ORIGINAL RESEARCH

Health Outcomes of Older Adults after a Hospitalization for a Hip Fracture

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ABSTRACT

Background

Hip fractures in older adults often lead to adverse health outcomes, which may be related to time to surgery and longer hospital stays. The experience of older adults with hip fractures in New Brunswick is not known.

Methods

This was a retrospective observational study. All hip fracture patients 65 years of age and older admitted to one hospital designated as a Level One Trauma Centre between April 1, 2015 and March 31, 2019 comprised the sample.

Results

The majority (86.5%) received surgery within 48 hours and those who had surgery beyond this time frame had a significantly longer stay in acute care (OR: 3.79, 95% CI: 2.05-7.15). The mean total length of stay (Total-LOS) for patients discharged after their acute care needs were met was 9.8 days (SD=8.1) compared to patients experiencing delays in discharge for nonmedical reasons which was 26.3 days (SD=33.7). An extended stay in acute care (OR: 1.93, 95% CI: 1.09-3.43) and increasing age (OR: 1.03, 95% CI: 1.001-1.06) were associated with a higher likelihood of death at one year post-discharge. Time to surgery beyond 24 hours (OR: 2.80, 95% CI: 1.13-7.38) was associated with a higher likelihood of death 30 days post-discharge.

Conclusions

Most patients had surgery within the national benchmark of less than 48 hours. The Total-LOS increased 2.5-fold in patients who remained in hospital after their acute care needs were met. A better understanding of patient characteristics, such as frailty, may better predict patients at risk for longer hospital stays and adverse health outcomes.

Key words: seniors, hospital stay, length of stay, mortality, alternate level of care, time to surgery

INTRODUCTION

Falls are a common cause of injury among Canadians 65 years and older. Between 2009 and 2014, approximately 56% of all traumatic injuries resulted from falls, with 42% occurring in the older adult population.(1) These events often result in a fractured hip and subsequent hospitalization,(2) and the personal, societal, and health-care costs associated with hip fractures will increase as our population ages.(3,4)

Current estimates suggest that mortality within one year of discharge occurs among 20 to 30% of patients experiencing a hip fracture, and many will develop complications(5,6) which often leads to loss of independence and the need for institutionalization at a long-term care facility.(7)

On average, patients experiencing a hip fracture require 15 days to recover in an acute care hospital, and typically need a longer hospital stay than other patients.(8) Some patients remain in hospital after their acute care course and become designated as being Alternate Level of Care (ALC).(9) When ALC days are added to the acute care length of stay (Acute-LOS), the total length of stay (Total-LOS) for people with hip fractures in an acute care bed may increase to approximately 22 days on average.(8) While an ALC designation allows hip fracture patients to stay in an acute care bed while waiting to return home or to a long-term care facility,(9) acute care hospital settings may not be equipped to offer the rehabilitation needed to restore patients to their previous level of function.(10)

The clinical and demographic characteristics commonly associated with adverse health outcomes and increased use of hospital resources among hip fracture patients have been previously reported. Dementia, cardiovascular disease, and diabetes are known risk factors for mortality after hospitalization

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for a hip fracture.[11–13] Demographic and surgical factors, such as being an older male,[14] post-surgical complications,[15] and receiving surgery beyond 48 hours,[16] are also associated with a higher probability of mortality. Taken together, these risk factors increase the likelihood that a hip fracture patient will require a longer hospitalization and a long-term care facility placement after discharge.[16,17]

Despite the understanding of hip fractures and their impact on health outcomes and health-care resources in Canada, little is known about the experience of those living in New Brunswick (NB). Since the second fastest growing population of older adults in Canada is in NB,[18] it is expected that the number of hip fractures in older adults and associated hospital resources required will increase. This study describes the clinical and demographic characteristics observed in this population at one acute care hospital designated as a Level 1 Trauma Center in NB. Factors related to adverse health outcomes such as prolonged length of stay (LOS) and mortality following hospital discharge at 30 days and one year were also explored.

