The Predictive Utility of Functional Status at Discharge: A Population-level Cohort Analysis

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Abstract

Background: Functional status is a patient-important, patient-centered measurement. The utility of functional status measures to inform post-discharge patient needs is unknown. We sought to examine the utility of routinely collected functional status measures gathered from older hospitalized patients to predict a panel of post-discharge outcomes.

Methods: In this population-based retrospective cohort study, Adults 65+ who experienced an acute hospitalization between 4 November 2008 and 16 March 2016 in Ontario, Canada and received an assessment of functional status at discharge using the Health Outcomes for Better Information and Care (HOBIC) tool were included. Multivariable regression analysis was used to determine the relationship between functional status and emergency department (ED) presentation, hospital readmission, long term care facility (LTCF) admission or wait listing ('LTCF readiness'), and death at 180 days from discharge.

Results: A total of 80,020 patients were included. 38,928 (48.6%) re-presented to the ED, 24,222 (30.3%) were re-admitted, 5,037 (6.3%) were LTCF ready, and 9,047 (11.3%) died at 180 days. Beyond age, functional status at discharge was the factor most associated with LTCF readiness (Odds Ratio [OR] 4.11; 95% Confidence Interval [CI]: 3.70-4.57) and death (OR 3.99; 95% CI: 3.67-4.35). Functional status also had a graded relationship with each outcome and improved the discriminability of the models predicting death and LTCF readiness ($p < 0.01$) but not ED re-presentation or hospital re-admission.

Conclusion: Routinely collected functional status at discharge meaningfully improves models to predict long term care home readiness and death. The routine assessment of functional status can inform post-discharge care and service planning for older adults.

Background

Predicting health service use after discharge from acute hospital admissions is generally based on physiologic measurements such as age, diagnoses, or test results. Such parameters, however, are narrow definitions of health that do not fully reflect the patient as an independent human being. Functional status describes the ability of a patient to perform the daily activities required to meet their basic needs and maintain their health and well-being.(1) As a global measure, functional status is a patient-centred, patient-understood metric of health that integrates their overall physiologic capabilities and can be used to monitor effectiveness of therapy, quality of care, and inform discharge planning.(2–5)

In studies of hospital inpatients, functional status is a robust predictor of post-discharge outcomes for older adults including admission to long-term care homes (LTCFs), mortality, and development of geriatric syndromes (e.g. falls and incontinence).(4, 6–9) The value of functional status measures has also been established to have prognostic and therapeutic utility in individual diseases including heart failure, stroke, and cancer.(10–12) Despite this, functional data is often not collected for inpatients nor routinely considered by physicians, and consequently not included in administrative datasets used for population studies.(13–15)

The Health Outcomes for Better Information in Care (HOBIC) initiative was a large-scale pilot program implemented in Ontario, Canada from 2008 to 2016 that sought to routinely capture data concerning patient

function, self-care, symptom burden, and safety for all hospitalized patients at admission and discharge.(16) Using discharge functional status data collected during the program, we sought to examine its utility in predicting a panel of post-hospital discharge outcomes. We hypothesized that for all outcomes, discharge functional status will be an independent predictor of each outcome, and the strongest predictors of future LTCF admission and death post-discharge.

Methods

Study Design

We conducted a retrospective cohort study of adults aged 65 or older who were successfully discharged following an unplanned hospitalization in Ontario, Canada, from hospitals that participated in the HOBIC initiative between 2008 and 2016. Ontario is Canada's most populous province, containing approximately 40% of the Canadian population and 268 publicly funded hospitals (27.8% of all hospitals in Canada).(17, 18)

This study was granted an exemption from formal ethics review by the Hamilton Integrated Research Ethics Board, as the use of data in this project was authorized under Sect. 45 of Ontario's Personal Health Information Protection Act. We followed the Strengthening the Reporting of Observational Studies in Epidemiology and Reporting of Studies Conducted using Observational Routinely-Collected Health Data guidelines.(19, 20)

Data Sources

HOBIC was not evenly implemented in all hospitals in Ontario. As such, we defined three criteria to designate hospitals that completed an adequate number of HOBIC assessments to be included: 1) at least 100 HOBIC assessments were completed at the hospital; 2) at least five percent of all admissions and/or discharges had a HOBIC assessment completed; and 3) during each quarter that HOBIC assessments were being completed, during at least two of the three months of that quarter there were enough HOBIC assessments completed to be greater than or equal to 25% of overall mean monthly HOBIC assessments at that hospital.

