Thirty-day readmission rates are commonly used to assess health system performance and to guide resource allocation; they are also used as end points in studies of interventions designed to improve quality of care.1–3 Much of the research on 30-day readmission rates has focused on populations that are admitted to hospital from the community with subsequent return to the community. Although this group is useful for understanding readmissions among certain segments of the population, it overlooks users of home care and residential long-term care services, more specifically, frail older adults whose care poses one of the biggest challenges currently facing the health care system.

Much of the previous research on readmissions, including studies on population trends and risk prediction models, either excluded older adults discharged to home care or long-term care or did not account for the use of these services.1,4,5 The small number of studies that compared readmission rates across discharge settings have reported conflicting results.6–9 Even fewer studies have considered the care setting before hospital admission or the effects of a change in setting at discharge. As such, there is an important gap in our understanding of the frequency of the simple transition from the community to hospital and back to the community relative to that of other, more complicated transitions across care settings, and the impact of this on readmission rates. Furthermore, clinicians have little guidance about how to assess or reduce the risk of readmission for older adults admitted from and discharged to these care settings, and policy-makers have little evidence to

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**ABSTRACT**

**BACKGROUND:** Despite the fact that many older adults receive home or long-term care services, the effect of these care settings on hospital readmission is often overlooked. Efforts to reduce hospital readmissions, including capacity planning and targeting of interventions, require clear data on the frequency of and risk factors for readmission among different populations of older adults.

**METHODS:** We identified all adults older than 65 years discharged from an unplanned medical hospital stay in Ontario between April 2008 and December 2015. We defined 2 preadmission care settings (community, long-term care) and 3 discharge care settings (community, home care, long-term care) and used multinomial regression to estimate associations with 30-day readmission (and death as a competing risk).

**RESULTS:** We identified 701,527 individuals (mean age 78.4 yr), of whom 414,302 (59.1%) started in and returned to the community. Overall, 88,305 individuals (12.6%) were readmitted within 30 days, but this proportion varied by care setting combination. Relative to individuals returning to the community, those discharged to the community with home care (adjusted odds ratio [OR] 1.43, 95% confidence interval [CI] 1.39–1.46) and those returning to long-term care (adjusted OR 1.35, 95% CI 1.27–1.43) had a greater risk of readmission, whereas those newly admitted to long-term care had a lower risk of readmission (adjusted OR 0.68, 95% CI 0.63–0.72).

**INTERPRETATION:** In Ontario, about 40% of older people were discharged from hospital to either home care or long-term care. These discharge settings, as well as whether an individual was admitted to hospital from long-term care, have important implications for understanding 30-day readmission rates. System planning and efforts to reduce readmission among older adults should take into account care settings at both admission and discharge.
inform system-level strategies designed to improve population health and use available resources efficiently.

Our objective was to describe and compare 30-day unplanned hospital readmissions among older adults characterized by their care setting both before and after hospital discharge. We hypothesized that a large proportion of older adults would experience a change in care setting after the hospital stay, that older adults with different care setting pathways would have different clinical and health service use profiles, and that older adults admitted from and discharged back to the community would have the lowest rate of readmission, even after adjustment for other variables. Given the limited data on readmissions that are available from other care settings, we could not anticipate how older adults discharged to home care and long-term care would differ. The information from this study will contribute to a better understanding of the extent to which complicated transitions to and from hospital influence readmission among older adults, which is essential for system planning, performance measurement, and the targeting and testing of interventions to improve transitions and reduce readmissions.

Methods

For this retrospective cohort study, we used health administrative data from multiple sectors in Ontario. Information on these data sources, including the Discharge Abstract Database, is provided in Appendix 1 (available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.180290/-/DC1). Data were linked using unique encoded identifiers and analyzed at ICES in Toronto.