METHODS

Study Sample

The Discharge Abstract Database (DAD) from the Canadian Institute for Health Information (CIHI)[19] was used to identify all adults 65 years and older admitted to hospital with isolated hip fractures between April 1, 2015 and March 31, 2019. The acute care hospital is situated in a city with a population of almost 70,000 residents,[20] and has 486 hospital beds which service approximately 170,000 residents including those from surrounding areas.[21,22]

All hip fractures, as defined by the Canadian modification of the International Classification of Disease and Related Health Problems classification system (ICD 10-CA),[23] were included. Individuals who fractured one of their hips at different times during the study period were counted as separate patients.

Data Collected

Demographic and clinical data were retrieved from the DAD and death up to one-year post-discharge was determined using data from NB Vital Statistics.[24] Information on prior residence and discharge location provided by the DAD were confirmed using the hospital's electronic health record accessed through the regional health authority.

Patient Description

Demographic data included age at the time of admission, sex, and co-morbidities.

Surgical experience was defined as whether patients had surgery or not, and time to surgery after admission. Time to surgery was categorized as: less than 24 hours, 24 to 48 hours, and greater than 48 hours. This is consistent with CIHI's indicator for time to surgery after hip fracture and other reported thresholds for surgery.[25,26]

Total-LOS was reported in days and included both the number of days admitted to hospital for acute care (Acute-LOS) and the number of days the patient remained in an acute care bed for an extended time when that level of care was no longer needed (ALC-LOS).[9] The ALC-LOS in this study does not include days spent on geriatric rehabilitative units or on designated ALC units.

Residence prior to admission was defined as where the patient was living before hospitalization and included private homes/apartments (inclusive of retirement homes), nursing homes, or other residences (e.g., adult residential care facilities[27,28] which provide 24-hour supervision for older adults who do not require nursing care). Patients were also classified as being either directly admitted to the hospital for treatment or transferred from another hospital.

Discharge location was the same as residence prior to admission, but also included a designated ALC hospital unit, an acute care hospital bed at a different facility, death or other.

Mortality was determined at three points: during the hospital stay; 30 days post-discharge from hospital; and one year post-discharge.

Statistical Analysis

Descriptive statistics were reported as frequencies and percentages, and measures of central tendency (e.g., means and standard deviations) were used to describe quantitative variables. Chi-square tests of independence and *t*-tests were used as appropriate to analyze pairs of descriptive variables such as age, biological sex, LOS, and in-hospital mortality.

Logistic regressions were performed to determine which variables were associated with an Acute-LOS greater than 10 days, 30-day mortality post-discharge, and one-year mortality post-discharge. Demographic and clinical covariates such as age, sex (female as the reference), time to surgery (receiving surgery within 24 hours as the reference), and a diagnosis of dementia were included in these models. Residence prior to admission (using home as the reference) was also included as a surrogate indicator of frailty and functional ability, since patients living in their private homes tend to be less frail than those residing at a nursing home. A covariate was created for patients who were discharged back to a nursing home or to another acute care facility because these patients were likely discharged earlier from hospital since they were able to receive some care at their discharge locations. This covariate was a binary variable, where 1 represented those discharged to a nursing home or an acute care facility and 0 represented all other patients. An Acute-LOS greater than 10 days was controlled for in the regression analyses looking at the risk of mortality. All analyses were conducted in RStudio version 4.2.1 (Posit Software [formerly RStudio PBC], Boston, MA), using a p value of less than 0.05 to determine statistical significance.

This study was reviewed and approved by the Research Ethics Boards at Horizon Health Network and the University of New Brunswick.

RESULTS

There were 765 admissions for hip fractures during the study period. Of these, 83 were excluded as they were either repeat admissions for the same fracture, resided outside of the province, or the fracture had occurred as an inpatient in that hospital. Twenty-three patients were admitted on separate occasions for different hip fractures and were included in the descriptive results because their age, co-morbidities, surgical experience, and discharge locations were potentially different during their second admission. For the descriptive statistics, 682 patients were included. When statistical analyses were completed the second admission for individuals with two hip fractures was removed, resulting in analyses of 659 patients.