Data were accessed at the Institute for Clinical Evaluative Sciences, an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows for a waiver of consent, when data is intended for the purpose of health system evaluation and improvement.(21)

Study population

Participants were selected if they were discharged from the hospital during the dates that the HOBIC program was active (4 November 2008 to 18 March 2016) and had undergone an assessment of their functional status through the HOBIC tool. The following exclusion criteria were applied to address those who were expected to or had already experienced an outcome: age less than 65 on admission; planned admission; hospital transfer; admission from LTCF; patient undergoing dialysis or chemotherapy; patient discharged to a non-community location (e.g. LTCF, rehabilitation facility, or palliative care); patient discharged after being placed on an LTCF wait list.

Exposures

Within HOBIC, functional status was assessed through the following basic activities of daily living (bADLs): bathing, hygiene, walking, toilet transfer, toileting, bed mobility, and eating. bADLs were recorded using an ordinal score via the system set out by Morris, Fries & Norris (22, 23). Where values were missing across two or fewer bADLs, missing values were imputed using the integer-rounded mean of present bADLs. ADL scores for patients were then compiled into a bADL hierarchy (ADLH) that stratified them into clinically meaningful phenotypes (Supplementary data Figure SF1).(23) Pre-admission functional data, which has demonstrated prognostic utility in other cohorts, was unavailable, rendering functional trajectories unmeasurable such that a functional trajectory could be tested. Discharge ADLH was treated as a categorical variable on a scale of zero to five (referent zero). HOBIC has demonstrable internal validity and interrater reliability.(16)

Additional variables were collected across four groups: demographics (age, sex, if they lived in a rural location, and income quintile); continuity of primary care (usual provider index), number of visits to the primary care provider in the last year);(24–26) index admission characteristics (length of stay, admission to the intensive care unit (ICU)); and burden of comorbidities (Charlson comorbidity index), diagnosis of asthma, chronic obstructive pulmonary disease, angina, coronary artery disease, heart failure, hypertension, type II diabetes mellitus type II, epilepsy, dementia, delirium, injurious falls, and/or stroke).(27, 28) Detailed information concerning variables, exposure definitions and data sources can be found in Supplementary data tables ST1 and ST2. Age category (referent age 65–69) and income quintile (referent highest quintile) were treated as categorical variables, length of stay was treated as a continuous variable, all other variables were treated as binary variables.

Outcomes

The following outcomes at 180 days after discharge from the index admission were used: Emergency department (ED) re-presentation, hospital re-admission, death, and a composite of being admitted to an LTCF or being placed on the wait list for an LTCF ('LTCF readiness') as in both circumstances the patient was sufficiently impaired that they required LTCF-level assistance.

Analysis

Descriptive analysis of outcomes was completed using mean and standard deviation as well as median and interquartile range where appropriate; results were stratified by outcome. Where a patient had multiple outcomes, each outcome was considered separately. Models predicting each outcome were constructed using multivariable logistic regression analysis. Given the high number of events for each outcome, all variables were able to be considered across each model.

The additive value of function in predicting each outcome was assessed by performing regressions including and excluding discharge ADLH and comparing Receiver-Operating Characteristics (ROC) using χ^2 . Goodness-of-fit was determined using the calibration plots of the models for each outcome stratified by age.(29, 30) Sensitivity analysis was performed using the bADL long form (the gross sum of a patient's bADL scores), individual bADL scores, as well as the non-imputed data set where data was considered missing if any bADLs required to calculate the ADLH were missing.

All analyses were completed using SAS version 9.4.(31)

Results

Population Characteristics

A total of 53 (28.8%) hospitals in Ontario completed sufficient HOBIC assessments to be included in the analysis, which allowed for the inclusion of 80,020 patient admissions (Supplementary figure SF2). The cohort was 48.7% male, with an average age of 77.9 ± 7.9 . Within 180 days after discharge, 38,928 (48.6%) re-presented to the ED, 24,222 (30.3%) were re-admitted to hospital, 5,037 (6.3%) were LTCF ready and 9,047 (11.3%) died. Similar rates have been seen in other studies.(32, 33)

LTCF ready patients had longer lengths of stay, lower rates of ICU admission, and higher admission and discharge ADLHs; patients who had no outcome had the shortest stays and the lowest discharge ADLHs (Table 1). Patients who died had the highest Charlson comorbidity index as well as higher rates of heart failure and COPD; those who were LTCF ready had higher rates of dementia, delirium, stroke, and injurious falls.

Table 1
Demographics, comorbidities, and index hospitalization characteristics stratified by individual outcome.

