High Hospitalization Rates among Older Residents in Assisted Living Facilities: Opportunities for Intervention and Impact on Acute Care

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All co-authors declare that they have no competing interests.

Abstract:

Background: Little is known about the health or service use outcomes for residents of Canadian assisted living (AL) facilities. Our objectives were to estimate the incidence of hospitalization over a year for residents of designated AL (DAL) facilities in Alberta, compare this to the rate found among long-term care (LTC) residents, and identify individual and facility predictors of hospitalization for DAL residents.

Methods: Participants were 1,066 DAL (mean age 84.9±7.3 years) and 976 LTC (85.4±7.6 years) residents from the Alberta Continuing Care Epidemiological Studies (ACCES). Research nurses completed inter*RAI* resident assessments and interviewed family caregivers at baseline and one year. Standardized administrator interviews provided facility level data. Hospitalization was determined via linkage with the Alberta Inpatient Discharge Abstract Database. Multivariable Cox proportional hazards models identified predictors of hospitalization.

Results: The cumulative annual incidence of hospitalization was 38.9% (35.9-41.9%) for DAL and 13.7% (11.5-15.8%) for LTC residents. A significantly increased risk for hospitalization was observed for DAL residents with greater health instability, fatigue, medication use (11+ medications), and 2+ hospitalizations in the preceding year. Residents from DAL facilities with a smaller number of spaces, no LPN and/or RN on site (or on site <24/7), no chain affiliation and from select health regions showed a significantly higher risk of hospitalization.

Interpretation: The incidence of hospitalization for DAL residents was approximately 3-times higher than that observed among LTC residents and risk for hospitalization was associated with a number of potentially modifiable factors. These findings raise questions about the complement of services and staffing required within AL and the potential impact on acute care of the shift from LTC to AL for the facility-based care of vulnerable seniors. (Word Count = 274)

Introduction

Assisted Living (AL) is a residential option increasingly used by older adults requiring supportive care [1,2]. AL facilities aim to provide secure housing, personal support and limited health care while promoting autonomy and privacy [3]. In response to the escalating costs of long term care (LTC) facilities (i.e., nursing homes) and seniors' preferences for home-like settings, several Canadian provinces have rapidly expanded publicly funded AL over recent years [1,4].

In jurisdictions such as Alberta, AL is considered an alternative to LTC for many older adults requiring supportive care [4]. However, AL differs from traditional nursing homes in a number of important ways. AL residents show a high prevalence of chronic illness, disability and frailty [5-7]. Relative to nursing homes, AL facilities are characterized by lower levels of staffing and professional service, raising questions about their ability to care for more vulnerable seniors [8-11]. Delayed detection of emerging health issues and diminished ability to provide augmented care could lead to poorer outcomes for AL residents and ultimately, higher acute care use [12,13]. When asked to compare AL with LTC, American physicians reported less confidence in the skills of AL staff, described fewer treatment options in this setting, and indicated they were more likely to transfer an AL resident with a medical problem to an emergency room [14].

Our current understanding of the place of AL in the continuum of supportive housing options for older Canadians is largely extrapolated from American studies [2,5-14]. The differing structure and function of our health care systems makes this problematic. An important outcome for AL facilities is the proportion of residents requiring an overnight stay in an acute care setting. While many of these admissions are necessary, some are potentially avoidable with appropriate and timely care and clinical oversight. Our study objectives were to estimate the incidence of hospitalization among designated AL (DAL) residents in Alberta over one year, compare this rate

to that observed among LTC residents from the same catchment areas and time period, and identify DAL resident and facility characteristics associated with an increased risk for hospitalization.

Methods

Study design

Data were derived from the Alberta Continuing Care Epidemiological Studies (ACCES), a longitudinal investigation of AL and LTC residents in the Province of Alberta, Canada [15,16]. The AL cohort included older residents of *designated* (publicly funded) AL and supportive housing (DAL) facilities in five former health regions (two major urban and three largely rural regions). At the time of the study, these regions accounted for over 80% of provincial continuing care beds. These facilities are now referred to as Supportive Living Level 3 or 4 [4].

Eligible DAL facilities had been in operation for 6+ months, did not primarily serve residents with mental illness or developmental disabilities and housed a minimum number of DAL residents 65+ years old (≥4 for small and ≥10 for large facilities). Fifty-nine of the 60 DAL facilities meeting these criteria agreed to participate. Residents in participating DAL sites were excluded if they were aged less than 65 years, recently admitted (<21 days), receiving palliative care (expected survival <6 months) and/or their participation was otherwise deemed inappropriate by staff or family. A total of 1,089 participants of the 1,510 eligible residents (72.1% response rate) were enrolled and assessed (339 [22.5%] refused and for 82 [5.4%] their legally designated surrogate could not be contacted). Age and sex were available for 364/421 (86.5%) of nonparticipants and showed a similar distribution (mean age 84.4±7.1, 74% women) to participants. The present analyses included 1,066 residents (3 residents with unknown outcomes and 20 who refused consent for administrative data linkage were excluded).