Selection of study cohort

We identified all individuals aged 66 years and older who were discharged alive after a nonelective medical hospital admission between Apr. 1, 2008, and Dec. 31, 2015. For individuals with more than 1 discharge within the study period, we selected the first discharge. Hospital stays with evidence of transfer between institutions were treated as single episodes. Medical hospital admissions were identified using the Canadian Institute for Health Information’s case mix grouping (known as the CMG+ methodology).10 We excluded admissions associated with surgery, psychiatry, obstetrics or cancer therapy. We focused on medical admissions, to be consistent with other literature.9,11,12

Care settings

We created 4 mutually exclusive categories based on the combination of care settings before and after the index hospitalization (Figure 1): admission from and return to the community (C–C), admission from the community and return to the community with home care (C–H), admission from the community and discharge to long-term care (C–L), and admission from and return to long-term care (L–L). For individuals who started in long-term care, we considered only return to long-term care, because these people were unlikely to be discharged elsewhere. We considered an individual to have been discharged to home care or long-term care if we found evidence of either form of care within 14 days after discharge. We did not include home care as a care setting before hospital admission because we were unable to determine consistent use of home care services reliably, given the nature of
these services and available data. We excluded individuals discharged to any rehabilitation setting because rehabilitation is likely to have different influences on readmission.

**Characteristics of study cohort**

We characterized members of the cohort by demographic characteristics and chronic conditions that were present during the 5 years before the index hospital admission, specifically anxiety and depression, arthritis, cancer, chronic obstructive pulmonary disease, congestive heart failure, dementia, diabetes mellitus, upper gastrointestinal bleeding, hypertension, inflammatory bowel disease, ischemic heart disease, osteoporosis or osteopenia, and renal disease (with and without long-term dialysis). We characterized physician visits, emergency department visits and hospital admission in the year and in the 30 days before the index hospitalization, as well as home care use in the 30 days before hospitalization.

**Index hospital admission**

We estimated the total length of stay, in days, from the date of admission to the date of discharge (or from the initial admission to the final discharge if the patient was transferred during the hospitalization). We identified the most responsible diagnosis, defined as the diagnosis most responsible for the overall length of stay. We categorized these diagnoses according to case mix group, and then aggregated the case mix groups on the basis of clinical input, to reduce the number of categories. We identified days with alternate level of care (ALC), which refers to periods when an individual is considered to no longer require acute level services but cannot be discharged because appropriate care is not available elsewhere (such as when a long-term care bed is not available). In-hospital complications were defined as diagnoses that arose after admission.

**Hospital readmissions**

Each individual was followed from the discharge date for up to 30 days, during which time any nonelective admission to any hospital in Ontario or death was identified. If more than 1 readmission was detected, we used only the first. We characterized readmissions according to timing relative to index discharge, total length of stay, most responsible diagnosis, ALC days and readmission discharge disposition. We categorized discharge disposition as the same or a lower level of care (relative to before the readmission), a higher level of care or death.

**Statistical analysis**

For each combination of care settings, we used descriptive statistics to characterize baseline and index hospitalization variables, and to estimate the proportion of individuals who either were readmitted or died (without readmission) within 30 days after discharge. For those who were readmitted, we described the readmission. Estimates are presented with 95% confidence intervals (CIs).

To address competing risks, we created a multinomial outcome: readmission, death (without readmission) or neither within 30 days. We used a single multinomial model to quantify the effect of the care setting combination on the likelihood of each 30-day readmission and death, with C–C as the reference category. To address confounding, we included all baseline and index hospitalization variables that changed the unadjusted associations between care setting and either outcome by 10% or more. We used a generalized estimating equation to account for clustering within the index hospital. Final estimates were adjusted for age, sex, number of pre-existing chronic conditions, dementia, any emergency department visits in the previous 6 months, any nonelective hospital admissions in the previous year and index hospitalization variables (aggregated case mix groups, any ALC days, length of stay and in-hospital complications). We also adjusted for any home care visit within 30 days before the index hospitalization, because we did not have a pre-hospitalization home care group.

All analyses were conducted using SAS software, version 9.4 (SAS Institute).

**Ethics approval**

The study was approved by the institutional review boards at Sunnybrook Health Sciences Centre and Women’s College Hospital, Toronto.

**Results**

We identified a cohort of 701 527 individuals. The majority (414 302 or 59.1%) started in and returned to the community after the index hospital admission, whereas 221 169 (31.5%) were discharged with home care and 21 440 (3.1%) were newly admitted to long-term care.

The mean age for the cohort was 78.4 (standard deviation [SD] 8.0) years, 375 657 (53.5%) of cohort members were women, and 283 064 (40.3%) had 5 or more chronic conditions. In the year before the index admission, virtually everyone (685 372 [97.7%]) had visited a physician at least once, 331 168 (47.2%) had visited the emergency department, and 72 536 (10.3%) had been admitted to hospital.