Demographics

Almost half of the patients, 45.4% (n=310), were 85 years of age or older and 71.7% (n=489) were female, with 71.8% (n=490) having at least one pre-existing co-morbidity. The most common co-morbidities included dementia (33.5%, n=164), diabetes (33.3%, n=163), and osteoporosis (24.6%, n=121) (Table 1).

Surgical Experience

Most patients, 89.6% (n=611), underwent a surgical procedure for their hip fracture, with 47.9% (n=293) receiving surgery within 24 hours of admission. This increased to 86.5% (n=529) within 48 hours of admission (Table 1).

Length of Stay

The average Total-LOS for all patients (N=682) was 15 days (SD=21.6 days). The Total-LOS for patients without an ALC designation in an acute care bed (n=465) was 9.8 days (SD=8.1 days), whereas patients with an ALC designation in an acute care bed (n=217) had a Total-LOS of 26.3 days (SD=33.7 days). This represents a significant difference of 16.5 days between the Total-LOS of these two groups (t(680)=10.0, 95% CI=13.3, 19.8). Patients (n=103) that were living in nursing homes prior to admission reported a Total-LOS of 8.3 days (SD=20.6 days) (Figure 1).

Based on a logistic regression, being male (OR: 1.64, 95% CI: 1.03, 2.06); waiting 48 hours or more for surgery (compared to those receiving surgery within 24 hours) (OR: 3.79, 95% CI: 2.05, 7.15); and previously living in an adult residential care facility (compared to those living in a private residence) (OR: 3.69, 95% CI: 1.65, 8.77) were more likely to have an increased Acute-LOS. Interestingly, patients who were previously living in a nursing home (OR: 0.09, 95% CI: 0.03, 0.22) or who were inpatients in surrounding acute care hospitals (OR: 0.07, 95% CI: 0, 0.38) were significantly more likely to have a shorter Acute-LOS (Appendix A, Table 1A).

Residence Prior to Admission & Discharge Location

The majority, 71.3% (n=486), were living in a private residence in the community prior to admission. Most patients, 519 (76%), were directly admitted to the hospital, but 163 (24%) were transfers from surrounding hospitals (Figure 2).

Of the 486 patients who were living in their private residences prior to their fracture, 50.6% (n=246) were discharged back home, while 31.9% (n=155) were transferred to an inpatient bed in another hospital. Of the 121 patients who were living in a nursing home prior to their hip fracture, 85.1% (n=103) returned to the nursing home, seven were discharged to another acute care facility, seven died, and four were discharged to other locations (Figure 3).

Mortality

Overall, 7.2% (n=49) of patients died during their hospitalization. Patients were significantly more likely to die during their hospitalization if they were male (n=25, $\chi^2 = 11.8$, $p<.001$), or 85 years of age and older (n=31, $\chi^2 = 6.4$, $p=.01$) (Table 2).

There were an additional 36 deaths within 30 days of discharge. Being male (OR: 3.05, 95% CI: 1.15, 8.01), receiving surgery between 24 to 48 hours (OR: 2.8, 95% CI: 1.13, 7.38),

TABLE 1.
Demographic, clinical, and surgical characteristics of patients with hip fracture (N=682)

Age (years)	*n (% of 682)*[a]
Mean [SD]	*82.8 [8.4]*
65-69	58 (8.5%)
70-74	80 (11.7%)
75-79	97 (14.2%)
80-84	137 (20.1%)
85-89	148 (21.7%)
90-94	112 (16.4%)
95+	50 (7.3%)
Biological sex	
Female	489 (71.7%)
Male	193 (28.3%)
Pre-admission co-morbidities[b]	
0	192 (28.2%)
1	200 (29.3%)
2	134 (19.6%)
3+	156 (22.8%)
Most Common pre-admission co-morbidities	n (% of 490)
Dementia	164 (33.5%)
Diabetes	163 (33.3%)
Osteoporosis	121 (24.6%)
Infections[c]	70 (14.3%)
Cardiovascular	62 (12.7%)
Surgical intervention	n (% of 682)
No	71 (10.4%)
Yes	611 (89.6%)
Time to surgery	n (% of 611)
<24 hours	293 (47.9%)
24-48 hours	236 (38.6%)
≥48 hours	82 (13.4%)

[a] Percentages do not sum to 100% due to rounding.
[b]Reported by the Discharge Abstract Database.
[c]The most reported infections were *Escherichia coli*, drug-resistant *Staphylococcus aureus*, *Enterococcus* spp., and urinary tract infections.