Given the large numbers of LTC spaces, a random sample of small and large facilities (based on median bed number) were selected in each region employing the same facility eligibility criteria. Fifty-four of the 59 facilities approached agreed to participate. A random sample of 1,731 eligible residents (same resident criteria) in the participating facilities was approached, and 1000 were enrolled and assessed (57.8% response rate). Age and sex were available for 665/731 (91%) of nonparticipants and showed a similar distribution (mean age 84.7±7.5, 67% women) to participants. Of enrolled LTC participants, 976 were included in our analyses (3 could not be linked with administrative data and 21 did not consent to data linkage). Further details regarding ACCES are published elsewhere [15-17].

Ethics approval was obtained from the University of Calgary Conjoint Health Research Ethics Board, the University of Alberta Health Research Ethics Board and the University of Lethbridge Human Subject Research Committee.

Resident Level Characteristics

At baseline (2006-08), trained research nurses administered the Resident Assessment Instrument for Assisted Living or LTC (inter*RAI-AL* or inter*RAI-LTCF*) among DAL and LTC residents, respectively. These validated instruments provide a comprehensive, standardized assessment of residents' sociodemographic characteristics, physical and cognitive status, health conditions, behavioural problems, and use of medications and services [18,19].

Resident characteristics examined included age, sex, marital status, length of stay, social engagement, cognitive and functional status, depressive symptoms, health stability, fatigue (defined as inability to complete normal daily activities in past 3 days), aggressive behaviours, number of chronic diseases and medications (including *hyperpolypharmacy* [20] defined as the use of 11+ medications), falls, previous hospitalizations (past year), bladder and/or bowel

incontinence, and presence of advanced directives. Inter*RAI* derived scales included the following: Cognitive Performance Scale (CPS) [21]; Activities of Daily Living (ADL) Self-Performance Hierarchy Scale [22]; Depression Rating Scale (DRS) [23]; Changes in Health, End-stage disease and Symptoms and Signs (CHESS) Scale (for health instability) [24]; and, Aggressive Behaviour Scale (ABS) [25]. Higher scores on all scales indicate more severe impairment. Co-morbidity was measured by the sum of recorded diagnoses on the inter*RAI* instruments. Social engagement was assessed by two measures calculated from items on the instruments: (i) strength of social relationships; and, (ii) average time involved in activities when awake and not receiving treatments or ADL assistance.

Facility Level Characteristics

Facility administrators, managers or directors of care (i.e., someone familiar with the facility with direct knowledge about the residents) were surveyed approximately midway during follow-up. Facility characteristics examined included: location (health region; community size), ownership (for-profit vs. not; whether part of a chain), year spaces opened, availability of other levels of care on site including LTC and acute care beds, type and size of facility (number of spaces and total facility spaces), and staffing levels and oversight (24 hour/7 day availability of licensed practical and/or registered nurses [LPNs/RNs] on site; physician involvement/affiliation with site).

Outcomes

The primary outcome was time to first acute care hospitalization within a year of baseline assessment. This was determined via linkage with the Alberta Inpatient Discharge Abstract Database. The date of admission, most responsible diagnosis (based on ICD-10-CA codes) [26], length of stay (LOS), and Alternate Level of Care (ALC) bed-days (i.e., occupying a hospital bed when not requiring the intensity of resources/services provided in this care setting) were examined. We assessed the first discharge event associated with an admission to acute care rather than total hospitalizations as the latter may include hospitalization occurring after a move from the original setting and may reflect characteristics of the new location. This approach captured nearly all residents hospitalized (97.4% of DAL and 98.6% of LTC residents) during follow-up. Detailed information on other transitions was obtained from facility discharge tracking forms (provided at the time of transfer or death), family caregiver discharge/decedent interviews (performed around the time of transfer or death), and family caregiver interviews at one-year follow-up (assessing all moves from baseline).

Analysis

Descriptive analyses examined the distribution of DAL resident and facility characteristics overall and by outcome status. Incidence of hospitalization was derived for DAL and LTC cohorts accounting for the occurrence of death as a competing risk using Cumulative Incidence Competing Risk (CICR) curves [27].

Multivariable Cox proportional hazards models [28,29], adjusted for clustering of residents within facilities, were used to examine the relative importance of resident and facility characteristics as predictors of time to first acute care hospitalization for the DAL cohort. Residents were classified into discrete outcome groups according to the date of their first event

(i.e., inpatient hospitalization, LTC admission or death without prior hospitalization, other transitions without prior hospitalization, no event and remained in DAL throughout the year). Residents were censored on the date of occurrence of LTC admission (DAL cohort), death, or discharge to some another setting. Those experiencing none of these events and remaining in DAL throughout the year were censored at their one-year follow-up assessment date.

Baseline resident and facility characteristics examined as potential predictors of hospitalization were selected based on previous literature [8,12,13,30-35]. Resident-level variables significant ($p<0.05$) in age-adjusted analyses were entered one at a time and retained if they remained significant predictors ($p<0.10$) in the full model. We then incorporated health region (fixed effect) and tested the significance of each of the facility-level variables entered separately. Because of relatively high correlations among facility characteristics, we examined separate models testing the effect of each facility variable adjusting for resident characteristics [13].

Analyses were conducted using SAS version 9.2 and R version 2.13-1.

