# Getting Older? Where you live matters: Regional variations of care in home care and long-term care

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**ABSTRACT (word count: 250)**

**Background:** Many aging adults undergo progressive loss of autonomy and increasingly complex medical needs that lead to numerous transitions between different care settings. We compared these transitions in three Canadian provinces to identify potential care gaps.

**Methods:** We examined transitions from home care services and long-term care to different possible end states (change of health status [using the Changes in Health, End-Stage Disease, and Signs and Symptoms (CHESS) Scale], transfer to hospital or other care settings, death) using standardized interRAI assessments linked to hospital records from 2010 to 2016. Multistate modelling was used to adjust for patients with complex health and transitions in care.

**Results:** We report data for 254,664 individuals in home and 162,045 residents from long-term care programs. Compared to Ontario, individuals requiring home care services in Alberta [at CHESS=0, the adjusted odds ratio was of 2.08 (1.92-2.24)] and British Columbia [at CHESS=0, adjusted odds ratio of 1.46 (1.39-1.54)], had increased odds of being hospitalized regardless of the underlying severity of illness. Residents in long-term care in Alberta (at CHESS=0, odds ratio of 0.38 [0.35-0.40]) and British Columbia (at CHESS=0, odds ratio of 0.44 [0.42-0.46]) had less than half the odds of being transferred to hospital, independent of all other factors, when compared to Ontario.

**Interpretation:** Significant variations in transfer rates were observed between provinces, even after controlling for individual patient characteristics. These results suggest that transfers to hospital are largely driven by healthcare policies, healthcare professional practice patterns and available infrastructure rather than individual patient needs.

**Introduction (417)**

Many older adults embark on a journey of increasing comorbidity burden, progressive frailty, and functional decline that takes them from full independence, to receiving assistance in the community, to full care, eventual palliation and death (often in institutional settings). Poorly executed transitions, inconsistencies in assessments among practitioners, and interventions that are often not tailored to the person's needs and expressed goals, available resources and health care settings puts frail older adults at risk of adverse outcomes[1]. Indeed, poor transitions can lead to deleterious consequences such as premature transfers from home care to nursing homes, unnecessary transfers to hospital emergency departments, and inadequate end-of-life care planning.

Frail home care clients with complex comorbidities are especially vulnerable to care fragmentation. Effective chronic disease management requires the targeted delivery of multiple care components and patient self-care coaching by a coordinated multidisciplinary care team. These programs should be efficiently deployed as integrated care processes that respect individual patient needs and goals[2-4]. Jurisdictional differences in these programs, resources, their structure and care provider training and communication may result in distinct patterns of care. Admissions to hospitals through Emergency Departments, often for anticipated or preventable, are driven by the complexity and frailty of these individuals[5-7]. Deteriorations in overall health during acute care hospitalization often result in admission to a long-term care facility[8], if not death.

Long-term care residents, many already very frail, are far from a uniform group. While individual prognoses, care needs, values and expectations may vary substantially, clinical deterioration and death can be anticipated for most long-term care residents. In fact, life expectancy once admitted to a long-term care

facility is relatively short, with approximately 30-50% dying each year[9] - an outcome comparable to many aggressive cancers[10]. Notably, use of emergency care and acute care facilities remains elevated, often for potentially avoidable reasons[11], and often in disaccord with resident wishes. End of life is one of the most sensitive and difficult situations to manage and - for many - occurs in long-term care, yet a substantial proportion of long-term care residents still die in hospital[12].

If the ultimate goal is to provide the right care, in the right place, at the right time, by the right persons, we first need to examine the settings where care is provided for frail older adults and the factors that drive transitions from one care setting to another. Therefore, we examined critical transition points in the care of older adults in home care and long-term care and compared risks for these transfers across health systems.

## Methods (688)

### Ethics

We obtained Research Ethics approval from the University of Waterloo's Office of Research Ethics (ORE# 18228).

### Source of data

We followed the method previously detailed by Cook and colleagues[17] and have summarized it briefly here. The RAI-Home Care (RAI-HC) and RAI-MDS 2.0 for nursing homes are two of a suite of standardized assessment tools developed by the interRAI consortium[18-21]. Ontario (ONT), Alberta (ALTA) and British Columbia (BC) mandate the assessment of home care patients expected to require services for more than 60 days and long-term care residents with stays of 14 days or more. Each assessment contains more than 300 items measuring cognition, mood and behavior, informal support services, physical functioning, and other patient characteristics. The assessments have multiple embedded scales such as the Activities of Daily Living Hierarchy Scale[22]; Instrumental Activities of Daily Living Scale[23]; Changes in Health, End-Stage Disease, and Signs and Symptoms Scale (CHESS)[24, 25]; Depression Rating Scale [26, 27]; and Cognitive Performance Scale [28-30]. The reliability and validity of the RAI 2.0 and RAI-HC as used in normal clinical practice has been established[31, 32].

