable 30-Day Hospital Readmissions in Medical Patients: Derivation and Validation of a Prediction Model. *JAMA Internal Medicine*. 2013;173(8):632-8.
9. O'Connor M, Murtaugh CM, Shah S, Barrón-Vaya Y, Bowles KH, Peng TR, et al. Patient Characteristics Predicting Readmission Among Individuals Hospitalized for Heart Failure. *Medical Care Research and Review*. 2015:1-38.
10. Kansagara D, Englander H, Salanitro A, Kagan D, Theobald C, Freeman M, et al. Risk prediction models for hospital readmission: A systematic review. *JAMA*. 2011;306(15):1688-98.
11. Calvillo-King L, Arnold D, Eubank KJ, Lo M, Yunyongying P, Stieglitz H, et al. Impact of social factors on risk of readmission or mortality in pneumonia and heart failure: systematic review. *J Gen Intern Med*. 2013;28.
12. Hasan O, Meltzer DO, Shaykevich SA, Bell CM, Kaboli PJ, Auerbach AD, et al. Hospital Readmission in General Medicine Patients: A Prediction Model. *Journal of General Internal Medicine*. 2010;25(3):211-9.
13. van Walraven C, Wong J, Forster AJ. Influence of neighborhood household income on early death or urgent hospital readmission. *Journal of Hospital Medicine*. 2013;8:261-6.
14. Garcia-Perez L, Linertova R, Lorenzo-Riera A, Vazquez-Diaz JR, Duque-Gonzalez B, Sarria-Santamera A. Risk factors for hospital readmissions in elderly patients: a systematic review. *QJM*. 2011;104(8):639-51.
15. Mudge AM, Kasper K, Clair A, Redfern H, Bell JJ, Barras MA, et al. Recurrent readmissions in medical patients: A prospective study. *Journal of Hospital Medicine*. 2011;6:61-7.

16. Fleming LM, Gavin M, Piatkowski G, Chang JD, Mukamal KJ. Derivation and Validation of a 30-Day Heart Failure Readmission Model. *The American Journal of Cardiology*. 2014;114(9):1379-82.
17. Hu J, Gonsahn MD, Nerenz DR. Socioeconomic Status And Readmissions: Evidence From An Urban Teaching Hospital. *Health Aff*. 2014;33(5):778-85.
18. Mather JF, Fortunato GJ, Ash JL, Davis MJ, Kumar A. Prediction of pneumonia 30-day readmissions: a single-center attempt to increase model performance. *Respiratory Care*. 2014;59(2):199-208.
19. Coventry PA, Gemmell I, Todd CJ. Psychosocial risk factors for hospital readmission in COPD patients on early discharge services: A cohort study. *BMC Pulmonary Medicine*. 2011(11):49.
20. McGregor MJ, Reid RJ, Schulzer M, Fitzgerald JM, Levy AR, Cox MB. Socioeconomic status and hospital utilization among younger adult pneumonia admissions at a Canadian hospital. *BMC Health Services Research*. 2006;6(152):1-10.
21. Karliner LS, Kim SE, Meltzer DO, Auerbach AD. Influence of language barriers on outcomes of hospital care for general medicine inpatients. *Journal of Hospital Medicine*. 2010;5(5):276-82.
22. Peterson PN, Campagna EJ, Maravi M, Allen LA, Bull S, Steiner JF, et al. Acculturation and Outcomes among Patients with Heart Failure. *Circulation: Heart Failure*. 2012;5(2):160-6.
23. Watson AJ, O'Rourke J, Jethwani K, Cami A, Stern TA, Kvedar JC, et al. Linking electronic health record-extracted psychosocial data in real-time to risk of readmission for heart failure. *Psychosomatics*. 2011;52(4):319-27.
24. Ketterer MW, Draus C, McCord J, Mossallam U, Hudson M. Behavioral Factors and Hospital Admissions/Readmissions in Patients With CHF. *Psychosomatics*. 2014;55(1):45-50.
25. van Oeffelen AM, Agyemang C, Stronks K, Bots ML, Vaartjes I. Prognosis after a first hospitalisation for acute myocardial infarction and congestive heart failure by country of birth. *Heart*. 2014;100(18):1436-43.
26. Andersen RM, Davidson PL. Chapter 1: Improving Access to Care in America--Individual and Contextual Indicators. In: Andersen RM, Rice TH, Kominski GF, editors. *Changing the US health care system: key issues in health services policy and management*. 3rd. San Francisco: Jossey-Bass; 2007. p. 3-31.
27. Kirst M, Shankardass K, Bomze S, Lofters A, Quiñonez C. Sociodemographic data collection for health equity measurement: a mixed methods study examining public opinions. *International Journal for Equity in Health*. 2013;12(1):1-10.
28. Wray R, Agic B, Bennett-AbuAyyash C, Kane K, Lam R, Mohamed A, et al. We ask because we care: The Tri-Hospital + TPH Health Equity Data Collection Research Project Report. Toronto, Canada; 2013.
29. Measuring Health Equity: Mount Sinai Hospital and Toronto Central Local Health Integration Network; 2016 [Available from: <http://torontohealthequity.ca/>].
30. Canadian Institute for Health Information. Technical Note: 30-Day Adult Medical Readmission Rate: Canadian Institute for Health Information; 2015 [Available from: <https://www.cihi.ca/en/health-system-performance/performance-reporting/indicators/technical-note-30-day-adult-medical>].