Results

DAL residents were typically older widowed women (mean age 84.9±7.3 years, 71.4% widowed and 76.7% female). Mean number of diagnoses was 4.7±2.0 (range 0-14) with Alzheimer's disease and related dementias (57.1%), hypertension (56.7%), arthritis (53.7%), depression (34.6%) and osteoporosis (31.7%) the most common. Approximately one-tenth were reported to have a "Do Not Hospitalize" advance directive. The proportion hospitalized as their first event did not differ between those with (38.5%) and without (38.8%) this advance directive. Approximately two thirds of DAL residents (n=663) resided in a facility with an LPN and/or RN on site 24/7. Please see Tables 1 and 2 for additional baseline information.

Relative to DAL, LTC residents were more likely to be male and married (Supplementary Appendix 1). They had weaker social relationships, were less active, and had more health issues, cognitive and functional impairments, mood and behavioural challenges, and comorbidity. The two cohorts were similar in the proportion with moderate to high CHESS scores, recent falls, and high levels of medication use. LTC residents were significantly less likely (24.5%) than DAL (37.8%) residents to have been admitted to hospital during the year prior to baseline. Nearly one-third of LTC residents were reported to have a "Do Not Hospitalize" directive. Of this group, 26 (9%) were admitted to hospital as their first event compared to 111 (16.2%) without such a directive (p = 0.003). LTC facilities were more likely to have not-for-profit ownership, less likely to be part of a chain, were generally older with more beds, and universally had 24/7 LPN/RN coverage on site.

During the one-year follow-up, 413 (38.7%) DAL residents experienced an acute care hospitalization as their first event. The rate was 55.6 per 100 person-years. The cumulative incidence was 25.2% (95% CI 22.6-27.8) at 6 months and 38.9% (95% CI 35.9-41.9%) at 12 months (Figure 1A). The median LOS for hospitalizations was 12 days (IQR 5 to 33 days). Total bed days were 10388. Ninety-two (28.4%) had one or more ALC bed-days (total ALC bed-days = 1907; median ALC length of stay 11.5, range 1-96).

During the one-year follow-up, 137 LTC residents experienced an acute care hospitalization as their first event. The corresponding CICR estimate for the LTC cohort is presented in Figure 1B. The cumulative incidence of hospitalization was 8.0% (95% CI 6.3-9.7%) at 6 month and 13.7% (95% CI 11.5-15.8%) at 12 months (significantly lower than that observed for DAL residents, p<0.001). Median LOS was 6 days (IQR 3 to 11 days) and total bed days were 1146. One admission (0.7%) had any ALC bed-days (16 total ALC bed-days). Information on the common causes for hospitalization is given in Supplementary Appendix 2. The corresponding

CICR curves stratified by number of previous hospitalizations are presented in Supplementary Appendix 3.

In adjusted analyses, a significantly increased risk for hospitalization was observed for DAL residents with moderate to high health instability (CHESS score), moderate to severe fatigue, hyperpolypharmacy (i.e., use of 11+ medications), and 2+ hospitalizations during the preceding year (Table 3). Residents aged 90+ years and those with poor social relationships had a modestly increased risk. DAL residents from one health region showed a significantly higher risk of hospitalization. Community size was highly correlated with region and not retained in the models.

In models adjusted for resident characteristics and health region, a significantly higher likelihood of hospitalization was observed for residents from DAL facilities that were smaller (<30 DAL spaces or <55 total spaces), had no LPN and/or RN on site (or on site <24/7), and were not affiliated with a chain (Table 4).

Interpretation

This is the first Canadian study to examine the incidence of hospitalization for AL residents. Our cumulative incidence of hospitalization over one year (38.9%) was similar to two American studies. Zimmerman et al [13] reported a rate of 12.7% per 100-day quarter (46-51% per year) while Hedrick et al [36] found that 40.2% of their AL residents were hospitalized at least once over a year.

Admission to a nursing home can lead to a reduction in hospital use [37]. Whether this is also true for AL represents a key policy question in assessing the potential impact on other components of the health care system if AL displaces LTC as a housing option for vulnerable seniors. A striking finding was the lower rate of hospitalization concurrently seen among LTC

residents notwithstanding their generally worse baseline health (Supplementary Appendix 1). Relatively low rates of acute care utilization for Albertan LTC residents have been previously reported [38]. Possibly LTC residents, their families, and/or care providers elect not to seek transfer to acute care for changes in health status because of the severity of pre-existing health concerns. Advance planning may be discussed, implemented and adhered to in a more systematic manner within LTC facilities relative to DAL settings. A "Do Not Hospitalize" directive was more commonly found among LTC residents and even when present had no evident impact on the likelihood of hospitalization for DAL residents.

In fully adjusted models, residents with higher levels of health instability (CHESS score), fatigue, medication use, and previous hospitalizations (i.e., 2+ in the past year) exhibited a significantly higher risk for acute care hospitalization over one year. A high CHESS score has previously been shown to be predictive of hospitalization [39] while continuing care clients who have been high users of hospital care have a higher likelihood of future hospitalizations [40]. Fatigue may be functioning as a marker of frailty. All three characteristics could be used to define a target group for interventions designed to prevent further hospitalizations. While the dose-dependent relationship between medication use and hospitalization risk may reflect the relevance of drug number as a marker of multiple morbidity and/or severity of illness, many hospital admissions of older individuals are drug-related [41]. Optimizing medication use and administration in AL have been highlighted as areas requiring improvement [7,42-44].