Baseline variables differed by care setting combination (Table 1). Those who started in and returned to the community were the youngest and had the lowest proportion of women, whereas those discharged to long-term care were the oldest and had the highest proportion of women. Stark differences in pre-existing chronic conditions emerged, with the greatest difference observed for dementia (from 11.6% for the C–C combination to 82.7% for the L–L combination). The C–H combination had the greatest frequency of emergency department visits in the year before the index admission, whereas the C–L combination had the greatest use of home care before hospital admission.

Gastrointestinal conditions were the most common reason for hospital admission among those in the C–C and C–H combinations (14.5% and 8.6%, respectively), stroke was the most common reason among those in the C–L combination (7.5%), and pneumonia or another respiratory condition was the most common reason among those in the L–L combination (15.5%) (Table 2). Dementia, which was not among the 10 most common reasons overall, was the most common reason for admission.
Table 1 (part 1 of 2): Characteristics of older Ontarians at time of discharge from first nonelective medical hospital admission (baseline), by care setting combination (Apr. 1, 2008, to Dec. 31, 2015)

| Characteristic | Community to community | Community to community with home care | Community to long-term care | Long-term care to long-term care |
|----------------|------------------------|---------------------------------------|-----------------------------|---------------------------------|
|                | n = 414 302            | n = 221 169                           | n = 21 440                  | n = 44 616                      |
| Age, yr, mean ± SD | 76.6 ± 7.3             | 80.0 ± 8.0                            | 84.2 ± 7.2                  | 84.2 ± 7.8                      |
| Age group, yr |                          |                                       |                             |                                 |
| 66–69          | 88 485                 | 28 075                                | 821                         | 2573                            |
|                | (21.4–21.5)            | (12.6–12.8)                           | (3.6–4.1)                   | (5.6–6.0)                       |
| 70–74          | 92 083                 | 33 072                                | 1491                        | 3104                            |
|                | (22.1–22.4)            | (14.8–15.1)                           | (6.6–7.3)                   | (7.0–7.2)                       |
| 75–79          | 89 271                 | 40 931                                | 137.7                       | 5556                            |
|                | (21.4–21.7)            | (18.3–18.7)                           | (3.2–12.4)                  |                                 |
| 80–84          | 76 876                 | 49 091                                | 5121                        | 9575                            |
|                | (18.4–18.7)            | (22.0–22.4)                           | (23.2–24.5)                 |                                 |
| 85–89          | 47 885                 | 42 806                                | 5881                        | 12 030                          |
|                | (11.4–11.7)            | (19.2–19.5)                           | (26.7–28.1)                 | (26.5–27.5)                     |
| ≥ 90           | 19 702                 | 27 194                                | 12 030                      | 11 778                          |
|                | (4.7–4.8)              | (12.3–12.4)                           | (26.5–27.4)                 |                                 |
| Sex, female    | 205 067                | 127 511                               | 5121                        | 9575                            |
|                | (49.3–49.7)            | (22.5–22.7)                           | (23.2–24.5)                 |                                 |
| Neighbourhood income quintile |                   |                                       |                             |                                 |
| Lowest         | 83 342                 | 49 817                                | 5551                        | 10 635                          |
|                | (20.1–20.2)            | (22.5–22.7)                           | (25.9–26.6)                 | (23.8–24.3)                     |
| Highest        | 79 871                 | 39 025                                | 3305                        | 7354                            |
|                | (19.1–19.4)            | (17.6–17.8)                           | (14.9–16.0)                 |                                 |
| Pre-existing chronic conditions |             |                                       |                             |                                 |
| Any            | 408 499                | 219 871                               | 5551                        | 44 552                          |
|                | (98.6–98.9)            | (99.4–99.8)                           | (99.7–100)                  | (98.9–100)                      |
| Anxiety or depression | 129 617            | 83 443                                | 10 227                      | 23 227                          |
|                | (31.3–31.5)            | (37.5–38.0)                           | (47.7–48.6)                 | (51.4–52.7)                     |
| Arthritis      | 252 524                | 139 831                               | 12 797                      | 23 897                          |
|                | (61.0–61.7)            | (62.9–63.6)                           | (59.7–60.7)                 |                                 |
| Cancer         | 100 783                | 76 715                                | 4652                        | 9284                            |
|                | (24.2–24.5)            | (34.4–34.9)                           | (21.1–22.3)                 |                                 |
| Chronic obstructive pulmonary disease | 183 407              | 50 907                                | 3721                        | 10 776                          |
|                | (20.1–20.3)            | (22.8–23.2)                           | (16.8–17.9)                 | (23.7–24.6)                     |
| Congestive heart failure | 93 773              | 64 041                                | 5527                        | 15 678                          |
|                | (22.6–22.8)            | (28.7–29.2)                           | (25.8–26.5)                 |                                 |
| Dementia       | 48 036                 | 58 250                                | 15 175                      | 36 897                          |
|                | (11.6–11.7)            | (26.1–26.5)                           | (69.6–71.8)                 |                                 |
| Diabetes mellitus | 148 694              | 85 597                                | 7033                        | 82.7 (81.7–83.5)                 |
|                | (35.7–36.1)            | (38.4–39.0)                           | (32.0–33.6)                 | (39.0–40.1)                     |
| Gastrointestinal bleeding, upper | 21 943              | 9844                                  | 762                         | 3767                            |
|                | (5.3–5.4)              | (4.4–4.5)                             | (3.3–3.8)                   | (8.2–8.7)                       |
| Hypertension   | 338 096                | 184 739                               | 17 776                      | 36 460                          |
|                | (81.6–81.9)            | (83.5–83.9)                           | (82.9–84.1)                 |                                 |
| Inflammatory bowel disease | 65 893              | 40 611                                | 3748                        | 9136                            |
|                | (15.8–16.0)            | (18.2–18.5)                           | (17.5–18.0)                 |                                 |
| Ischemic heart disease | 156 005              | 72 955                                | 5581                        | 13 851                          |
|                | (37.7–37.8)            | (32.7–33.2)                           | (26.0–26.7)                 | (31.0–31.6)                     |
within the C–L combination (3521/21,440 [16.4%], compared with 9432/70,152 [1.3%] overall). Individuals in the C–L combination had the longest mean length of stay (56.9 [SD 70.6] d), the greatest proportion in hospital for 14 days or longer (83.6%), the highest proportion with ALC days (85.4%) and the longest mean time with ALC status (48.7 [SD 69.0] d).