We used data from 2010 to 2016 for home care clients with a RAI HC in the province of Ontario, Alberta and British Columbia and long-term care residents with a RAI 2.0 in the same provinces in addition to one territory, the Yukon. We obtained linked data sets from the Canadian Institute for Health Information and combined with the following data sets: (1) interRAI data RAI-MDS 2.0 and RAI-HC; (2) Discharge Abstract Database (DAD) to track acute hospitalizations; (3) National Ambulatory Care Reporting System (NACRS) to

track emergency department visits. We included linked patients (i.e., patients whose information was contained in multiple data sources) if they had (1) at least 1 consecutive follow-up assessment within the same admission episode; or (2) a date of discharge or death. Baseline assessments were defined as occurring within 14 days of admission to long-term care or home care. As mandated, follow-up RAI-MDS 2.0 and HC assessments are completed every 90 days or 6 months, respectively, or earlier in the event of major clinical changes. During the study period, some patients had multiple admissions to the home care system; these were treated as separate episodes.

Assessment times are reported as Time 1 ($T_1$) for baseline assessment and Time 2 ($T_2$) for the follow-up assessment. The CHESS score is a measure of instability in health, ranging from 0 to 5 and with 0 denoting low instability and 5 denoting high instability and greater risk of death. We then stratified patients into 3 different CHESS categories: (1) CHESS 0 scores, (2) CHESS 1-2 and (3) CHESS 3+, which corresponds to CHESS scores of 3-5[29].



**Statistical methods**

We used previously applied methods[17] and summarize them briefly here. Multistate processes are a powerful tool to examine changes in health status over time and identify factors that influence these changes. Figures 1a and 1b are state-space diagrams for home care and long-term care, respectively, comprised of 7 states that are defined as 3 possible CHESS states (CHESS = 0, 1-2, 3+) if the patient remains in home care or long-term care facility and 4 possible discharge destinations (hospital, death, long-term care

facility/other settings and discharged from service/home care). Movement in time (for example, $T_1$ to $T_2$) towards a higher CHESS scores represent a decrease in health stability whereas a movement towards a lower CHESS score indicates an increase in health stability. Discharge destinations are so-called absorbing states, since transitioning to one of these states defines the end of the particular care episode with home care or the long-term care facility.

To contribute to the analysis, all cases must have complete baseline covariate information at the time of entering into home care or a long-term care facility and a completed assessment as per required schedule (180 days for home care, 90 days for long-term care facilities) until discharge (the 4 absorbing states). The list of covariates are listed in the legend to Tables 3 and 4.

The statistical analyses, aimed at modeling changes in states, were based on a discrete time nonhomogeneous Markov chain model, using a previously detailed method[17].

## Results (681)

*Baseline characteristics in home care and long-term-care*

Among the 416,709 elderly individuals in this study, 254,664 received home care services and 162,045 lived in long term care facilities between 2010 and 2016 (Tables 1 and 2). Overall, about 60% were female, and about 80% of patients were older than 75 years. The majority of residents in long-term facilities had "Do Not Resuscitate" advanced directives (overall 71.3%) with the greatest proportion in Alberta at 82.9% and the lowest in Ontario at 69.5% (Table 2); over a quarter of Canadian residents have "Do Not Hospitalize" directives (Table 2).

*Characteristics influencing mortality and hospitalizations*

Figures 2 and 3 show the unadjusted 6-month rates of hospitalization, death and long-term care placement for home care, and the unadjusted 90-day hospitalization and death rates for long-term care, by CHESS score and provinces. In both settings, higher CHESS scores are consistently associated with higher hospitalization and mortality rates (except for the highest CHESS score in British Columbia home care). However, there are regional variations in these rates within CHESS scores.

We initially examined individual characteristics to determine if they explained some of the differences observed in transitions between CHESS states, as well as discharges including hospitalization and mortality. Several of the covariates were associated with differential transition rates. For example, increased age consistently increases the risk of death, irrespective of the CHESS score, in both long-term care (from 1.4 to 4.0 at CHESS=0, when compared to the lowest age range) and home care services (from 1.0 to 2.8 at CHESS=0, when compared to the lowest age range; Supplemental Table 1). Diagnoses of COPD (at the lower CHESS scores) and pneumonia (especially in long-term care) also increase the risk of death and transfer to hospital (Supplemental Table 1).

*Provincial variations in home care and long-term care*

We next examined whether we could observe differences in care patterns across the provinces, with emphasis on mortality and hospitalizations that involve active decisions by care providers and can be modulated by advanced directives. We compared Alberta and British Columbia to Ontario. Irrespective of CHESS score, patients in home care in Alberta have increased odds of being admitted to hospital when compared to Ontario (Table 3). Indeed, at a CHESS score of 0, the adjusted odds ratio was 2.08 [1.92-2.24) while at CHESS score of 3 or more, the adjusted odds ratio was 3.77 (3.24-4.40) in Alberta when compared to Ontario (Table 3). Similarly, in British Columbia, patients in home care had increased odds of being admitted to a hospital irrespective of the initial CHESS score (Table 3); at a CHESS score of 0, the adjusted odd ratio was 1.46 (1.39-1.54). Adjusted odds ratios for mortality were higher in Alberta and lower in British Columbia, when compared to Ontario (Table 3). As noted, these effects were adjusted for about 20 other covariates including demographic, diagnostic, and clinical indicators. In both provinces, the odds ratios for long term care admissions from home care were considerably lower than in Ontario.