- 1
- 2
- 3
- 4 31. Smith RW. Patient-level Social Determinants of Unplanned Hospital Readmission among
- 5 General Internal Medicine Patients. University of Toronto; 2016.
- 6 32. Statistics Canada. Same-sex couples and sexual orientation. The Daily: By the numbers.
- 7 2016. [Available from: http://www.statcan.gc.ca/eng/dai/smr08/2015/smr08_203_2015].
- 8 33. Quan H, Li B, Couris CM, Fushimi K, Graham P, Hider P, et al. Updating and Validating
- 9 the Charlson Comorbidity Index and Score for Risk Adjustment in Hospital Discharge
- 10 Abstracts Using Data From 6 Countries. *American Journal of Epidemiology*.
- 11 2011;173(6):676-82.
- 12 34. Fitzpatrick T, Rosella LC, Calzavara A, Petch J, Pinto AD, Manson H, et al. Looking
- 13 Beyond Income and Education: Socioeconomic Status Gradients Among Future High-Cost
- 14 Users of Health Care. *American Journal of Preventative Medicine*. 2015;49(2):161-71.
- 15 35. SAS Institute Inc. SAS Version 9.4. Cary, NC: SAS Institute Inc.; 2012.
- 16 36. Allaudeen N, Vidyarthi A, Maselli J, Auerbach A. Redefining readmission risk factors for
- 17 general medicine patients. *Journal of Hospital Medicine*. 2011;6:54-60.
- 18 37. Lanière I, Couturier P, Dramé M, Gavazzi G, Lehman S, Jolly D, et al. Incidence and main
- 19 factors associated with early unplanned hospital readmission among French medical
- 20 inpatients aged 75 and over admitted through emergency units. *Age and Ageing*.
- 21 2008;37(4):416-22.
- 22 38. Meyers AG, Salanitro A, Wallston KA, Cawthon C, Vasilevskis EE, Goggins KM, et al.
- 23 Determinants of health after hospital discharge: rationale and design of the Vanderbilt
- 24 Inpatient Cohort Study (VICS). *BMC Health Serv Res*. 2014 Jan;14(1):10.
- 25 39. Kahlon S, Pederson J, Majumdar SR, Belga S, Lau D, Fradette M, et al. Association
- 26 between frailty and 30-day outcomes after discharge from hospital. *Canadian Medical*
- 27 *Association Journal*. 2015.
- 28 40. Greysen S, Stijacic Cenzer I, Auerbach AD, Covinsky KE. Functional Impairment and
- 29 Hospital Readmission in Medicare Seniors. *JAMA Internal Medicine*. 2015;175(4):559-65.
- 30 41. National Academies of Sciences Engineering and Medicine. Accounting for Social Risk
- 31 Factors in Medicare Payment: Identifying Social Risk Factors. Washington, DC: The
- 32 National Academies Press; 2016.
- 33 42. National Quality Forum. Risk adjustment for socioeconomic status or other
- 34 sociodemographic factors. Washington, DC: National Quality Forum; 2014.
- 35
- 36
- 37
- 38
- 39
- 40
- 41
- 42
- 43
- 44
- 45
- 46
- 47
- 48
- 49
- 50
- 51
- 52
- 53
- 54
- 55
- 56
- 57
- 58
- 59
- 60