Of the facility-level factors, size, staffing hours and mix are also potentially modifiable. Others have shown that a higher proportion of licensed nursing staff hours (whether RN or LPN) or more hours of RN staff time per resident might reduce hospitalization risk in residential care and AL [9,13]. The staffing model used in AL should be commensurate with the needs of residents. As Table 1 indicates, their health concerns are significant. Our study suggests that

greater access to skilled nursing care may be needed to both monitor for early manifestations of declining health and ensure the capacity to accommodate short-term illnesses on site.

Limitations

Strengths of our study include the large sample, diverse range of resident- and facility-level characteristics examined, and comprehensive prospective data collection. Some limitations warrant consideration. Approximately 28% and 42% of eligible DAL and LTC residents respectively were not enrolled. Although their demographic characteristics were similar to participants, this may limit the generalizability of our findings. Our study was restricted to residents of publicly subsidized AL spaces in Alberta as these settings are subject to provincial care standards and admission is through a single point of entry. While some caution is warranted in generalizing our results to private-pay institutions or to AL facilities in other provinces, it is important to note that AL facilities share common elements that differentiate them from LTC. Alberta has been a trendsetter in exploring the role of AL within Canada, and other provinces currently considering an expansion of AL settings for the care of vulnerable seniors can learn from its experiences. Finally, data collection took place between 2006 and 2009 and since then changes have taken place within the Alberta AL sector. Their possible effect on hospitalization rates is unknown.

Conclusion

Nearly forty percent of DAL residents in Alberta were hospitalized over one year, a rate substantially higher than that found among LTC residents. Hospitalization risk was associated with a number of characteristics that could be used for targeting (e.g., health instability, frequent prior hospitalizations, fatigue) and/or developing interventions (e.g., optimizing medication use, staffing). A shift towards AL from LTC for the supportive care of vulnerable seniors, as proposed in both Alberta [45] and Ontario [46], could lead to an increase in the demand for hospital beds.

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While our study does not indicate the "correct" rate, we believe a proportion of the hospital admissions for DAL residents were potentially preventable. Avoiding such admissions would protect DAL residents from the negative consequences associated with hospitalization and mitigate the attendant costs and inefficiencies arising from the inappropriate use of hospital beds.

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Figure 1. Cumulative incidence of hospitalization during 1 year follow-up, ACCES-DAL Cohort (n=1,066) [A] and ACCES-LTC Cohort (n=976) [B]
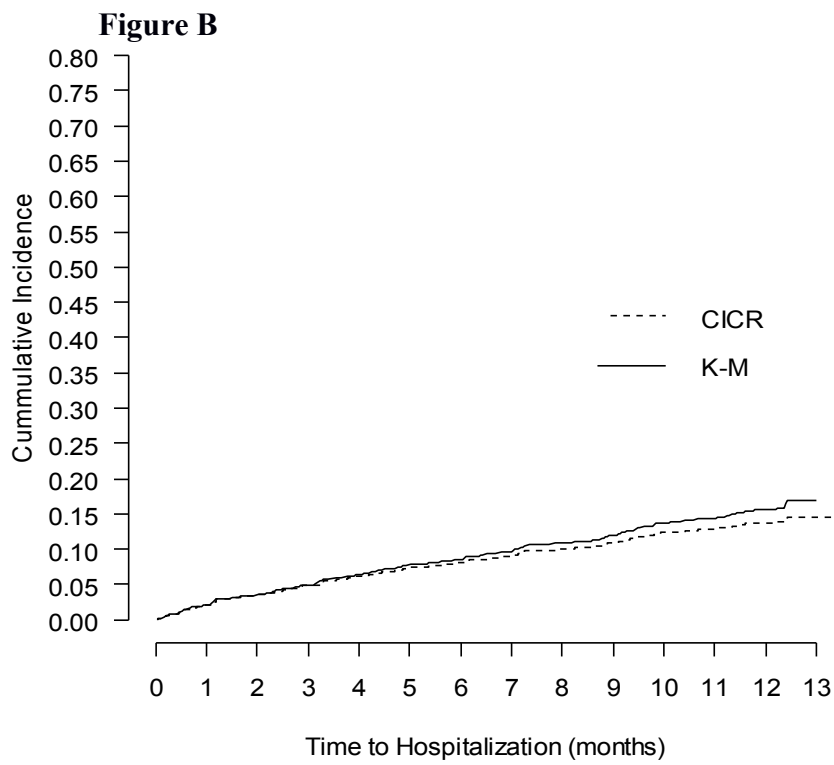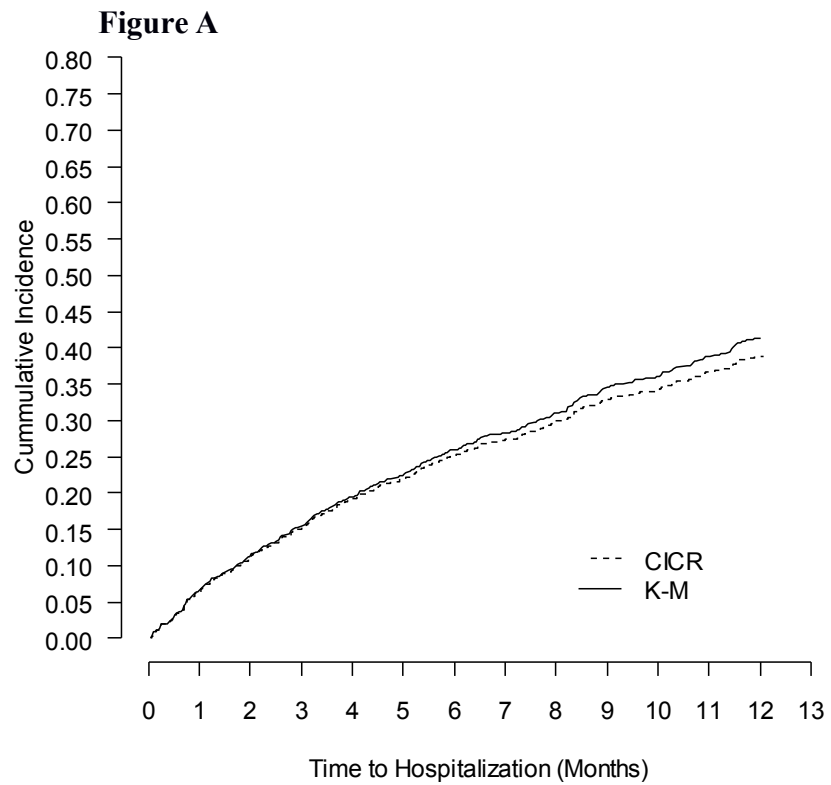
Figure A