The overall frequency of 30-day readmission was 12.6%, but frequency varied by setting combination: 10.6% of those returning to the community, 16.8% of those receiving home care, 8.4% of those newly admitted to long-term care and 12.4% of those returning to long-term care (Table 3). Overall, 2.3% of the cohort died within 30 days of discharge, and this too varied by setting.

The mean time between the index hospitalization and readmission was 11.9 (SD 8.5) days, with little difference by setting combination. Readmissions were longer than index hospitalizations for all combinations except C–L; this finding was driven by an increase in the proportion whose stay was 14 days or longer. Nearly 20% of those in the C–H combination had ALC days during the readmission. Ultimately, 10.5% of individuals in the C–C combination died during the readmission, compared with about 20% in the other setting combinations.

Following adjustment for demographic, clinical and health service use variables, including prior home care, we found that the C–H and L–L combinations had an increased likelihood, relative to the C–C combination, of 30-day readmission (adjusted odds ratio [OR] 1.43, 95% CI 1.39–1.46, and adjusted OR 1.35, 95% CI 1.27–1.43, respectively), and the C–L combination had a reduced likelihood (adjusted OR 0.68, 95% CI 0.63–0.72) (Table 4). Full model results are presented in Appendix 2 (available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.180290/-/DC1).

**Interpretation**

In this large, population-based cohort of older adults with an unplanned medical hospitalization, 31.5% were discharged to home care and 9.5% to long-term care (6.4% returning to long-term care and 3.1% newly admitted). Although most patients had a relatively simple transition, from the community to hospital and back to the community, a substantial proportion experienced more complicated transitions. These more complicated transitions have important resource implications that are directly related to the costs of home care and long-term care, but our work also shows that they are associated with important differences in terms of hospital readmission. Nearly 13% of the cohort was readmitted within 30 days after discharge, but this proportion varied by a factor of 2 when we considered the care setting combination.
Table 2: Features of the index unplanned medical hospital admission for older Ontarians, by care setting combination (Apr. 1, 2008, to Dec. 31, 2015)