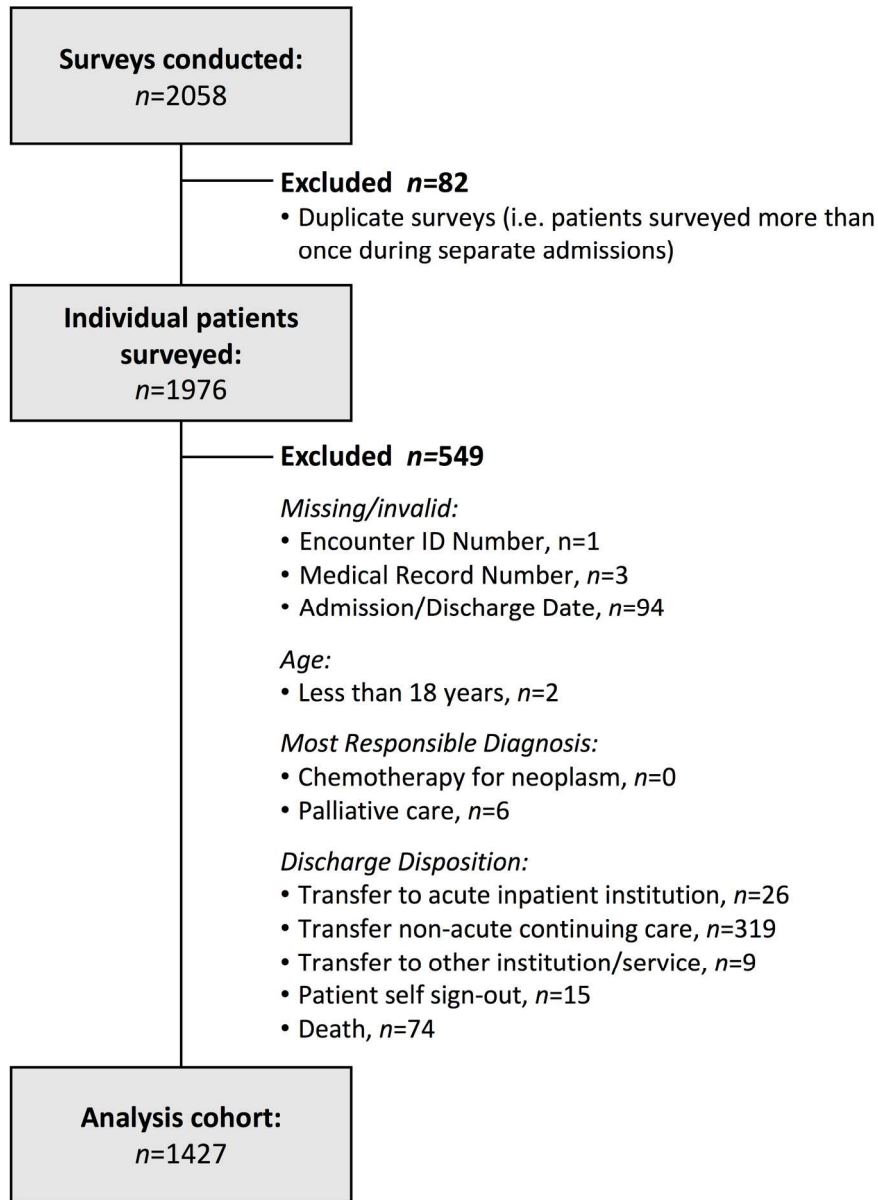


Figure 1. Cohort derivation procedures and final sample size.!! +

167x225mm (300 x 300 DPI)

Table 1. Source survey questions, definition and structure of independent variables and covariates.