	ED re- presentation	Re-admitted to hospital	LTCF ready	Death	None
Patients (%)	38 928 (48.6)	24 222 (30.3)	5 037 (6.3)	9 047 (11.3)	35 831 (44.8)
Age**	76.4 (76.3–76.5)	76.5 (76.4–76.6)	81.5 (81.3– 81.7)	77.8 (77.7– 78.0)	74.8 (74.7– 74.9)
Female	50.7	48.6	60.3	45.8	51.8
Income Quintile*	3 (2–4)	3 (2–4)	2 (1–4)	3 (2–4)	3 (2–4)
Lives Rurally	23.7	20.8	22.2	23.8	18.9
Family physician visits in last year**	0.90 (0.89–0.91)	0.82 (0.80–0.83)	0.62 (0.59– 0.64)	0.60 (0.58– 0.62)	0.91 (0.89– 0.96)
Usual provider index**	0.35 (0.35–0.36)	0.35 (0.35–0.35)	0.40 (0.39– 0.40)	0.34 (0.34– 0.35)	0.40 (0.40– 0.40)
days to outcome*	36 (11–87)	42 (14–92)	51 (23– 99)	59 (27– 106)	
Comorbidities					
Charlson comorbidity index**	1.51 (1.49–1.52)	1.72 (1.69–1.74)	1.45 (1.41– 1.49)	2.50 (2.45– 2.54)	1.03 (1.02– 1.04)
Angina	9.6	8.6	5.1	7.1	9.4
Asthma	0.7	0.7	0.5	0.4	0.9
Coronary Artery Disease	17.7	16.8	10.9	14.5	17.6
Heart Failure	15.6	17.7	15.7	21.6	10.1
COPD	12.5	13.2	10.7	15.5	9.4
Diabetes	24.4	25.9	23.1	25.3	21.2
Epilepsy	0.5	0.5	0.5	0.4	0.3
Hypertension	27.7	26.9	27.9	22.7	30.1
ICU = intensive care unit; ADLH = activities of daily living hierarchy; COPD = chronic obstructive pulmonary disease. *median and interquartile range;					
**mean and 95% Confidence interval.					

	ED re- presentation	Re-admitted to hospital	LTCF ready	Death	None
Stroke	2.1	1.9	3.8	1.7	2.6
Delirium	4.0	4.2	11.3	4.2	3.0
Dementia	1.1	1.2	5.3	1.4	0.8
Injurious Fall	5.0	4.4	11.8	3.6	7.0
Index hospitalization characteristics					
Length of stay*	5 (3–9)	5 (3–10)	8 (4–15)	6 (4–11)	4 (2–7)
Admitted to ICU	13.0	12.6	8.3	10.1	14.2
Discharge ADLH*	0 (0–2)	0 (0–2)	2 (0–4)	1 (0–3)	0 (0–1)
ICU = intensive care unit; ADLH = activities of daily living hierarchy; COPD = chronic obstructive pulmonary disease. *median and interquartile range;					
**mean and 95% Confidence interval.					

Functional Status and Outcomes

At discharge, most patients were functionally independent (38.6%). Increasing age and discharge ADLH were both associated with higher rates of each of the four outcomes (Fig. 1). In those who were functionally dependent, 20.2% were LTCF ready and 23.5% died at 180 days, compared to 7.7% and 11.6%, respectively, of those who were functionally independent at discharge.

In unadjusted analysis, a discharge ADLH cut-off of rank 3 or higher (requiring extensive supports to perform bADLs) was associated with increased odds of each outcome (Table 2). These results are similar to those found in the regression analysis; extensive or more supports were associated with increased risk of each outcome but were most potently associated with LTCF readiness (OR 4.96, 4.67–5.28) and Death (OR 3.04, 2.89–3.20).

Table 2
Predictive Utility of Discharge Functional Status (limited or no ALD support vs. extensive or more ALC)
for each outcome using unadjusted analysis.

Outcome	Sensitivity (95% CI)	Specificity (95% CI)	Odds Ratio (95% CI)	Positive LR (95% CI)	Negative LR (95% CI)
ED re-presentation	13.9% (13.5–14.2)	88.5% (87.6–89.4)	1.24 (1.19–1.30)	1.21 (1.17–1.25)	0.97 (0.97–0.98)
Hospital re-admission	16.0% (15.6–16.5)	88.8% (88.1–89.6)	1.52 (1.46–1.59)	1.44 (1.39–1.49)	0.95 (0.94–0.95)
LTCF Readiness	37.9% (36.5–39.2)	89.1% (88.4–89.7)	4.96 (4.67–5.28)	3.46 (3.32–3.61)	0.70 (0.68–0.71)
Death	26.9% (26.0–27.8)	89.2% (88.5–89.9)	3.04 (2.89–3.20)	2.49 (2.39–2.59)	0.82 (0.81–0.83)
LR = likelihood ratio.					