| Feature of hospital admission | Community to community; no. of individuals and % of individuals (95% CI for %)* | Community to community with home care; no. of individuals and % of individuals (95% CI for %)* | Community to long-term care; no. of individuals and % of individuals (95% CI for %)* | Long-term care to long-term care; no. of individuals and % of individuals (95% CI for %)* |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Top 10 aggregated CMGs (based on overall population) | | | | |
| Gastroenteritis, bowel obstruction, other GI problem | 60 159 14.5 (14.4–14.6) | 18 951 8.6 (8.4–8.7) | 675 3.1 (2.9–3.4) | 5167 11.6 (11.3–11.9) |
| Ischemic heart disease | 47 031 11.4 (11.2–11.4) | 9890 4.5 (4.4–4.6) | 509 2.4 (2.2–2.6) | 1843 4.1 (3.9–4.3) |
| Chronic obstructive pulmonary disease | 25 273 6.1 (6.0–6.2) | 12 262 5.5 (5.4–5.6) | 522 2.4 (2.2–2.6) | 2693 6.0 (5.8–6.3) |
| Pneumonia or other respiratory infection | 22 955 5.5 (5.5–5.6) | 12 940 5.9 (5.7–6.0) | 4560 4.2 (4.2–4.8) | 6907 15.5 (15.1–15.9) |
| Heart failure | 20 301 4.9 (4.8–5.0) | 12 007 5.4 (5.3–5.5) | 657 3.1 (2.8–3.3) | 2227 5.0 (4.8–5.2) |
| Arrhythmia | 26 458 6.4 (6.3–6.4) | 6099 2.8 (2.7–2.8) | 266 1.2 (1.1–1.4) | 958 2.1 (2.0–2.3) |
| Stroke | 18 124 4.4 (4.3–4.4) | 9801 4.4 (4.3–4.5) | 1598 7.5 (7.1–7.8) | 1761 3.9 (3.8–4.1) |
| Urinary tract infection | 11 890 2.9 (2.8–2.9) | 9227 4.2 (4.1–4.3) | 755 3.5 (3.3–3.8) | 4360 9.8 (9.5–10.1) |
| Cardiovascular problem | 16 616 4.0 (4.0–4.1) | 8374 3.8 (3.7–3.9) | 286 1.3 (1.2–1.5) | 901 2.0 (1.9–2.2) |
| Cancer | 10 742 2.6 (2.5–2.6) | 6 260 2.6 (2.5–2.6) | 369 1.7 (1.5–1.9) | 611 1.4 (1.3–1.5) |
| Length of stay, d, mean ± SD | 4.8 (7.7) | 9.4 (11.6) | 56.9 (70.6) | 7.3 (13.6) |
| Length of stay category, d | | | | |
| 1–3 | 220 555 53.2 (53.0–53.5) | 58 238 26.3 (26.1–26.5) | 680 3.2 (2.9–3.4) | 15 848 35.5 (35.0–36.1) |
| 4–6 | 111 322 26.9 (26.7–27.0) | 55 731 25.2 (25.0–25.4) | 712 3.3 (3.1–3.6) | 12 833 28.8 (28.3–29.3) |
| 7–10 | 49 728 12.0 (11.9–12.1) | 46 475 21.0 (20.8–21.2) | 1132 5.3 (5.0–5.6) | 8366 18.8 (18.3–19.2) |
| 11–13 | 13 414 3.2 (3.2–3.3) | 18 837 8.5 (8.4–8.6) | 985 4.6 (4.3–4.9) | 2942 6.6 (6.4–6.8) |
| ≥ 14 | 19 283 4.7 (4.6–4.7) | 41 888 18.9 (18.8–19.1) | 17 931 83.6 (82.4–84.9) | 4627 10.4 (10.1–10.7) |
| Alternate level of care (ALC) | | | | |
| Any ALC time | 10 143 2.4 (2.4–2.5) | 23 507 10.6 (10.5–10.8) | 18 303 85.4 (84.1–86.6) | 1881 4.2 (4.0–4.4) |
| Time in ALC, d, mean ± SD | 14.0 ± 30.1 | 11.4 ± 16.9 | 48.7 ± 69.0 | 23.6 ± 50.8 |
| In-hospital complication | 25 617 6.2 (6.1–6.3) | 29 882 13.5 (13.4–13.7) | 6747 31.5 (30.7–32.2) | 5013 11.2 (10.9–11.5) |

Note: CI = confidence interval, CMG = case mix group, GI = gastrointestinal, SD = standard deviation.