Variable	Definition	Data Source	Survey Question	Survey Response Options	Aggregated Groups
Age	The number of years between date of birth and index admission date.	CIHI-DAD	N/A	N/A	18-64 years 65-84 years 85+ years
Gender	Self-identified gender.	Patient/Proxy	What is your gender?	Female Male Trans Intersex Prefer not to answer Do not know	Female Male Trans/Prefer not to answer/Do not know
Sexual Orientation	Self-identified sexual orientation.	Patient/Proxy	What is your sexual orientation?	Heterosexual ("straight") Gay Lesbian Bisexual Two-Spirit Queer Questioning Prefer not to answer Do not know	Heterosexual ("straight") Not Heterosexual Prefer not to answer/Do not know
Race	Self-identified race.	Patient/Proxy	Which of the following best describes your race?	Aboriginal (e.g., Inuit, First Nations Non-status Indian, Métis, Aboriginal person from outside Canada) Asian - East (e.g., Chinese, Japanese, Korean) Asian - South (e.g., Indian, Pakistani, Sri Lankan, Indo-Caribbean) Asian - South East (e.g., Malaysian, Filipino, Vietnamese) Black - Africa (e.g., Ghanaian, Kenyan, Somali) Black - North America Black - Caribbean Region (e.g., Barbadian, Jamaican) Latin American (e.g., Argentinian, Chilean, Salvadorean) Middle Eastern (e.g., Egyptian, Iranian, Lebanese) Mixed heritage: _____ White/ European (e.g., English, Italian, Portuguese, Russian) Other(s): _____ Prefer not to answer Do not know	White-European Asian Black Not Asian/Black/White Prefer not to answer/Do not know
Religious/Spiritual Affiliation	Self-reported affiliation with religious/spiritual community.	Patient/Proxy	What is your religious or spiritual affiliation?	I do not have a religious or spiritual affiliation Animism or Shamanism Atheism Baha'i Faith Buddhism Christianity Christian Orthodox Protestant Roman Catholic Christian, not included elsewhere on this list Confucianism Hinduism Jainism Judaism Islam Native Spirituality Rastafarianism Sikhism Spiritual Unitarianism Wicca Zoroastrianism	Affiliated Not Affiliated Prefer not to answer/Do not know

				Other: _____	
				Prefer not to answer	
				Do not know	
Place of Birth	Self-reported birth place (Canada vs. Not Canada)	Patient/ Proxy	Were you born in Canada?	Yes No Prefer not to answer Do not know	Yes No Prefer not to answer/ Do not know
Primary Spoken Language	Self-reported preferred language to speak with health care providers.	Patient/ Proxy	What language would you feel most comfortable speaking in with your health care provider?	American Sign Language Arabic Bengali Chinese (Cantonese) Chinese (Mandarin) Cree Dari English French German Greek Gujarati Hebrew Hindi Hungarian Italian Korean Ojibwe Oji-Cree Farsi (Persian) Polish Portuguese Punjabi Russian Spanish Somali Tagalog Tamil Urdu Vietnamese Other (Please specify) Prefer not to answer Do not know	English Not English Prefer not to answer/ Do not know
Primary Reading Language	Self-reported preferred language within which to read health information.	Patient/ Proxy	In what language would you prefer to read health care information?	American Sign Language Arabic Bengali Braille Chinese (Cantonese) Chinese (Mandarin) Cree Dari English French German Greek Gujarati Hebrew Hindi Hungarian Italian Korean Ojibwe Oji-Cree Farsi (Persian) Polish Portuguese Punjabi Russian Spanish Somali Tagalog Tamil Urdu Vietnamese Other (Please specify) Prefer not to answer	English Not English Prefer not to answer/ Do not know