In long-term care (Table 4), we note that patients in Alberta had less than half the odds of going to hospital compared to Ontario, regardless of baseline severity of illness. For example, at CHESS scores of 3 or more, the adjusted odds ratio was of 0.39 (0.34-0.43). The situation was very similar in British Columbia, with an adjusted odds ratio of 0.33 (0.29-0.37) of being admitted to hospital when compared to Ontario (Table 4). Mortality rates were more nuanced, with higher mortality at the lower CHESS score of 0 in Alberta and British Columbia, but lower adjusted odds ratio at the higher CHESS scores (Table 4).

Alberta has substantially increased its emphasis on assisted living as a form of residential care, so it is not surprising to see considerably greater odds of transfers to other care settings in that province (2.31 [1.93-2.77] at CHESS=0; Table 4) compared with Ontario. Those odds were generally lower in British Columbia. Finally, being discharged home from long-term care was a rare event, but it was least likely to occur in British Columbia after adjusting for other covariates (Table 4).

**Interpretation (792)**

Overall, we identified substantial inter-provincial variations in hospitalizations for patients using home care services or living in long-term care. In Ontario, long-term care residents had more than twice the odds of being transferred to hospital, independent of all other factors compared to Alberta and British Columbia. In contrast, persons making use of home care services in Alberta and British Columbia were *more* likely to be hospitalized regardless of their underlying severity of illness and other factors compared to Ontario. In both Alberta and British Columbia, home care clients were also less likely to be admitted to long-term care facilities than in Ontario.

Our multistate model approach allowed us to simultaneously consider patients who transition from one health state at baseline to another state ( better or worse in care setting, transferred to another care setting, or deceased), all the while considering a number of important individual, facility and system characteristics. While certain conditions, such as heart failure and pneumonia, were associated with increased transfer to hospital from either long-term care or home care services, these differences did not explain the large regional variations. Indeed, the health system itself, that is the province, remained one the most important drivers of decisions to transfer patients. Local practice patterns played an important role and suggest that system-based considerations such as the distribution of resources were dominant factors in determining care and access to services rather than diagnostic and clinical factors or patient desires. These results are in agreement with previous work suggesting that care decisions such as hospitalization are being driven by differing care patterns and resources rather than the best outcome for patients[33, 34].

Even though we documented a high rate of “Do Not Resuscitate” and “Do Not Hospitalize” orders on the medical records, and orders did decrease transfer rates, they did not account for 2-fold differences between

jurisdictions. Thus, to provide care better aligned with evidence and wishes, a much more active approach to involvement and engagement of patients and their significant others should be considered. In addition, advance care plans should be properly communicated to all caregivers and health professionals who have access to all necessary resources to execute patient-centered plans.

At a population level, a doubling in the odds of transfers in one jurisdiction compared to another represents sending a large number of patients to hospital. Inappropriate transfers to acute care settings can be very costly monetarily and can strain limited healthcare resources. With over 75,000 patients living in long-term care in Ontario, a doubling of hospital transfers will result in augmented use of emergency, acute care and critical care services which could overwhelm services, especially during periods of high occupancy such as flu season. Worse still, for long-term care residents who are known to have a limited life expectancy, aggressive care may be completely inappropriate and not even respect their wishes; iatrogenic complications from the acute care episode may also lead to reduced quality of life. On the other hand, it is possible that provinces with half the number of transfers are not providing acute medical services to patients who would benefit from such care, particularly for patients with lower severity of illness. In either scenario, services could be misaligned with patients' wishes or need.

One of the strengths of this study was the use of multistage modelling to examine a complex system wide process. Our approach may be used to monitor the implementation of system wide initiatives using transfer rates and mortality as outcomes. Indeed, the analytic approach may be adapted to facilitate stepwise comparisons of interventions. It also demonstrates the importance of taking into account confounding variables related to differences in patient characteristics that may mask the true magnitude of regional differences. We were unable to identify other studies examining care of frail older adults using comparable statistical methods.

Our study has limitations. Despite the use of advanced modelling techniques, our approach may not have fully captured the nuances of complex care and systems. The use of administrative data on hospitalization may have also resulted in misclassifications of diagnoses or transitions. However, the interRAI assessments are based on direct clinical observations by trained health professionals done at the point of care. Further, data are not continuous in this study and represent snapshots at different points in time. These snapshots may not be an accurate reflection of patient status at the moment that transfer decisions have been made. However, we do not expect that these limitations could have accounted for these large differences in rates of transfer to hospitals or mortality between provinces.

In conclusion, our study highlights substantial variations in transfer rates suggesting organizational concerns or care gaps. Clearly, health systems should strive to align healthcare delivery with meeting the actual needs and wishes of this vulnerable population.

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**Table 1. Baseline characteristics of 254,664 patients who received home care services**