*Except where indicated otherwise.
Table 3 (part 1 of 2): All unplanned hospital readmissions among older Ontarians, within 30 days of discharge from index medical hospital admission, by care setting combination (Apr. 1, 2008, to Dec. 31, 2015)

| Variable | Community to community | Community to community with home care | Community to long-term care | Long-term care to long-term care |
|----------|------------------------|---------------------------------------|----------------------------|----------------------------------|
| Died without readmission within 30 d of discharge | n = 414 302 | n = 221 169 | n = 21 440 | n = 44 616 |
| Readmitted within 30 d of discharge | n = 43 731 | n = 37 251 | n = 1793 | n = 5530 |
| Among those with readmission | n = 43 731 | n = 37 251 | n = 1793 | n = 5530 |
| Time to readmission, d, mean ± SD | 11.5 ± 8.6 | 12.4 ± 8.4 | 13.3 ± 8.8 | 11.5 ± 8.5 |
| Time to readmission category, d | 0 | 1040 (2.2–2.5) | 344 (0.8–1.0) | 20 (0.7–1.7) | 65 (0.9–1.5) |
| | 1–3 | 9042 (20.2–21.1) | 5718 (14.9–15.7) | 15.6 (13.8–17.6) | 20.5 (19.4–21.8) |
| | 4–7 | 8387 (18.8–19.6) | 7495 (19.7–20.6) | 16.7 (14.9–18.7) | 20.0 (18.9–21.2) |
| | 8–14 | 10 333 (23.2–24.1) | 9589 (25.2–26.3) | 24.0 (21.8–26.4) | 1324 |
| | 15–21 | 7500 (16.8–17.5) | 7223 (18.9–18.9) | 19.8 (17.8–22.0) | 17.4 (16.3–18.5) |
| | 22–30 | 7429 (16.8–17.4) | 6882 (18.0–18.9) | 22.7 (20.5–25.0) | 16.9 (15.9–18.1) |
| Top 10 aggregated CMGs† at time of readmission | | | | |
| Surgical | 7280 (16.3–17.0) | 3716 (10.0–9.7–10.3) | 173 (9.6–6.3–11.2) | 385 (7.0–6.3–7.7) |
| Ischemic heart disease | 2548 (5.6–6.1) | 1171 (3.1–3.0–3.3) | 44 (2.5–1.8–3.2) | 208 (3.8–3.3–4.3) |
| Chronic obstructive pulmonary disease | 2049 (4.5–4.9) | 1535 (4.1–3.9–4.3) | 97 (5.4–4.4–6.6) | 279 (5.0–4.5–5.7) |
| Pneumonia or other respiratory infection | 1400 (3.0–3.4) | 1535 (4.1–3.9–4.3) | 178 (9.5–11.5) | 765 (13.8–12.9–14.8) |
| Heart failure | 3194 (7.1–7.6) | 2572 (6.9–6.6–7.2) | 121 (6.7–6.8–7.1) | 403 (7.3–6.6–8.0) |
| Arrhythmia | 1727 (3.8–4.1) | 654 (1.8–1.6–1.9) | 22 (1.2–0.8–1.9) | 90 (1.6–1.3–2.0) |
| Stroke | 1277 (2.8–3.1) | 802 (2.2–2.0–3.2) | 42 (2.3–1.7–3.2) | 119 (2.2–1.8–2.6) |
| Urinary tract infection | 780 (1.7–1.9) | 1117 (3.0–2.8–3.2) | 116 (6.5–5.3–7.8) | 410 (7.4–6.7–8.2) |
| Cardiovascular problem | 1528 (3.3–3.7) | 1176 (3.2–3.0–3.3) | 29 (1.6–1.1–2.3) | 131 (2.4–2.0–2.8) |
| Cancer | 2352 (5.2–5.6) | 2548 (6.8–6.6–7.1) | 29 (1.6–1.1–2.3) | 65 (1.2–0.9–1.5) |
| Diagnostic concordance between index admission and readmission | | | | |
| Same CMG | 9572 (21.4–22.3) | 7117 (19.1–18.7–19.5) | 193 (10.8–9.7–12.4) | 1076 (19.5–18.3–20.7) |
| Same aggregated CMGs† | 3163 (7.0–7.5) | 1858 (5.0–4.8–5.2) | 35 (2.0–1.4–2.7) | 321 (5.8–5.2–6.5) |
| Different aggregated CMGs† | 30 996 (70.9–71.7) | 28 276 (75.9–75.0–76.8) | 1565 (87.3–83.0–91.7) | 4133 (74.7–72.5–77.0) |
Table 3 (part 2 of 2): All unplanned hospital readmissions among older Ontarians, within 30 days of discharge from index medical hospital admission, by care setting combination (Apr. 1, 2008, to Dec. 31, 2015)