Figure B

Table 1. Baseline sociodemographic, health and functional characteristics of residents by outcome event during 1 year follow-up, ACCES-DAL Cohort (n=1,066).

		Total Number[*] (% of total)	Outcome Number (% of row total)[†]			p-value
			Hosp	LTC/Death	Still in DAL	
Overall		1,066	413 (38.7)	115 (10.8)	534 (50.1)	
Age	mean ±SD	84.9±7.3	85.2±7.1	86.1±6.5	84.4±7.5	0.0451
	65-79	268 (25.1)	97 (36.6)	22 (8.3)	146 (55.1)	0.3925
	80-85	280 (26.3)	110 (39.4)	28 (10.0)	141 (50.5)	
	86-89	243 (22.8)	92 (37.9)	32 (13.2)	119 (49.0)	
	90+	275 (25.8)	114 (41.5)	33 (12.0)	128 (46.6)	
Sex	Female	818 (76.7)	312 (38.2)	86 (10.5)	418 (51.2)	0.5266
	Male	248 (23.3)	101 (41.2)	29 (11.8)	116 (47.2)	
Marital Status						0.7711
	Widowed	761 (71.4)	293 (38.7)	82 (10.8)	383 (50.5)	
	Married / Partner	156 (14.6)	63 (40.4)	20 (12.8)	73 (46.8)	
	Never married / separated / divorced	149 (14.0)	57 (38.5)	13 (8.8)	78 (52.7)	
Strength of Social Relationships[‡]						0.0026
	Moderate/High (3-5)	873 (81.9)	332 (38.2)	83 (9.5)	455 (52.3)	
	Low/None (0-2)	193 (18.1)	81 (42.2)	32 (16.7)	79 (41.2)	
Avg Time Involved in Activities[§]						0.0002
	Most (>2/3 time)	157 (14.7)	54 (34.8)	9 (5.8)	92 (59.4)	
	Some (1/3 to 2/3 time)	417 (39.1)	165 (39.6)	32 (7.7)	220 (52.8)	
	Little-None (<1/3 time)	492 (46.2)	194 (39.6)	74 (15.1)	222 (45.3)	
Cognition (CPS Score)						
	Intact (0)	223 (20.9)	98 (44.6)	8 (3.6)	114 (51.8)	< 0.0001
	Borderline Intact (1)	211 (19.8)	82 (38.9)	15 (7.1)	114 (54.0)	
	Mild Impairment (2)	336 (31.5)	131 (39.1)	31 (9.3)	173 (51.6)	
	Mod-Severe-Very Severe Impairment (3+)	296 (27.8)	102 (34.5)	61 (20.6)	133 (44.9)	
Activities of Daily Living (ADL score)						
	Independent (0)	454 (42.6)	179 (39.6)	13 (2.9)	260 (57.5)	< 0.0001
	Supervision Required (1)	186 (17.5)	62 (33.5)	26 (14.1)	97 (52.4)	
	Limited Impairment (2)	126 (11.8)	42 (33.3)	21 (16.7)	63 (50.0)	
	Extensive Assistance Req'd/Dependent (3+)	300 (28.1)	130 (43.5)	55 (18.4)	114 (38.1)	
Health Instability (CHESS score)[¶]						
	Stable (0)	496 (46.5)	165 (33.5)	40 (8.1)	288 (58.4)	< 0.0001
	Mild (1)	312 (29.3)	137 (43.9)	31 (9.9)	144 (46.2)	
	Mild-Moderate (2)	184 (17.3)	74 (40.2)	24 (13.0)	86 (46.7)	
	Moderate-High (3+)	74 (6.9)	37 (50.7)	20 (27.4)	16 (21.9)	
Fatigue, <3 days						<0.0001
	None	433 (40.6)	147 (34.2)	37 (8.6)	246 (57.2)	
	Minimal	461 (43.3)	181 (39.4)	46 (10.0)	233 (50.7)	
	Moderate-Severe	172 (16.1)	85 (49.4)	32 (18.6)	55 (32.0)	