| | | Province | | | | |
|---|---|---|---|---|---|---|
| **Covariate** | **Domain** | **ON (n=194,094)** | **BC (n=46,359)** | **AB (n=13,983)** | **YT (n=228)** | **Over all (n=254,664)** |
| **Age Group** | 65≤Age <75 | 43941 (23) | 6592 (14) | 2838 (20) | 69 (30) | 53440 (21) |
| | 75 ≤ Age <85 | 83866 (43) | 18767 (40) | 5925 (42) | 107 (47) | 108665 (43) |
| | 85 ≤ Age <95 | 61763 (33) | 19181 (41) | 4885 (35) | 50 (22) | 85879 (34) |
| | 95 ≤Age | 4524 (2) | 1819 (4) | 335 (2) | 2 (1) | 6680 (3) |
| **Gender** | Female | 115723 (60) | 27749 (60) | 8331 (60) | 122 (54) | 151925 (60) |
| **Marital Status** | Married | 88506 (46) | 16049 (35) | NA | 70 (31) | 104625/ 240680 (43) |
| **CHESS** | 0 | 32708 (17) | 10842 (23) | 4642 (33) | 79 (35) | 48271 (19) |
| | 1 | 60761 (31) | 14031 (30) | 4186 (30) | 71 (31) | 79049 (31) |
| | 2 | 57666 (30) | 12781 (28) | 3111 (23) | 44 (19) | 73602 (29) |
| | 3 | 33266 (17) | 6284 (14) | 1547 (11) | 24 (11) | 41121 (16) |
| | 4 | 9030 (5) | 2165 (5) | 456 (3) | 9 (4) | 11660 (5) |
| | 5 | 663 (0) | 256 (1) | 41 (0) | 1 (0) | 961 (0) |
| **Diagnoses** | Congestive Heart Failure | 22860 (12) | 6763 (15) | 2026 (14) | 18 (8) | 31667 (12) |
| | Chronic obstructive pulmonary disease | 33603 (17) | 8177 (18) | 2850 (20) | 53 (23) | 44683 (18) |
| | Pneumonia | 6566 (3) | 835 (2) | 447 (3) | 6 (3) | 7854 (3) |
| | Diabetes | 51006 (26) | 10172 (22) | 3408 (24) | 54 (24) | 64640 (25) |
| | Arthritis | 89113 (46) | 17804 (38) | 6617 (47) | 112 (49) | 113646 (45) |
| | Renal Infection | 13803 (7) | 5290 (11) | 1099 (8) | 6 (3) | 20198 (8) |
| | Urinary track infection | 10724 (6) | 2322 (5) | 903 (6) | 8 (4) | 13957 (5) |
| | Dementia | 41128 (21) | 17234 (37) | 3620 (26) | 51 (22) | 62033 (24) |
| | Depression | 22388 (12) | 7237 (16) | 1906 (14) | 16 (7) | 31547 (12) |
| | Cancer | 34531 (18) | 5593 (12) | 1971 (14) | 37 (16) | 42132 (17) |
| **Nurse Visits** | in the last 7 days | 54906 (28) | 5942 (13) | 4043 (29) | 46 (20) | 64937 (25) |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Cognitive Performance Scale** | Scale = 0 | 75913 (39) | 11198 (24) | 6241 (45) | 98 (43) | 93450 (37) |
| | Scale = 1,2 | 98933 (51) | 26766 (58) | 6390 (46) | 108 (47) | 132197 (52) |
| | Scale = 3,4 | 14340 (7) | 6612 (14) | 1010 (7) | 21 (9) | 21983 (9) |
| | Scale = 5,6 | 4908 (3) | 1783 (4) | 342 (2) | 1 (0) | 7034 (3) |
| **Activities of Daily Living Hierarchy Scale** | Scale = 0 | 119003 (61) | 27841 (60) | 10759 (77) | 190 (83) | 157793 (62) |
| | Scale = 1,2 | 53350 (27) | 12647 (27) | 2343 (17) | 28 (12) | 68368 (27) |
| | Scale >=3 | 21741 (11) | 5871 (13) | 881 (6) | 10 (4) | 28503 (11) |
| **Activities of Daily Living Functional improvements** | Yes | 61273 (32) | 11045 (24) | 3869 (28) | 73 (32) | 76260 (30) |

**Proportions (percentages) are presented in brackets**

**Table 2. Baseline characteristics of 162,045 patients living in long-term care facilities**

| Covariate | Domain | Province | | | Over all (n=162,045) |
|---|---|---|---|---|---|
| | | ON (n=113,552) | BC (n=22,732) | AB (n=25,761) | |
| **Age Group** | 65≤Age <75 | 12317 (11) | 2409 (11) | 2980 (12) | 17706 (11) |
| | 75 ≤ Age <85 | 41164 (36) | 7783 (34) | 8874 (34) | 57821 (36) |
| | 85 ≤ Age <95 | 52842 (47) | 10771 (47) | 11844 (46) | 75457 (47) |
| | 95 ≤Age | 7229 (6.4) | 1769 (8) | 2063 (8) | 11061 (7) |
| **Gender** | Female | 74023 (65) | 14407 (63) | 15966 (62) | 104396 (64) |
| **Marital Status** | Married | 35651 (31) | 6666 (29) | NA | 42317/136284 (31) |
| **Diagnoses** | Congestive Heart Failure | 16504 (15) | 3626 (16) | 4701 (18) | 24831 (15) |
| | Chronic obstructive pulmonary disease | 18375 (16) | 3374 (15) | 5291 (21) | 27040 (17) |
| | Pneumonia | 2103 (2) | 347 (2) | 566 (2) | 3016 (2) |
| | Diabetes | 29677 (26) | 4739 (21) | 6079 (24) | 40495 (25) |
| | Arthritis | 46807 (41) | 6753 (30) | 9371 (36) | 62931 (39) |
| | Renal Infection | 11791 (10) | 2769 (12) | 2755 (11) | 17315 (11) |
| | Urinary track infection | 9758 (9) | 1883 (8) | 3108 (12) | 14749 (9) |
| | Dementia | 70244 (62) | 14521 (64) | 15597 (61) | 100362 (62) |
| | Depression | 25913 (23) | 4308 (19) | 7223 (28) | 37444 (23) |
| | Cancer | 12060 (11) | 2246 (10) | 2666 (10) | 16972 (11) |
| **CHESS** | 0 | 55901 (49) | 13431 (59) | 9081 (35) | 78413 (48) |
| | 1 | 36206 (32) | 5882 (26) | 8034 (31) | 50122 (31) |
| | 2 | 15305 (13) | 2431 (11) | 5425 (21) | 23161 (14) |
| | 3 | 4552 (4) | 735 (3) | 2257 (9) | 7544 (5) |
| | 4 | 1363 (1) | 213 (1) | 877 (3) | 2453 (2) |
| | 5 | 225 (0) | 40 (0) | 87 (0) | 352 (0) |
| **Physician Examination** | In last 14 days | 96057 (85) | 11708 (52) | 21038 (82) | 128803 (80) |
| **Cognitive Performance Scale** | Scale = 0 | 14444 (13) | 2134 (9) | 1930 (7) | 18508 (11) |
| | Scale = 1,2 | 41830 (37) | 8100 (36) | 8214 (33) | 58144 (36) |
| | Scale = 3,4 | 46466 (41) | 9464 (42) | 11640 (45) | 67570 (42) |