In adjusted analysis, age and functional status were most predictive of LTCF readiness or death at 180 days, though both were associated with increased odds of ED re-presentation and hospital re-admission as well (Table 3). Those who required extensive assistance or more had OR 4.11–4.75 for being LTCF ready as compared to those who were independent. Delirium, dementia, injurious falls, and seizures were all associated with higher odds of being LTCF ready; the Charlson comorbidity index was not.

Table 3
Adjusted Odds Ratios by outcome.

	ED Re- presentation		Hospital Readmission		LTCF Readiness		Death	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age 70–74*	1.08	(1.03–1.13)	1.08	(1.02–1.13)	1.36	(1.15–1.61)	1.14	(1.05–1.25)
75–79*	1.19	(1.14–1.24)	1.18	(1.12–1.24)	2.52	(2.16–2.93)	1.38	(1.26–1.50)
80–84*	1.32	(1.26–1.38)	1.27	(1.21–1.34)	3.61	(3.12–4.17)	1.59	(1.47–1.73)
85–89*	1.48	(1.41–1.56)	1.39	(1.31–1.47)	5.06	(4.37–5.85)	1.81	(1.65–1.97)
≥ 90*	1.67	(1.57–1.78)	1.51	(1.41–1.62)	7.22	(6.21–8.39)	2.47	(2.24–2.73)
Sex (F v M)	0.97	(0.94–1.00)	0.86	(0.84–0.89)	1.16	(1.09–1.23)	0.76	(0.73–0.80)
Income Quintile 2 **	0.90	(0.86–0.94)	0.96	(0.91–1.00)	0.82	(0.75–0.89)	1.03	(0.96–1.11)
3 **	0.87	(0.83–0.9)	0.97	(0.93–1.02)	0.78	(0.71–0.85)	1.04	(0.97–1.12)
4 **	0.84	(0.8–0.87)	0.94	(0.89–0.98)	0.69	(0.62–0.76)	1.01	(0.94–1.09)
5 **	0.83	(0.79–0.86)	0.94	(0.89–0.98)	0.71	(0.65–0.78)	0.97	(0.9–1.04)
Lives Rurally	1.38	(1.33–1.42)	0.97	(0.93–1.01)	1.13	(1.05–1.22)	1.19	(1.12–1.26)
Usual Provider index	0.92	(0.88–0.96)	0.91	(0.87–0.96)	0.71	(0.63–0.79)	0.77	(0.71–0.84)
FP visits	1.08	(1.06–1.10)	0.95	(0.94–0.97)	0.86	(0.83–0.90)	0.78	(0.76–0.80)
ICU admit	0.92	(0.88–0.96)	0.91	(0.87–0.96)	0.71	(0.63–0.79)	0.77	(0.71–0.84)
Length of Stay	1.00	(1.00–1.00)	1.01	(1.00–1.01)	1.02	(1.01–1.02)	1.00	(1.00–1.00)
Discharge ADLH								

*compared to age 65–69; **compared to income quintile 1; FP = family physician; CCI = Charlton Comorbidity Index; COPD = Chronic Obstructive Pulmonary Disease.