| Care setting combination; no. of individuals and % of individuals (95% CI for %)* | Community to community | Community to community with home care | Community to long-term care | Long-term care to long-term care |
|---|---|---|---|---|
| Among those with readmission | n = 43 731 | n = 37 251 | n = 1793 | n = 5530 |
| Length of readmission stay, d, mean ± SD | 11.2 ± 20.2 | 13.4 ± 23.3 | 12.4 ± 39.7 | 9.6 ± 25.3 |
| Length of stay category for readmission, d | | | | |
| 1–3 | 13 165 (30.1 (29.6–30.6)) | 9136 (24.5 (24.0–25.0)) | 524 (29.2 (26.8–31.8)) | 1616 (29.2 (27.8–30.7)) |
| 4–6 | 10 033 (22.9 (22.5–23.4)) | 8154 (21.9 (21.4–22.4)) | 457 (25.5 (23.2–27.9)) | 1460 (26.4 (25.1–27.8)) |
| 7–10 | 7639 (17.5 (17.1–17.9)) | 6909 (18.5 (18.1–19.0)) | 341 (19.0 (17.0–21.1)) | 1113 (20.1 (18.9–21.3)) |
| 11–13 | 3237 (7.4 (7.2–7.7)) | 2989 (8.0 (7.7–8.3)) | 126 (7.0 (5.8–8.4)) | 393 (7.1 (6.4–7.9)) |
| ≥ 14 | 9657 (22.1 (21.6–22.5)) | 10 063 (27.0 (26.5–27.5)) | 345 (19.2 (17.3–21.4)) | 948 (17.1 (16.1–18.3)) |
| Any ALC time during readmission | 4554 (10.4 (10.1–10.7)) | 7166 (19.2 (18.8–19.7)) | 259 (14.4 (12.7–16.3)) | 340 (6.1 (5.5–6.8)) |
| Readmitted to same hospital as for index admission | 36 485 (83.4 (82.6–84.3)) | 32 021 (86.0 (85.0–86.9)) | 1231 (68.7 (64.9–72.6)) | 4743 (85.8 (83.3–88.2)) |
| Outcome, as level of care at discharge or death | | | | |
| Returned to same site or lower level of care | 26 532 (60.7 (59.9–61.4)) | 25 120 (67.4 (66.6–68.3)) | 1336 (74.5 (70.6–78.6)) | 4324 (78.2 (75.9–80.6)) |
| Moved to higher level of care | 12 625 (28.9 (28.4–29.4)) | 5158 (13.8 (13.5–14.2)) | 62 (3.5 (2.6–4.4)) | 98 (1.8 (1.4–2.2)) |
| Died | 4574 (10.5 (10.2–10.8)) | 6973 (18.7 (18.3–19.2)) | 395 (22.0 (19.9–24.3)) | 1108 (20.0 (18.9–21.2)) |

Note: ALC = alternate level of care, CI = confidence interval, CMG = case mix group, SD = standard deviation.
*Except where indicated otherwise.
†Groupings of related CMGs (based on overall population), where the CMGs were defined according to the Canadian Institute for Health Information’s CMG+ methodology.10