| | | | | | |
|---|---|---|---|---|---|
| | Scale = 5,6 | 10812 (10) | 3034 (13) | 3977 (15) | 17823 (11) |
| **Activities of Daily Living Hierarchy Scale** | Scale = 0 | 5238 (4.6) | 2298 (10.1) | 517 (2) | 8053 (5) |
| | Scale = 1,2 | 29518 (26) | 8157 (36) | 5441 (21) | 43116 (27) |
| | Scale >=3 | 78796 (69) | 12277 (54) | 19803 (77) | 110876 (68) |
| **Activities of Daily Living Functional improvements** | Yes | 27578 (24) | 5930 (26) | 6890 (27) | 40398 (25) |
| **Advanced directives** | Do Not Hospitalize | 26679 (25) | 4557 (24) | 4664 (31) | 35900 (26) |
| | Do Not Resuscitate | 74464 (70) | 13982 (72) | 12360 (83) | 100806 (71) |
| **Facility Size** | 1-49 beds | 3764 (3) | 1426 (6) | 2468 (10) | 7658 (5) |
| | 50-99 beds | 27656 (24) | 7046 (31) | 6363 (25) | 41065 (25) |
| | 100_149 beds | 57147 (50) | 6559 (29) | 11123 (43) | 74829 (46) |
| | 150+ beds | 24985 (22) | 7701 (34) | 5807 (23) | 38493 (24) |

**Proportions (%) are presented in brackets**

**Table 3. Effect of province on home care transitions (ref=Ontario): Adjusted odds ratios[*] (95% CL) for transition from baseline CHESS[**] state in home care at $T_1$ to other CHESS state (if stayed in home care), hospital, death, long-term care or other setting[***] at 6-month follow-up ($T_2$)**

| | | Transitions at follow-up ($T_2$) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Remained in Home Care CHESS Score | | | Admitted to Hospital | Died | Admitted to Long-term Care | Other |
| | | 0 | 1-2 | 3+ | | | | |
| Alberta (ref=Ontario) | | | | | | | | |
| CHESS Score at baseline ($T_1$) | 0 | -- | 0.82 (0.75-0.90) | ns | 2.08 (1.92-2.24) | 1.80 (1.48-2.20) | 0.26 (0.18-0.36) | 0.67 (0.62-0.72) |
| | 1-2 | 1.85 (1.71-2.00) | -- | ns | 2.44 (2.30-2.59) | 2.11 (1.84-2.42) | 0.42 (0.35-0.49) | 1.14 (1.07-1.21) |
| | 3+ | 4.83 (3.82-6.12) | 1.80 (1.51-2.16) | -- | 3.77 (3.24-4.40) | 2.63 (2.09-3.32) | ns | 2.67 (2.26-3.16) |
| British Columbia (ref=Ontario) | | | | | | | | |
| CHESS Score at baseline ($T_1$) | 0 | -- | 1.44 (1.38-1.51) | 1.98 (1.80-2.18) | 1.46 (1.39-1.54) | 0.46 (0.37-0.56) | 0.55 (0.48-0.62) | 0.31 (0.30-0.33) |
| | 1-2 | 1.67 (1.60-1.73) | -- | 1.45 (1.39-1.52) | 1.39 (1.35-1.43) | 0.54 (0.49-0.60) | 0.76 (0.72-0.81) | 0.62 (0.60-0.64) |
| | 3+ | 3.13 (2.81-3.48 | 1.39 (1.30-1.48) | -- | 1.28 (1.21-1.35) | 0.39 (0.34-0.45) | 0.85 (0.78-0.93) | 1.53 (1.44-1.63) |

[*]Multi-state transition models adjusted for: home nursing visits, age, gender, marital status, ADL Hierarchy scale score, Cognitive Performance Scale score, diagnosis (binary variables for COPD, pneumonia, diabetes, arthritis, renal failure, UTI, ADRD, heart failure, cancer, depression), facility size, day of stay, functional improvement potential

[**]Changes in Health, End-stage disease, Signs and Symptoms (CHESS) scale is a measure of instability in health; higher scores indicate greater instability