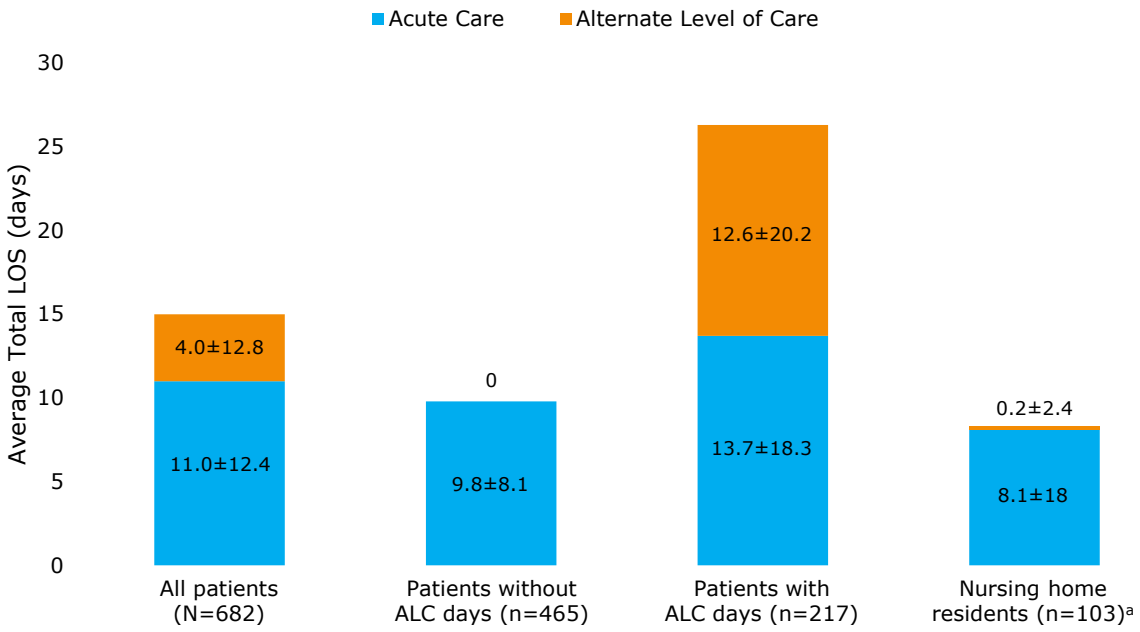

FIGURE 1. Length of stay in an acute care bed or as alternate level of care (values are means and SDs)
[a]The sample size for nursing home residents in this figure only includes patients that came from and returned to their nursing home after discharge.