	ED Re- presentation		Hospital Readmission		LTCF Readiness		Death	
Independent	Referent		Referent		Referent		Referent	
Supervision	1.16	(1.10–1.22)	1.22	(1.16–1.30)	2.52	(2.27–2.80)	1.57	(1.44–1.71)
Limited Assist	1.24	(1.19–1.29)	1.33	(1.27–1.39)	2.86	(2.63–3.12)	1.87	(1.75–2.00)
Extensive Assist	1.42	(1.30–1.54)	1.44	(1.32–1.57)	4.75	(4.21–5.35)	2.46	(2.20–2.75)
Max Assist	1.27	(1.18–1.36)	1.52	(1.41–1.64)	4.90	(4.40–5.47)	2.95	(2.67–3.24)
Dependent	1.11	(1.04–1.19)	1.44	(1.34–1.54)	4.11	(3.70–4.57)	3.99	(3.67–4.35)
Comorbidities								
CCI	1.15	(1.14–1.17)	1.23	(1.22–1.25)	1.02	(0.99–1.04)	1.59	(1.57–1.61)
Angina	1.08	(1.01–1.16)	0.91	(0.84–0.98)	0.85	(0.71–1.02)	0.88	(0.77–0.99)
Coronary Artery Disease	0.95	(0.90–1.00)	0.91	(0.85–0.96)	0.82	(0.72–0.93)	0.80	(0.73–0.88)
Heart Failure	1.18	(1.12–1.23)	1.25	(1.20–1.31)	1.05	(0.96–1.15)	1.26	(1.18–1.34)
COPD	1.15	(1.10–1.20)	1.09	(1.04–1.14)	1.02	(0.93–1.13)	1.07	(1.00–1.14)
Delirium	1.07	(0.99–1.16)	0.96	(0.89–1.05)	1.88	(1.69–2.10)	0.74	(0.65–0.83)
Dementia	0.87	(0.76–1.00)	0.87	(0.75–1.00)	3.04	(2.59–3.57)	0.67	(0.54–0.82)
Diabetes	0.95	(0.91–0.99)	0.90	(0.87–0.94)	1.09	(1.00–1.18)	0.56	(0.53–0.60)
Injurious Fall	0.71	(0.67–0.76)	0.63	(0.59–0.68)	1.21	(1.10–1.34)	0.50	(0.44–0.56)
Hypertension	0.89	(0.86–0.92)	0.85	(0.82–0.88)	0.88	(0.82–0.95)	0.68	(0.64–0.72)
Seizure	0.73	(0.66–0.80)	0.62	(0.55–0.69)	1.41	(1.19–1.67)	0.43	(0.36–0.52)

*compared to age 65–69; **compared to income quintile 1; FP = family physician; CCI = Charlton Comorbidity Index; COPD = Chronic Obstructive Pulmonary Disease.

	ED Re- presentation		Hospital Readmission		LTCF Readiness		Death	
Stroke	1.63	(1.30– 2.05)	1.31	(1.03– 1.66)	1.23	(0.80– 1.88)	1.02	(0.70– 1.48)
*compared to age 65–69; **compared to income quintile 1; FP = family physician; CCI = Charlton Comorbidity Index; COPD = Chronic Obstructive Pulmonary Disease.								

Patients who died had similar finding, however the association with age was less pronounced. Worsening functional status was progressively associated with increased odds of dying; those who were functionally dependent had an OR of 3.99 (3.67–4.35) as compared to those who were independent. Charlson comorbidity index demonstrated the greatest magnitude of association for those who died as compared to other outcomes, OR 2.50 (2.45–2.54).

Predictive utility of models

Model ROCs demonstrated poor discriminability for ED re-presentation and hospital re-admission (ROC 0.621, 0.617–0.625 and 0.644, 0.640–0.648 respectively). LTCF readiness (0.819, 0.814–0.825) and death (0.782, 0.776–0.787) were predicted with reasonable discriminability. The addition of function to the ED or hospital re-admission models did not improve discriminability ($p = 0.27$ and 0.06 respectively) while significant improvements were seen in the discrimination of LTCF readiness and death ($p < 0.01$ for both). Calibration curves demonstrated goodness of fit across all outcomes (supplementary figure SF3).

Sensitivity analysis

Sensitivity analysis demonstrated that when the sum of each bADL score or patient bADLs was used in place of the discharge ADLH there was no difference in results ($p = 0.26$ for both sensitivity analyses). Analysis using a non-imputed dataset also yielded similar results.

Discussion

We found that lower functional status at discharge was a leading predictor of LTCF readiness and death at 180 days post-discharge. Increasing age was the factor that most impacted outcomes beyond functional status. Our results suggest that routinely collected functional status at discharge meaningfully improves the prediction of post-discharge LTCF readiness and death, but not ED re-presentation or hospital re-admission. The routine assessment of functional status can inform ongoing health care needs, post-discharge service planning, and provide better targeting of care.

A 'plateau' effect was seen where those requiring at least maximal assistance with bADLs were no more likely to be LTCF ready than those requiring extensive or maximal assistance, which was likely driven by patients dying or being discharged to a palliative setting (rather than a LTCF). Patients with independent functional status at discharge were more likely to experience an outcome than those who required supervision to complete ADLs. This may have represented preferential coding of patients as independent on discharge, that supervision provides a safety benefit, or both. The smaller magnitude of change in outcomes across

functional status compared to age for ED and hospital re-admission reflects that function may be a poor discriminator of these outcomes as well as the general stochasticity of these events.