[***]Other settings typically involved discontinuation of home care services (i.e., discharge from the program)

**Table 4. Effect of province on long-term care facility transitions (ref=Ontario): Adjusted odds ratios[*] for transition from baseline CHESS[**] state in long-term care at $T_1$ to other CHESS state (if remained in long-term care), hospital, death, other setting[***] or home at 90-day follow-up ($T_2$)**

| | | Transitions at follow-up ($T_2$) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Remained in Long-term Care CHESS Score | | | Admitted to Hospital | Died | Discharged Other Setting | Discharged Home |
| | | 0 | 1-2 | 3+ | | | | |
| Alberta (ref=Ontario) | | | | | | | | |
| CHESS Score at baseline ($T_1$) | 0 | -- | 1.43 (1.37-1.48) | 2.02 (1.83-2.23) | 0.38 (0.35-0.40) | 1.21 (1.09-1.36) | 2.31 (1.93-2.77) | ns |
| | 1-2 | 0.96 (0.92-0.99) | -- | 1.46 (1.38-1.54) | 0.39 (0.37-0.41) | 0.93 (0.87-0.98) | 1.46 (1.24-1.71) | ns |
| | 3+ | 0.76 (0.66-0.87) | 0.77 (0.71-0.85) | -- | 0.39 (0.34-0.43) | 0.52 (0.47-0.58) | ns | ns |
| British Columbia (ref=Ontario) | | | | | | | | |
| CHESS Score at baseline ($T_1$) | 0 | -- | 0.84 (0.77-0.93) | 0.84 (0.77-0.93) | 0.44 (0.42-0.46) | 1.39 (1.28-1.51) | 0.74 (0.62-0.90) | 0.50 (0.42-0.60) |
| | 1-2 | ns | -- | 1.15 (1.08-1.22) | 0.51 (0.48-0.53) | 1.35 (1.27-1.43) | ns | 0.55 (0.43-0.70) |
| | 3+ | 0.40 (0.34-0.48) | 0.55 (0.50-0.61) | -- | 0.33 (0.29-0.37) | 0.58 (0.52-0.65) | 0.51 (0.31-0.83) | 0.52 (0.27-0.99) |

[*]Multi-state transition models adjusted for: physician visits, age, gender, marital status, ADL Hierarchy scale score, Cognitive Performance Scale score, diagnosis (binary variables for COPD, pneumonia, diabetes, arthritis, renal failure, UTI, ADRD, heart failure, cancer, depression), facility size, Advanced directives (i.e., do not resuscitate, do not hospitalize), day of stay, functional improvement potential

[**]Changes in Health, End-stage disease, Signs and Symptoms (CHESS) scale is a measure of instability in health; higher scores indicate greater instability

[***]Other settings for transitions from nursing homes included discharges to other nursing homes, assisted living or retirement homes.

**Supplemental Table 1**: Effect of selected co-variates

| AGE | | | |
|---|---|---|---|
| **MORTALITY** | | | |
| | CHESS 0 | CHESS 1-2 | CHESS 3+ |
| **LTCF** | | | |
| 75≤Age<85 *versus* 65≤Age <75 | 1.441 (1.258,1.651), <.0001 | 1.247 (1.141,1.362), <.0001 | 1.177 (1.01,1.372), 0.0369 |
| 85≤Age<95 *versus* 65≤Age <75 | 2.306 (2.021,2.631), <.0001 | 1.608 (1.477,1.752), <.0001 | 1.413 (1.217,1.639), <.0001 |
| 95≤Age *versus* 65≤Age <75 | 4.023 (3.436,4.709), <.0001 | 2.111 (1.91,2.334), <.0001 | 1.589 (1.324,1.907), <.0001 |
| **Home care** | | | |
| 75≤Age<85 *versus* 65≤Age <75 | 0.97 (0.809,1.163), 0.7403 | 0.988 (0.904,1.08), 0.79 | 1.009 (0.915,1.114), 0.8535 |
| 85≤Age<95 *versus* 65≤Age <75 | 1.331 (1.107,1.601), 0.0024 | 1.233 (1.123,1.353), <.0001 | 1.264 (1.137,1.404), <.0001 |
| 95≤Age *versus* 65≤Age <75 | 2.813 (2.079,3.805), <.0001 | 2.357 (2.02,2.75), <.0001 | 1.632 (1.336,1.992), <.0001 |
| **HOSPITALIZATION** | | | |
| | CHESS 0 | CHESS 1-2 | CHESS 3+ |
| **LTCF** | | | |
| 75≤Age<85 *versus* 65≤Age <75 | 1.054 (1.015,1.095), 0.0062 | 0.955 (0.916,0.996), 0.0319 | 0.994 (0.857,1.153), 0.9388 |
| 85≤Age<95 *versus* 65≤Age <75 | 1.091 (1.05,1.133), <.0001 | 0.851 (0.817,0.888), <.0001 | 0.831 (0.718,0.961), 0.0125 |
| 95≤Age *versus* 65≤Age <75 | 1.046 (0.983,1.112), 0.1539 | 0.645 (0.608,0.685), <.0001 | 0.567 (0.466,0.69), <.0001 |
| **Home care** | | | |
| 75≤Age<85 *versus* 65≤Age <75 | 0.944 (0.889,1.003), 0.0605 | 0.927 (0.897,0.958), <.0001 | 0.952 (0.897,1.009), 0.097 |
| 85≤Age<95 *versus* 65≤Age <75 | 1.063 (0.999,1.132), 0.0556 | 0.985 (0.952,1.019), 0.3881 | 0.975 (0.915,1.038), 0.4212 |
| 95≤Age *versus* 65≤Age <75 | 1.537 (1.358,1.739), <.0001 | 1.17 (1.091,1.255), <.0001 | 0.984 (0.868,1.116), 0.8052 |
| **CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)** | | | |
| **MORTALITY** | | | |
| | CHESS 0 | CHESS 1-2 | CHESS 3+ |
| **LTCF** | | | |
| | 1.51 (1.383,1.647), <.0001 | 1.287 (1.224,1.353), <.0001 | 0.953 (0.871,1.044), 0.3021 |
| **Home care** | | | |
| | 1.539 (1.27,1.865), <.0001 | 1.187 (1.097,1.285), <.0001 | 0.997 (0.92,1.081), 0.9475 |
| **HOSPITALIZATION** | | | |