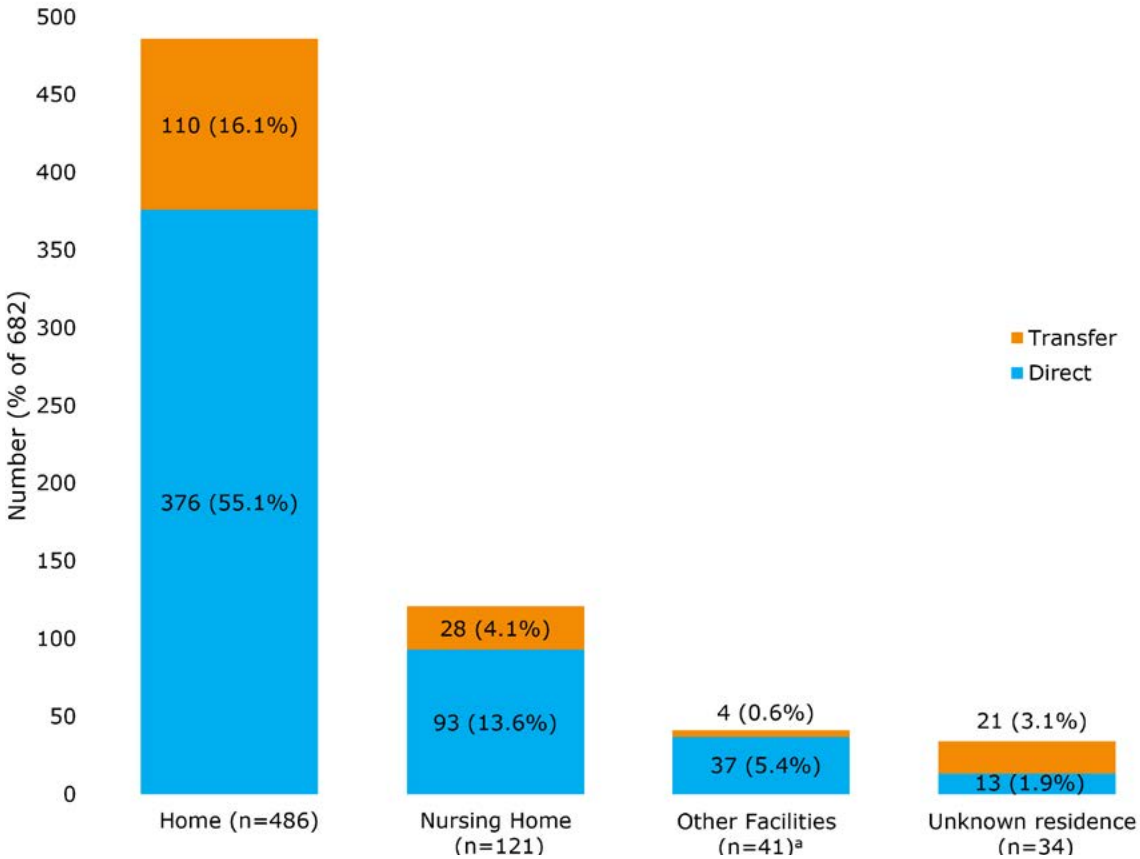

FIGURE 2. Residence of patient in the community prior to admission (N=682)
[a]Other facilities include assisted living and adult residential care facilities; Adult Residential Care Facilities, otherwise known as Special Care Homes in New Brunswick, offer 24 hours of assistance for older adults each day without supervision from registered nurses.[28-29]