Across the cohort, several findings were seen that are reflective of previous analyses. ICU admission was protective of each outcome; these patients had less comorbidity (lower Charlson comorbidity index, $p < 0.01$), a greater chance of surviving severe illness ($p < 0.01$), and were thus selected to be cared for there.(34) An increased usual provider index and number of recent family physician visits were protective for all except ED re-admission, reflecting that regular contact with the medical system may prevent acute decompensation.(24, 35) Heart failure and COPD were associated with increased odds of each outcome except LTCF readiness, indicating the additional prognostic burden they carry.

More heterogeneity is seen when contextualizing the prognostic value of function within previous studies. In terms of re-hospitalization, there has been conflicted data; smaller studies have demonstrated that functional data is helpful. Larger, database driven models, however, have generally not included functional measures.(5, 36–39) Smaller studies of ED re-presentation have also demonstrated the value of functional measurement in the prognostication of outcomes.(40, 41) A meta-analysis of factors contributing to LTCF readiness congruently found that requiring assistance with bADLs (1–2 bADLs OR 2.45, 2.02–2.97; 3 or more bADLs 3.25, 2.59–4.09) and prior nursing home use (OR 3.47, 1.88–6.37) were the factors most associated with LTCF admission.(3) There were several methods by which ADLs were assessed within the studies, suggesting that there can be flexibility in how function is measured. For mortality, function was only measured in non-database studies; where measured, functional deterioration was the greatest predictor of death.(4)

Collectively, these findings suggest that the greatest barrier to using functional measure within clinical care is not demonstrating its value, but rather the feasibility and routine practice of the collection of functional data itself. Future research should address this issue. While HOBIC data was collected by nurses during the program, its collection may be facilitated by looking to see if such information can be collected from assessments by physiotherapists and occupational therapists as well, who have traditionally addressed many of the HOBIC domains. Second, using such data to demonstrate how this data can change real world outcomes, such as ensuring senior friendly hospitals or reduced emergency applications to LTCFs, would reinforce the case for its routine collection.(42)

Limitations to this work largely relate to the deployment of the HOBIC program. Despite the use of liberal hospital inclusion criteria in the study, most hospitals were deemed ineligible due to an insufficient number of HOBIC assessments completed. Included hospitals were mostly urban, limiting the generalizability of this data in more rural settings. There was also poor capture of some comorbidities including delirium and dementia (though reasonable estimates of coronary artery disease, hypertension, diabetes, and chronic obstructive pulmonary disease).(43–46) Finally, this analysis does not include data concerning whether individuals received home care services post-discharge to support them remaining in the community, however, it was expected that the inclusion of such data would increase the magnitude of the association by demonstrating the necessity of these services for vulnerable individuals to remain alive and not LTCF ready.(47)

Functional status is an important predictor of LTCF readiness and death after acute hospitalization. Internal and external consistency of results validates the importance of assessing function in-hospital. Routinely

collected functional status data has the potential to meaningfully inform future health care planning.

Abbreviations

LTCF = long term care facility

HOBIC = Health Outcomes for Better Information in Care initiative

bADL = basic activities of daily living

ADLH = bADL hierarchy

ICU = intensive care unit

ED = emergency department

Declarations

Ethics approval and consent to participate

This study was granted an exemption from formal ethics review by the Hamilton Integrated Research Ethics Board, as the use of data in this project was authorized under section 45 of Ontario's Personal Health Information Protection Act.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from ICES but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the ICES. Protocol and statistical code are available on request from the main author.

Competing interests

The authors received no personal financial support from any organization for the submitted work, have not entered into an agreement with any organization that has limited their ability to complete the research as planned and publish the results, have no financial relationships with any organizations that might have an interest in the submitted work, and have no other relationships or activities that could appear to have influenced the submitted work.

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Authors' contributions

Mats Junek, Aaron Jones, George Heckman, Catherine Demers, Lauren Griffith, and Andrew Costa all contributed to the conception and design of this research. All authors acquired, analyzed and interpreted the data. Mats Junek performed the statistical analysis and drafted the manuscript. All of the authors critically revised the manuscript for important intellectual content and agreed to be accountable for all aspects of the work.

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Figures

Figure 1

Proportion of patients in the cohort with each outcome by age and discharge ADLH (dADLH). 0 = independent; 1 = requires supervision; 2 = requires limited assistance; 3 = requires extensive assistance; 4 = requires maximal assistance; 5 = dependent. Patients who experienced more than one outcome were included in each.

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