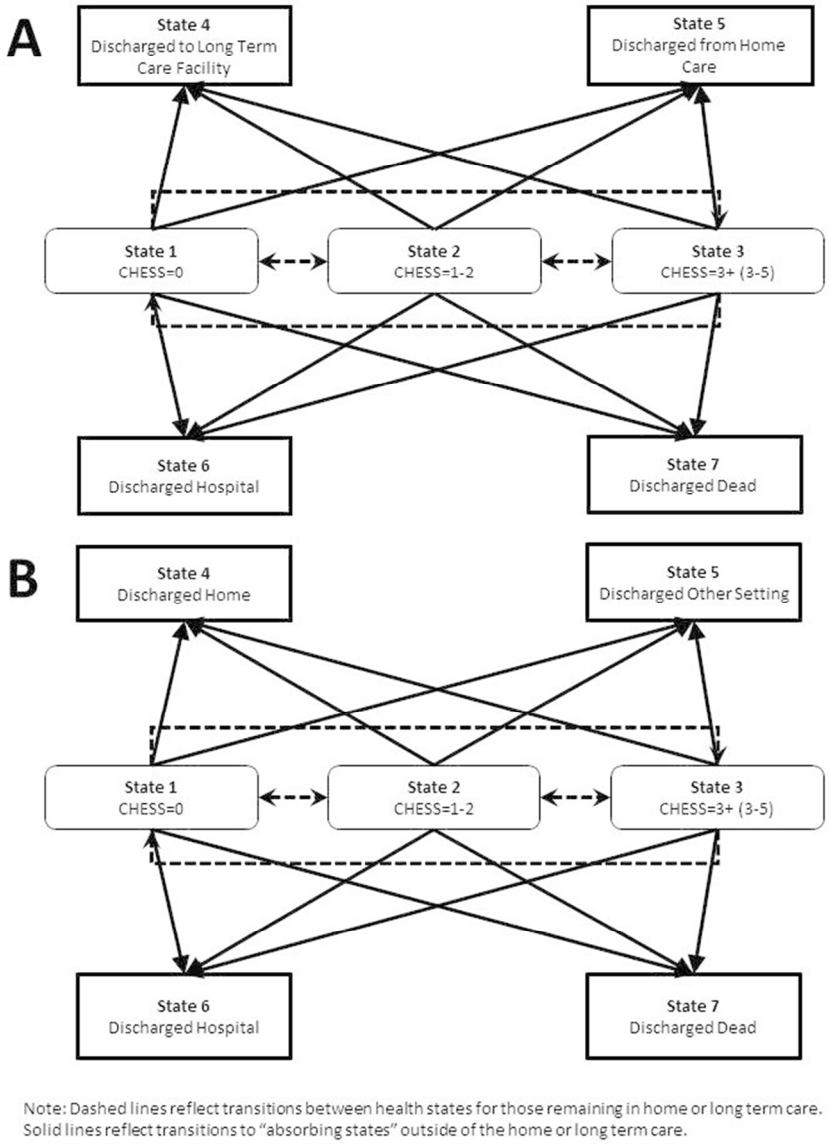
| | | | |
|---|---|---|---|
| **LTCF** | | | |
| | 1.41 (1.364,1.457), <.0001 | 1.24 (1.204,1.277), <.0001 | 1.057 (0.963,1.16), 0.2431 |
| **Home care** | | | |
| | 1.417 (1.323,1.517), <.0001 | 1.152 (1.119,1.187), <.0001 | 1.006 (0.961,1.053), 0.7966 |
| **PNEUMONIA** | | | |
| **MORTALITY** | | | |
| | CHESS 0 | CHESS 1-2 | CHESS 3+ |
| **LTCF** | | | |
| | 1.545 (1.195,1.997), 0.0009 | 1.814 (1.611,2.043), <.0001 | 2.019 (1.698,2.402), <.0001 |
| **Home care** | | | |
| | 1.539 (1.27,1.865), <.0001 | 1.244 (1.05,1.475), 0.0118 | 1.197 (1.026,1.397), 0.0225 |
| **HOSPITALIZATION** | | | |
| **LTCF** | | | |
| | 1.505 (1.343,1.685), <.0001 | 1.698 (1.567,1.84), <.0001 | 1.945 (1.624,2.33), <.0001 |
| **Home care** | | | |
| | 1.417 (1.323,1.517), <.0001 | 1.16 (1.081,1.244), <.0001 | 1.13 (1.027,1.243), 0.0126 |