Primary Mode Locomotion					
Walks independently	227 (21.3)	71 (31.4)	16 (7.1)	139 (61.5)	< 0.0003
Walks with Assistive Device	625 (58.6)	249 (40.0)	66 (10.6)	308 (49.4)	
Wheelchair/Scooter[**]	214 (20.0)	93 (43.7)	33 (15.5)	87 (40.9)	
Falls CAP					
1+ Falls / 90 days	305 (28.6)	129 (42.4)	39 (12.8)	136 (44.7)	0.0622
None	761 (71.4)	284 (37.5)	76 (10.0)	398 (52.5)	
Depressive Symptoms (DRS Score)					
Yes (3+)	203 (19.0)	75 (37.1)	35 (17.3)	92 (45.5)	0.004
No (<3)	863 (81.0)	338 (39.3)	80 (9.3)	442 (51.4)	
Aggressive Behaviour (ABS Score)[††]					
None (0)	760 (71.3)	305 (40.2)	69 (9.1)	384 (50.7)	0.0649
Moderate (1-2)	174 (16.3)	65 (37.8)	23 (13.4)	84 (48.8)	
Severe (3-5)	102 (9.6)	33 (32.4)	16 (15.7)	53 (52.0)	
Very Severe (6+)	30 (2.8)	10 (33.3)	7 (23.3)	13 (43.3)	
# Chronic Conditions					
mean ±SD	4.7±2.0	4.8±2.0	4.9±2.1	4.4±1.9	0.0026
0-3	323 (30.3)	107 (33.2)	30 (9.3)	185 (57.5)	0.0195
4-5	398 (37.3)	155 (39.0)	45 (11.3)	197 (49.6)	
6+	345 (32.4)	151 (44.0)	40 (11.7)	152 (44.3)	
# Medications					
mean ±SD	8.3 ±3.7	9.1±3.8	8.5±3.6	7.7±3.5	<0.0001
0-6	349 (32.7)	106 (30.5)	36 (10.3)	206 (59.2)	0.0002
7-8	232 (21.8)	88 (37.9)	31 (13.4)	113 (48.7)	
9-10	214 (20.1)	87 (41.0)	20 (9.4)	105 (49.5)	
11+	271 (25.4)	132 (48.9)	28 (10.4)	110 (40.7)	
Adv Directive – Do Not Hospitalize					0.9812
Yes	109 (10.2)	42 (39.3)	11 (10.3)	54 (50.5)	
No	957 (89.8)	371 (38.9)	104 (10.9)	480 (50.3)	
Previous Inpatient Hospitalizations (past year)					<0.0001
0	663 (62.2)	228 (34.5)	75 (11.4)	358 (54.2)	
1	254 (23.8)	100 (39.7)	23 (9.1)	129 (51.2)	
2+	149 (14.0)	85 (57.1)	17 (11.4)	47 (31.5)	
Bladder Incontinence					
Continent	436 (40.9)	168 (38.7)	27 (6.2)	239 (55.1)	<0.0001
Some control, infrequent episodes	156 (14.6)	64 (41.0)	12 (7.7)	80 (51.3)	
Occasional incontinence	114 (10.7)	48 (42.1)	11 (9.7)	55 (48.3)	
Frequent episodes, no control	360 (33.8)	133 (37.2)	65 (18.2)	160 (44.7)	
Bowel Incontinence					
Continent	766 (71.9)	290 (38.0)	66 (8.7)	407 (53.3)	< 0.0001
Some control, infrequent episodes	165 (15.5)	74 (45.1)	16 (9.8)	74 (45.1)	
Occasional incontinence	83 (7.8)	28 (33.7)	20 (24.1)	35 (42.2)	
Frequent episodes, no control	52 (4.9)	21 (40.4)	13 (25.0)	18 (34.6)	

Abbreviations: ACCES=Alberta Continuing Care Epidemiological Studies; DAL=designated assisted living; SD=standard deviation.

[*] Sample excludes 3 residents with unknown outcome who discontinued study and 20 who refused consent for administrative data linkage.

[†] 4 (0.4%) residents with other outcomes (censored at date of first discharge from DAL) omitted from comparisons.

[‡] Social relationships based on summary score of items assessing whether resident is close to someone in the facility, has a strong/supportive relationship with family, participates in social activities of longstanding interest and visits/has other interactions with longstanding social relation/family member (in past week).

[§] Activity involvement reflects when awake and not receiving treatments or ADL care.

[¶] 2 items (insufficient fluid, noticeable decline in food/fluid) used to calculate CHESS are not included on interRAI-AL tool.

[**] Includes 1 resident who was bedbound.

[††] ABS is a summary scale of 4 behaviours (verbal abuse, physical abuse, socially inappropriate or disruptive, resists care) with higher scores indicating a greater number and frequency of behavioural issues.

Table 2. Baseline system/facility characteristics of residents by outcome event during 1 year follow-up, ACCES-DAL Cohort (n=1,066).