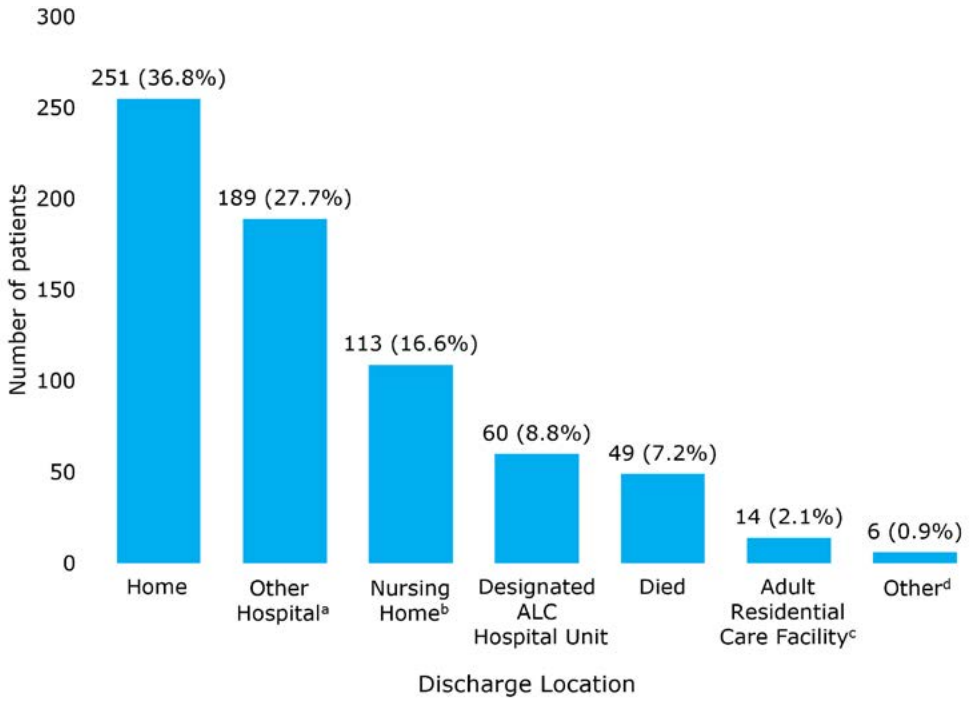

FIGURE 3. Discharge location of patients admitted with a hip fracture (N=682)
[a]Patients who were discharged to another hospital were discharged to an emergency department or an acute care bed in a different facility.
[b]Some patients (n=10) were newly admitted to nursing homes.
[c]Adult Residential Care Facilities, otherwise known as Special Care Homes in NB, offer 24 hours of assistance for older adults each day without supervision from registered nurses.[28,29]
[d]Other discharge dispositions included leaving against medical advice and palliative care.
ALC = alternate level of care.

and residing in a nursing home prior to hospitalization (OR: 3.82, 95% CI: 1.34, 12.02) were significantly associated with a higher likelihood of mortality within 30 days of discharge.

One year following discharge, 75.4% of patients were living and 24.6% had died (n=168). Of those who died within the year following discharge from hospital, those aged 85 and older were more likely to die than those younger than the age of 85 (21.3% versus 14.2%, $\chi^2 = 5.0$, $p<.05$) (Table 2).

By logistic regression, patients with an Acute-LOS greater than 10 days (OR: 1.93, 95% CI: 1.09, 3.43), increasing age (OR: 1.03, 95% CI: 1.001, 1.06), and those living in a nursing home (OR: 2.25, 95% CI: 1.2, 4.27), another hospital (OR: 5.96, 95% CI: 2.13, 16.45) or an adult residential care facility (OR: 2.85, 95% CI: 1.18, 6.63) had a higher risk of mortality at one-year post-discharge (Appendix A).

DISCUSSION

Our study population was similar to the results of others with the majority being female and almost half are 85 years of age or older.[29,30] The number and types of co-morbidities can differ between studies. For the entire sample, we note that 24.0% and 23.9% of our overall sample (N=682) had dementia and diabetes, respectively, which are slightly lower percentages than those reported in a study on 100,059 patients in Ontario (28% and 27%).[30] Only 24.6% of our sample had reported osteoporosis, which is lower than reported by similar age groups by Health Canada.[32]

The majority of our sample (86.5%) had surgery within 48 hours of being admitted to hospital, which is consistent with other Canadian provinces.[29,33] However, fewer patients had surgery within 24 hours compared to reports by Sheehan *et al*. (47.9% versus 63.8%).[29] It is unclear why this was the case; however underlying medical illnesses requiring a delay or the limited availability of surgical teams and operating rooms are possible contributors to this difference.[34,35]

The mean Total-LOS in this study was 15 days for all patients, which is slightly longer than the 12.5 days reported among nearly 65,000 hip fracture patients in Ontario.[36] A 2.5-day difference can be important from a hospital bed utilization perspective. While only 31.8% of the sample had an extended stay in hospital designated as ALC, the Total-LOS of these patients was approximately 2.5 times longer than those without an ALC-LOS (26.3 versus 9.8 days). This represents a significant number of acute bed days utilized for ALC days in this population. Our study looked at the Total-LOS inclusive of the Acute-LOS and the ALC-LOS, which may differ from the work of others. However, Total-LOS, inclusive of the ALC-LOS, may be a better indicator of the true demand on acute care beds in Canada by hip fracture patients.