**FIGURE LEGENDS**

**Figure 1. State-space diagram for possible transitions from home care (a) and long-term (b) care in multistate Markov model.**
At admission to home care (a) or long-term care (b), clients can be in State 1 (CHESS=0), State 2 (CHESS=1-2) or State 3 (CHESS=3+), with State 3 representing the greatest disease instability and State 1, the least disease instability. From this initial state, clients that remain in home care (a) or long-term care (b) can improve [for example, a transition from State 2 to State 1, or a transition from State 3 to State 1 or 2] or can worsen [for example, transition from State 1 to State 2 or 3, or transition from State 2 to State 3]. A client can also transition out of home care (a) from one of the three initial admission states (State 1, 2 and 3) to one of four possible discharge locations: long-term care facility (State 4), discharged from home care (no longer requiring services, State 5), hospital (State 6) or death (State 7). A resident (b) can transition out of long-term care from one of the three initial admission states (State 1, 2 and 3) to one of four possible discharge locations: home (State 4), other care settings (State 5), hospital (State 6) or death (State 7).

**Figure 2. Unadjusted rates of transitions from home care by CHESS score and by province.**
Percentage of home care clients who were admitted to long-term care, died (at home or in hospital), were admitted to hospital but did not die there within 6 months of intake assessment, by CHESS score at intake, in Ontario, Alberta and BC.

**Figure 3. Unadjusted rates of transitions from long-term care by CHESS score and by province.**
Percentage of residents who died (in long-term care facility or hospital) or were admitted to hospital but did not die there within 90 days of admission assessment, by CHESS score at admission, in Ontario, Alberta and BC.

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190x254mm (96 x 96 DPI)

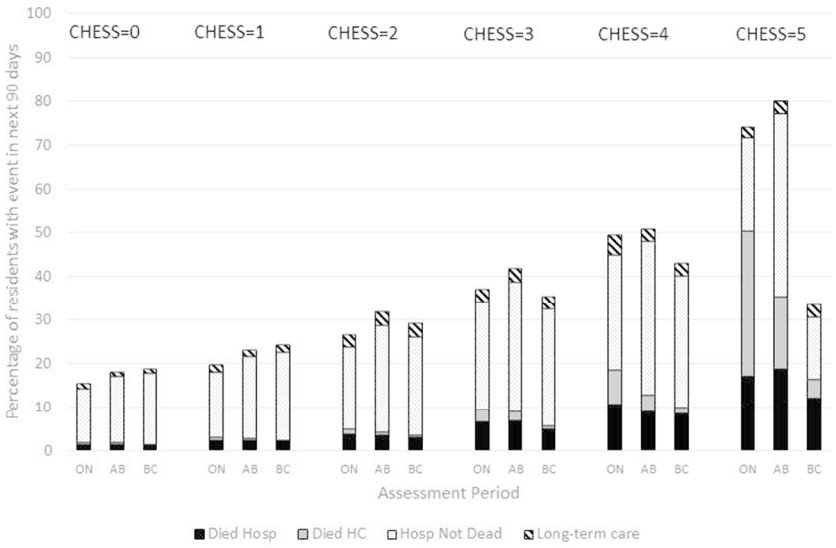
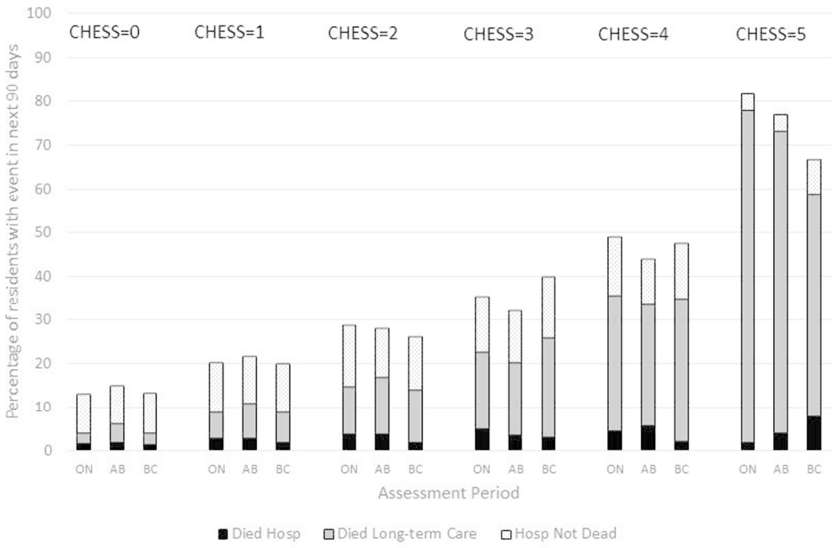



Figure 2. Unadjusted rates of transitions from home care by CHESS score and by province.
Percentage of home care clients who were admitted to long-term care, died (at home or in hospital), were admitted to hospital but did not die there within 6 months of intake assessment, by CHESS score at intake, in Ontario, Alberta and BC.

254x190mm (96 x 96 DPI)

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254x190mm (96 x 96 DPI)