		Total Number[*] (% of total)	Outcome Number (% of row total)[†]			p-value
			Hosp	LTC/Death	Still in DAL	
Overall		1,066	413 (38.7)	115 (10.8)	534 (50.1)	
Region	1 (urban)	311 (29.2)	111 (35.8)	30 (9.7)	169 (54.5)	< 0.0171
	2 (mixed urban/rural)	228 (21.4)	82 (36.1)	31 (13.7)	114 (50.2)	
	3 (rural)	153 (14.4)	78 (51.0)	12 (7.8)	63 (41.2)	
	4 (urban)	268 (25.1)	96 (36.0)	27 (10.1)	144 (53.9)	
	5 (rural)	106 (9.9)	46 (43.8)	15 (14.3)	44 (41.9)	
Ownership						0.0809
	For-profit	420 (39.4)	148 (35.4)	42 (10.1)	228 (54.6)	
	Not-for-profit/RHA	646 (60.6)	265 (41.2)	73 (11.3)	306 (47.5)	
Part of Chain						0.0005
	No / RHA operated	157 (14.7)	76 (48.7)	12 (7.7)	68 (43.6)	
	Yes – AL Chain	334 (31.3)	131 (39.3)	22 (6.6)	180 (54.1)	
	Yes – AL/LTC Chain	575 (53.9)	206 (36.0)	81 (14.1)	286 (49.9)	
Year DAL Spaces Opened						0.6471
	<2002	273 (25.6)	114 (42.1)	24 (8.9)	133 (49.1)	
	2002-03	362 (34.0)	135 (37.4)	43 (11.9)	183 (50.7)	
	2004+	431 (40.4)	164 (38.1)	48 (11.2)	218 (50.7)	
#DAL Spaces						0.0018
	<20	109 (10.2)	59 (54.6)	11 (10.2)	38 (35.2)	
	20-29	172 (16.1)	77 (44.8)	22 (12.8)	73 (42.4)	
	30-39	293 (27.5)	106 (36.4)	29 (10.0)	156 (53.6)	
	40+	492 (46.2)	171 (34.8)	53 (10.8)	267 (54.4)	
#Total Spaces						0.1549
	<55	148 (13.9)	70 (47.3)	19 (12.8)	59 (39.9)	
	55-89	263 (24.7)	104 (39.7)	29 (11.1)	129 (49.2)	
	90-147	259 (24.3)	97 (37.6)	29 (11.2)	132 (51.2)	
	148+	396 (37.2)	142 (36.0)	38 (9.6)	214 (54.3)	
Levels of Care on Site[‡]						0.3414
	DAL only / DAL+ Equivalent/Lower	859 (80.6)	325 (38.0)	97 (11.3)	434 (50.7)	
	DAL + Higher Level	207 (19.4)	88 (42.7)	18 (8.7)	100 (48.5)	
LTC Beds On Site						0.5426
	No	865 (81.1)	330 (38.3)	97 (11.3)	435 (50.5)	
	Yes (LTC/LTC-dem)	201 (18.9)	83 (41.5)	18 (9.0)	99 (49.5)	
LPN/RN Coverage on Site						0.0022
	Neither on site	295 (27.7)	138 (46.9)	34 (11.6)	122 (41.5)	
	LPN &/or RN <24/7	108 (10.1)	47 (43.9)	9 (8.4)	51 (47.7)	
	LPN &/or RN 24/7	663 (62.2)	228 (34.5)	72 (10.9)	361 (54.6)	
Physician (GP) Affiliated with Site						0.0656
	No	687 (64.5)	266 (38.8)	87 (12.7)	332 (48.5)	

Yes, office on site	169 (15.9)	63 (37.5)	10 (6.0)	95 (56.6)	
Yes, no office on site	210 (19.7)	84 (40.2)	18 (8.6)	107 (51.2)	
Community Size					0.0074
<10,000	222 (20.8)	104 (47.1)	18 (8.1)	99 (44.8)	
10,000-99,999	292 (27.4)	116 (39.9)	40 (13.8)	135 (46.4)	
1 million+	552 (51.8)	193 (35.1)	57 (10.4)	300 (54.6)	

Abbreviations: ACCES=Alberta Continuing Care Epidemiological Studies; DAL=designated assisted living; SD=standard deviation.

* Sample excludes 3 residents with unknown outcome who discontinued study and 20 who refused consent for administrative data linkage.

† 4 (0.4%) residents with other outcomes (censored at date of first discharge from DAL) omitted from comparisons.

‡ Equivalent level of care (private AL, residential, respite [not in LTC], community support and transition beds); Lower level of care (independent living, lodge, condo); Higher level of care (LTC [including respite], acute care).

Table 3. Adjusted hazard ratios[*] (95% CIs) for hospitalization during 1 year follow-up, ACCES-DAL Cohort (n=1066).