TABLE 2.
Mortality post hip fracture (N=682)

	Deaths During Hospital Admission	*Deaths Within 30-Days Post-Discharge*	*Deaths Within One-Year Post-Discharge*	*Deaths During Admission and One-Year Post-Discharge*	*Alive Within One-Year Post-Discharge*
	Number (row %)	*Number (row %)*	*Number (row %)*	*Number (row %)*	*Number (row %)*
Age (N=682)					
All ages (≥65)	49 (7.2%)	36 (5.3%)	119 (17.4%)	168 (24.6%)	514 (75.4%)
< 85 years (n=372)	18 (4.8%)	14 (2.1%)	53 (14.2%)	71 (19.1%)	301 (80.9%)
≥ 85 years (n=310)	31 (10.0%)	22 (3.2%)	66 (21.3%)	97 (31.3%)	213 (68.7%)
Sex (N=682)					
Male (n=193)	25 (13.0%)	12 (6.2%)	38 (19.7%)	63 (32.6%)	130 (67.4%)
Female (n=489)	24 (4.9%)	24 (4.9%)	81 (16.6%)	105 (21.5%)	384 (78.5%)
Most Common Pre-existing Co-morbidities[a]					
Dementia (n=164)	13 (7.9%)	13 (7.9%)	42 (25.6%)	55 (33.5%)	109 (66.5%)
Diabetes (n=163)	17 (10.4%)	14 (8.5%)	35 (21.5%)	52 (31.9%)	111 (68.1%)
Osteoporosis (n=121)	9 (7.4%)	5 (4.1%)	20 (16.5%)	29 (24.0%)	92 (76.0%)
Infections (n=70)[b]	5 (7.1%)	5 (7.1%)	20 (28.6%)	25 (35.7%)	45 (64.3%)
Cardiovascular (n=62)	14 (22.6%)	3 (4.8%)	14 (22.6%)	28 (45.2%)	34 (54.8%)

[a] More than one co-morbidity may be present in a patient, while some may exist but remain unreported by the DAD.
[b] The most reported infections were Escherichia coli, drug-resistant Staphylococcus aureus, Enterococcus spp., and urinary tract infections

Those who were living in a nursing home prior to their fracture had a similar Acute-LOS to those who did not have an ALC designation, suggesting that even though nursing home patients with hip fractures are likely frailer with more co-morbidities, their Acute-LOS in hospital is shorter than those admitted from home. Although not confirmed in this study, it is likely that these nursing home patients were discharged quickly after their acute care needs were met and were able to continue their recovery in the nursing home, thus explaining their shorter Acute-LOS.[37]

Our findings align with CIHI's recommendation that hip fracture patients benefit from receiving surgery within 48 hours. In our study, the likelihood of having a longer Acute-LOS was almost four times higher for patients who had surgery after 48 hours compared to patients receiving surgery within 24 hours. However, the delay in surgery is likely not the cause for the longer Acute-LOS as there are many factors related to both the need to delay surgery and longer recovery times.

We report 50.6% of our patients returning to a private residence after hospitalization, which is higher than reported elsewhere at 30%.[34] This percentage could be higher than we reported, as 31.9% of our sample were discharged to another acute care hospital and potentially returned home after their second discharge. It is unclear why a higher percentage of patients in this study were discharged home, but there are multiple factors that could influence this such as differences in functional ability prior to admission, comorbidities, or the availability of rehabilitation beds in the community.

The percentage of patients who died in-hospital (7.2%) and at 30-days post-discharge (5.3%) are within the ranges reported elsewhere;[30,38] however, fewer patients died at one-year post-discharge (17.4%) compared to a sample in Manitoba (24.9%).[39] The difference in sample sizes between these studies (n=682 versus n=6,542) may explain this finding, since smaller samples tend to exhibit more variability than larger samples.

Being male was associated with an increased risk of dying during hospitalization and within 30 days of discharge. Interestingly, increased age was associated with a higher likelihood of dying during hospitalization and one year, but not within 30 days. Previously living in a nursing home was significantly associated with higher odds of thirty-day mortality, suggesting that nursing home residents are likely frailer at the time of fracture compared to those living in private residences. Having surgery between 24 and 48 hours, compared to within 24 hours, was also associated with a higher risk of mortality within 30 days, which concurs with other studies and suggests that earlier surgery may result in better outcomes.[40]

Several limitations are present in this study. These data are a comprehensive investigation of isolated hip fractures at one Level 1 Trauma tertiary care hospital in New Brunswick and may not be generalizable to other cities, provinces or countries due to the differences in the health care resource variabilities between sites.