For peer review

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

				Do not know	
Self-perceived ability to speak/understand English	Self-evaluated ability to speak/understand English	Patient/Proxy	How would you rate your ability to speak and understand English?	Very well Well Not well Not at all Unsure Prefer not to answer Do not know	Well Not Well Prefer not to answer/ Do not know
Highest Level of Education	Self-reported highest achieved education level.	Patient/Proxy	What is the highest level of education you have completed?	Some grade school (grade 1-8) Some high school High school graduate Some College/University education College degree Undergraduate (university) Degree Postgraduate Degree Other: _____ Prefer not to answer Do not know	Some High School High School Diploma At least some post-secondary Other Prefer not to answer/ Do not know
Home Ownership	Self-reported housing situation.	Patient/Proxy	What type of housing do you live in?	Renting Own Living with family or friends Temporary housing (e.g. shelter, hostel) or homeless Correctional facility Other: _____ Prefer not to answer Do not know	Home owner Not home owner Prefer not to answer/ Do not know
Total Family Income	Self-reported total family income before taxes.	Patient/Proxy	What was your total family income before taxes last year?	Less than \$10,000 \$10,000 to \$19,999 \$20,000 to \$29,999 \$30,000 to \$39,999 \$40,000 to \$49,999 \$50,000 to \$59,999 \$60,000 to \$79,999 \$80,000 to \$99,999 \$100,000 to \$149,999 \$150,000 or more Prefer not to answer Do not know	Less than \$20,000 \$20,000 to \$39,999 \$40,000 to \$59,999 \$60,000 to \$99,999 At least \$100,000 Prefer not to answer/ Do not know
Disability Score	Total number of self-reported disabilities.	Patient/Proxy	Do you have any of the following disabilities? <i>Check all that apply</i>	No disabilities Chronic illness Developmental disability Learning disability Mental health disability Physical disability Sensory disability (i.e. hearing or vision loss) Drug or alcohol dependence Other: _____ Prefer not to answer Do not know	0 1 2+
Self-perceived General Health	Self-evaluated general health status.	Patient/Proxy	In general, would you say your health is:	Excellent Very good Good Fair Poor Prefer not to answer Do not know	Good Fair Poor Prefer not to answer/ Do not know
Inpatient Admissions Previous 6 Months	Number of hospital admissions 183 days preceding the index admission date.	CIHI-DAD	N/A	N/A	0 1 2 3+
ED Visits Previous 6 Months	Number of emergency department visits 183 days	CIHI-NACRS	N/A	N/A	0 1 2 3

	preceding the index admission date.				4+
Case Mix Group of Most Responsible Diagnosis	Case Mix Group (CMG) under which the index admission primary diagnosis code (most responsible diagnosis) is categorized under. Specified CMGs are associated with increased risk of 30-day readmission.	CIHI-DAD	N/A	N/A	All Other CMGs Chronic Obstructive Pulmonary Disease Congestive Heart Failure without Cardiac Catheterization Inflammatory Bowel Disease Gastrointestinal Obstruction Cirrhosis/Alcoholic Hepatitis Diabetes
Charlson Comorbidity Index Score	Total weighted score associated with the number and type of Charlson comorbidities.	CIHI-DAD	N/A	N/A	0 1+
Length of Stay	Number of days between index admission date and discharge disposition date.	CIHI-DAD	N/A	N/A	N/A
Discharge Disposition	Location to which patient was discharged.	CIHI-DAD	N/A	N/A	Home or home setting without services Home or home setting with services

BMJ Open: first published as 10.1136/bmjopen-2017-017956 on 12 December 2017. Downloaded from <http://bmjopen.bmj.com/> on April 17, 2024 by guest. Protected by copyright.

STROBE Checklist of items included in the manuscript entitled:

Investigating the Effect of Sociodemographic Factors on 30-day Hospital Readmission among Medical Patients in Toronto, Canada: a Prospective Cohort Study

	Item No	Recommendation	Addressed in Manuscript?
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	pp.1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	pp.2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	pp.4
Objectives	3	State specific objectives, including any prespecified hypotheses	pp.4
Methods			
Study design	4	Present key elements of study design early in the paper	pp.4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	pp.4-5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	pp.4-5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	pp.5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	pp.4-5
Bias	9	Describe any efforts to address potential sources of bias	pp.4,9
Study size	10	Explain how the study size was arrived at	pp.5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	pp.5-6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	pp.6
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	pp.6
		(d) If applicable, explain how loss to follow-up was addressed	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	pp.15
		(b) Give reasons for non-participation at each stage	pp.15
		(c) Consider use of a flow diagram	pp.15
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	pp.6-7, 11-12

		(b) Indicate number of participants with missing data for each variable of interest	pp.11-12
		(c) Summarise follow-up time (eg, average and total amount)	pp.6
Outcome data	15*	Report numbers of outcome events or summary measures over time	pp.6
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	pp.7, 13-14
		(b) Report category boundaries when continuous variables were categorized	pp.7
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	pp.7-8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	pp.9-10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	pp.8-10
Generalisability	21	Discuss the generalisability (external validity) of the study results	pp.9-10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	pp.10

*Give information separately for exposed and unexposed groups.