		HR (95% CIs)		
		Age-Adjusted	Fully Adjusted – 1[†]	Fully Adjusted – 2[‡]
Age	65-79, ref gp			
	80-85		1.16 (0.86-1.56)	1.15 (0.85-1.56)
	86-89		1.08 (0.77-1.52)	1.07 (0.76-1.51)
	90+		1.26 (0.97-1.64)[§]	1.26 (0.97-1.65)[§]
Female		0.87 (0.67-1.12)	0.89 (0.68-1.16)	0.90 (0.69-1.18)
Strength of Social Relationships				
	Moderate/High, ref gp			
	Low/None	1.21 (0.97-1.50)[§]	1.22 (0.98-1.52)[§]	1.23 (0.99-1.53)[§]
Avg Time Involved in Activities				
	Most (>2/3 time), ref gp			
	Some (1/3 to 2/3 time)	1.20 (0.92-1.55)	-	-
	Little-None (<1/3 time)	**1.28 (1.00-1.64)**	-	-
Activities of Daily Living (ADL score)				
	Independent (0), ref gp			
	Supervision Required (1)	0.85 (0.62-1.17)	-	-
	Limited Impairment (2)	0.93 (0.61-1.42)	-	-
	Extensive Assistance Req'd/Dependent (3+)	**1.28 (1.06-1.56)**	-	-
Health Instability (CHESS score)				
	Stable (0), ref gp			
	Mild (1)	**1.44 (1.16-1.80)**	**1.26 (1.02-1.57)**	**1.28 (1.02-1.59)**
	Mild-Moderate (2)	**1.39 (1.03-1.88)**	1.16 (0.90-1.49)	1.18 (0.92-1.51)
	Moderate-High (3+)	**2.47 (1.64-3.73)**	**1.65 (1.06-2.56)**	**1.64 (1.06-2.56)**
Fatigue, <3 days				
	None (0), ref gp			
	Minimal (1)	**1.25 (1.01-1.56)**	1.05 (0.86-1.28)	1.08 (0.89-1.32)
	Moderate-Severe (2+)	**1.97 (1.49-2.61)**	**1.59 (1.20-2.11)**	**1.65 (1.25-2.18)**
Primary Mode Locomotion				
	Walks independently, ref gp			
	Walks with device	**1.40 (1.03-1.88)**	-	-
	Wheelchair / Scooter	**1.71 (1.20-2.42)**	-	-
Falls CAP				
	1+ Falls / 90 days	**1.25 (1.03-1.53)**	-	-
# Chronic Conditions				
	0-3, ref gp			
	4-5	**1.28 (1.00-1.64)**	1.16 (0.90-1.49)	-
	6+	**1.60 (1.25-2.05)**	1.23 (0.93-1.62)	-
# Medications				
	0-6, ref gp			
	7-8	**1.37 (1.04-1.81)**	1.29 (0.96-1.72)[§]	**1.34 (1.01-1.77)**
	9-10	**1.50 (1.15-1.97)**	1.29 (0.97-1.70)[§]	**1.36 (1.04-1.77)**
	11+	**2.04 (1.54-2.70)**	**1.70 (1.31-2.21)**	**1.81 (1.40-2.33)**

Previous Inpatient Hospitalizations <1 yr

0, ref gp			
1	**1.23 (1.00-1.49)**	1.09 (0.89-1.35)	1.10 (0.90-1.35)
2+	**2.22 (1.78-2.76)**	**1.86 (1.48-2.35)**	**1.88 (1.49-2.37)**

System / Facility Factors

Region	1 (urban), ref gp			
	2 (mixed urban/rural)	1.04 (0.83-1.30)	0.88 (0.70-1.10)	0.90 (0.72-1.12)
	3 (rural)	**1.67 (1.28-2.19)**	**1.55 (1.22-1.98)**	**1.56 (1.23-2.00)**
	4 (urban)	1.00 (0.73-1.38)	0.96 (0.72-1.27)	0.96 (0.73-1.27)
	5 (rural)	1.43 (0.93-2.22)	1.32 (0.84-2.09)	1.29 (0.80-2.09)

Community Size

<10,000, ref gp			
10,000 – 99,999	0.80 (0.62-1.04)§	-	-
1 million+	**0.65 (0.50-0.84)**	-	-

Abbreviations: ACCES=Alberta Continuing Care Epidemiological Studies; DAL=designated assisted living; CI=confidence interval.

* Derived from Cox proportional hazards regression models (first event analysis), also adjusted for clustering by facility; sample excludes 3 residents with unknown outcome who discontinued study and 20 who refused consent for administrative data linkage.

† Model 1 including # chronic conditions; ‡ Model 2 excluding # chronic conditions.

§ $p < .10$

Table 4. Adjusted hazard ratios[*] (95% CIs) for hospitalization during 1 year follow-up associated with selected facility factors, ACCES-DAL Cohort (n=1066).

	Adjusted HR (95% CI)
Model A[†]	
#DAL Spaces	
<20	**1.79 (1.33-2.42)**
20-29	**1.29 (1.03-1.61)**
30-39	1.00 (0.75-1.34)
40+, ref group	-
Model B[†]	
#Total Spaces	
<55	**1.49 (1.12-1.97)**
55-89	0.97 (0.76-1.24)
90-147	1.06 (0.83-1.36)
148+, ref group	-
Model C[†]	
LPN/RN Coverage on Site	
Neither on site	**1.42 (1.16-1.73)**
LPN &/or RN <24/7	**1.43 (1.15-1.77)**
LPN &/or RN 24/7, ref gp	-
Model D[†]	
Part of Chain	
No / RHA operated	**1.37 (1.06-1.76)**
Yes – AL Chain	1.12 (0.93-1.35)
Yes – AL/LTC Chain, ref gp	-

Abbreviations: ACCES=Alberta Continuing Care Epidemiological Studies; DAL=designated assisted living; CI=confidence interval.

* Derived from Cox proportional hazards regression models (first event analysis), also adjusted for clustering by facility; sample excludes 3 residents with unknown outcome who discontinued study and 20 who refused consent for administrative data linkage.

† Models A-D are adjusted for age, sex, strength of social relationships, health instability, fatigue, comorbidity, # medications, previous hospitalizations, and region.