The study design did not allow for data collection for patients discharged to ALC units or other acute care hospitals, thus the true number of days a patient stayed in any hospital bed is not known. The time to surgery was determined only from the time of admission at the treating hospital until the time of the surgery. For the 24% of the patients transferred to this hospital, their wait for surgery was possibly longer due to waiting in an outlying hospital or the emergency department.

CONCLUSION & IMPLICATIONS

This sample of hip fracture patients is similar demographically to other Canadian reports, and the majority received surgery within CIHI's benchmark of 48 hours. Surgery within 24 hours not only resulted in a shorter Acute-LOS, but also a lower risk of mortality at 30-days. The results for time to surgery indicate that early surgery has major impacts on the individual's recovery and health-care utilization. A shorter Acute-LOS (≤10 days) was also associated with a lower risk of mortality at one year. When the Total-LOS was broken down into the Acute-LOS and the number of days patients who remained in hospital after their acute care needs were met (ALC-LOS), the total number of days in hospital increased almost 2.5-fold. This represents a significant number of acute care bed days utilized by patients who no longer needed acute care.

Only half of the patients who were living at home prior to their fracture returned home. Having a better understanding as to why patients could not return home may allow for improvements in early identification, targeted interventions, and discharge planning, which may be done by stratifying this population through a frailty lens.

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Not applicable.

CONFLICT OF INTEREST DISCLOSURES

We have read and understood the *Canadian Geriatrics Journal*'s policy on conflicts of interest disclosure and declare that we have none.

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APPENDIX A

TABLE 1A.
Regression results showing the effect of demographic and clinical characteristics on length of stay in acute care, mortality at 30 days and mortality one year post-discharge

Models[a] and Predictors	*Odds Ratio*	*95% CI*
Model 1: Acute Care Length Of Stay (> 10 days)		
Age (in years)	1.02	0.99, 1.05
Male biological sex (versus female)	1.64[b]	1.03, 2.60
Time to surgery within 24 to 48 hours (versus <24 hours)	1.42	0.92, 2.18
Time to surgery ≥ 48 hours (versus <24 hours)	3.79[b]	2.05, 7.15
Diagnosed with dementia	0.92	0.53, 1.59
Previously residing in nursing home	0.09[b]	0.03, 0.22
Previously residing in a hospital	0.07[b]	0.00, 0.38
Previously residing in an adult residential care facility	3.69[b]	1.65, 8.77
Model 2: Mortality Within 30 Days Post-Discharge		
Acute care length of stay > 10 days	1.75	0.55, 5.43
Age (years)	1.04	0.98, 1.11
Male biological sex (versus female)	3.05[b]	1.15, 8.01
Time to surgery within 24 to 48 hours (versus <24 hours)	2.80[b]	1.13, 7.38
Time to surgery ≥ 48 hours (versus <24 hours)	0.97	0.20, 3.59
Diagnosed with dementia	1.14	0.45, 2.82
Previously residing in nursing home (versus private residence)	3.82[b]	1.34, 12.02
Previously residing in an adult residential care facility (versus private residence)	1.83	0.25, 8.68
Model 3: Mortality Within One Year Post-Discharge		
Acute care length of stay > 10 days	1.93[b]	1.09, 3.43
Age (years)	1.03[b]	1.001, 1.06
Male biological sex (versus female)	1.66	0.97, 2.81
Time to surgery within 24 to 48 hours (versus <24 hours)	0.88	0.53, 1.46
Time to surgery ≥ 48 hours (versus <24 hours)	0.81	0.39, 1.62
Diagnosed with dementia	1.27	0.75, 2.13
Previously residing in nursing home (versus private residence)	2.25[b]	1.20, 4.27
Previously residing in a hospital (versus private residence)	5.96[b]	2.13, 16.45
Previously residing in an adult residential care facility (versus private residence)	2.85[b]	1.18, 6.63

[a] In each model, we controlled for patients continuing their acute care length of stay beyond our follow-up period.
[b] Statistically significant at the $p<0.05$ level.