Table 4: Odds ratios for 30-day unplanned hospital readmission and death, by care setting combination, among older adults in Ontario

| Care setting before index admission | Care setting after index admission | OR for 30-day readmission (95% CI) | OR for death (95% CI) |
|---|---|---|---|
| | | Unadjusted | Adjusted* |
| | | | Unadjusted | Adjusted* |
| Community to community | Community to community | 1.00 (ref) | 1.00 (ref) |
| Community to community with home care | 1.76 (1.72–1.80) | 1.43 (1.39–1.46) | 3.52 (2.97–4.18) | 1.67 (1.31–2.12) |
| Community to long-term care | 0.80 (0.74–0.86) | 0.68 (0.63–0.72) | 4.71 (3.81–5.83) | 1.05 (0.74–1.48) |
| Long-term care to long-term care | 1.40 (1.31–1.49) | 1.35 (1.27–1.43) | 18.52 (15.39–22.29) | 13.05 (10.85–15.69) |

Note: CI = confidence interval, OR = odds ratio, ref = reference.
*Adjusted for age categories, sex, pre-existing chronic conditions (total number, dementia), any visit to the emergency department within 6 months before index hospital admission, any nonelective hospital admission within 1 year before index admission, any home care use in the 30 days before index hospital admission, case mix group at index hospital admission, length of index hospital stay (log), any alternate-level-of-care days during index hospital stay and any in-hospital complications during index hospital stay.
setting before and after hospitalization. The spectrum of our results, from clinical profiles through service use patterns and outcomes, further shows that fundamental shortcomings in the health system’s ability to meet older adults’ needs, particularly those with dementia, manifest as frequent use of acute care, including readmissions, prolonged hospital stays with extended ALC periods and “non-acute” reasons for hospital admission.

Fundamental to a strong care system for older adults is sufficient access to appropriate home and long-term care services. We found that older adults discharged with home care were the most likely to be readmitted and, when they were readmitted, experienced the longest stays with the greatest frequency of ALC days. Others have suggested that mismatches between recipient needs and home care service provision result in poor outcomes, and a recent study suggested that associations between home care and emergency department use may result from the limited scope of home care services and lack of integration with primary care.

Individuals who started in the community and were discharged to long-term care had the lowest likelihood of hospital readmission, which suggests that they were in the appropriate care setting but that the path to long-term care was marked by frequent acute care use, very long hospital stays and lengthy ALC periods. Individuals admitted from and discharged to long-term care had an increased likelihood of readmission. Some evidence suggests that long-term care residents are prematurely discharged from hospital because providers have little experience in long-term care and make erroneous assumptions about available resources. Although this issue is separate from the need for enhanced home and long-term care services, it is a reminder that improved management of frail older adults in the hospital is an important component of any comprehensive care strategy for older adults.

Quality end-of-life care, in any setting, is also critical to such a strategy. Among those readmitted from home care or long-term care, about 20% died during the readmission. The frequency of death following repeated transitions is concerning. Preferences for death at home, or in a home-like setting, over death in the hospital have been well documented, as has the burden of hospital admissions at the end of life. Quality end-of-life care reduces symptom burden and hospital transfers that are not desired by patients.

Finally, our data show the value of considering the care setting in risk assessment. The developers of clinical risk tools, such as the LACE+ index, did not account for out-of-hospital care setting, but it is clear from our findings that this important measurable factor is a predictor of readmission. Clinicians should be aware of patients’ care setting before admission and any change at discharge. Thirty-day readmission models are often used to compare the quality of care between hospitals, but this variable may also be affected by the omission of pre- and posthospitalization care setting. Even after rigorous risk adjustment, care settings were strongly associated with 30-day readmission, which has implications for model validity, particularly when discharge patterns to home care, long-term care and other settings differ across hospitals.

Limitations

This study had limitations. Although we adjusted for many variables, we lacked data on measures such as physical or cognitive function and caregiver availability; however, we were able to adjust for dementia and other factors associated with declining function. Smaller studies have shown that physical function has a moderate influence on readmission, but it is difficult to know how this would translate to our cohort. That such measures are not routinely collected poses substantial barriers to implementing and monitoring a care system for older adults. We could not capture home care that was paid for privately. Nonetheless, we still found very large differences between the groups who did and did not receive publicly funded home care.

Conclusion

In this large cohort of older adults who had been admitted to hospital, we found that 40% had been discharged to either home care or long-term care and that the discharge setting, coupled with the prior care setting, had important implications for understanding 30-day hospital readmissions. Health system planning and strategies to reduce readmissions among older adults should take into account the care setting both before admission and at discharge. Furthermore, by contextualizing hospitalization within these care settings, our findings suggest an approach to understanding readmissions as a signal of the health system’s preparedness for the aging population.

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