Contextualizing functional status with comorbidities in prognosticating post-hospital discharge outcomes: a retrospective cohort study

Dr Mats Junek

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Student number 400103634

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Abstract

Background

Discharges from acute episodes of hospitalization are well recognized as periods where individuals are at high risk of poor outcomes including hospital and emergency re-presentation, death, and long-term care facility (LTCF) admission or wait listing for older adults. As the population of Ontario ages and is at higher risk of these outcomes, efforts to prognosticate these risks to optimize care delivery have recognized demographics and medical morbidity have been well-associated with these events using large datasets. The impact of individual patient function and capacity to carry out their activities of daily living (ADLs), however, is not as well understood despite being central to an individual's ability to remain successfully within the community. Recent efforts have allowed for the administrative collection of data concerning functional capacity to both demonstrate the functional characteristics of the acutely hospitalized adult and understand its impact on post-discharge outcomes.

Methods

Using databases housed at the Institute for Clinical Evaluative Sciences (ICES), a retrospective cohort of all adults 65 years of age or older who underwent assessment of their ADLs in the Healthcare Outcomes for Better Information and Care (HOBIC) during acute hospital admissions between 2008 and 2016. Individuals who were expected to return to hospital (e.g. due to chemotherapy or dialysis) or were receiving palliative care, as well as individuals assessed at hospitals who did not complete enough HOBIC assessments to provide reliable information were excluded. Descriptive analysis was performed to understand the functional and medical characteristics of the cohort. Multivariable logistic regression analysis was used to determine how demographics, comorbidities, previous health service use, and functional status were associated with hospital re-admission, emergency re-presentation, death, and LTCF admission or wait-listing at 180 days post-discharge. Subgroup analysis was also performed across

common comorbidities including chronic obstructive pulmonary disease, coronary artery disease, congestive heart failure, falls, delirium, and dementia.

Results

An analytic cohort of 139 798 was constructed for whom 67.4% of admission HOBIC assessments and 56.7% of discharge assessments were complete. With increasing age there was increasing functional disability as well as increasing burdens of congestive heart failure, delirium, dementia, and falls. The majority of individuals who were admitted with some degree of functional impairment experienced an improvement during their admission. Function and comorbidities were found to be equally and moderately associated with increased odds of experiencing ED re-presentation and re-hospitalization, though there was poor discriminability (AUROC 0.62, 95% confidence interval 0.62-0.63 and 0.64, 0.63 – 0.65 respectively). For death and LTCF admission or wait listing, however, functional impairment had greater association than comorbidities, and there higher discriminability was seen (AUROC 0.84, 0.83-0.85 and 0.79, 0.79-0.80). Functional impairment was also more highly associated with poor outcomes in those with chronic obstructive pulmonary disease and dementia.

Discussion

This analysis demonstrates that administrative data can be used to assess function, and that function is of comparable importance to the studied outcomes as medical comorbidity. It demonstrates that meaningful information concerning function can be derived from secondary data, though information gathered concerning function at admission appears to be of questionable reliability, and comorbidities are likely under-reported. Overall, however, it suggests that future efforts to assess individual risks of post-discharge outcomes should consider functional status as equally important to other factors more extensively historically studied.

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1. Introduction

1.1 Planning for an aging Ontario

Individuals 65 years and older are the fastest growing group of Ontarians. Based on 2019 estimates, they compose 17.2% of the population and are forecast to compose 25% in 2041 (1,2). Alongside this population growth, there has been a corresponding increase in the morbidity of this population, mostly in the form of chronic diseases and functional impairment (3-5). These factors have compounded to result in increasing demands being placed upon the health care system, particularly hospital re-admissions, emergency department presentations, admission to long-term care facilities (LTCFs), and death. There was an estimated 22 187 hospitalizations per 100 000 Ontarians 65 or older (compared to 8 805 in those 55 to 64) in 2010 (6); similarly demand for long term care beds has increased from approximately 100 000 in 2015 to over 110 000 in 2018 (7).

There are concerns over whether the Ontario health care system will be able to manage this burden effectively (8,9). To optimize the system and address these needs, one must recognize both those who are at the greatest risk of needing increased health care, as well as stratifying the average needs of the population. Several reports have suggested that three priority areas for health care planning are more resources, better targeting for home care and LTCFs, and addressing heavy users of health care in order to anticipate individual needs and ensure that the system is sufficient for a population who requires increasing amounts of assistance to function (8,10,11).

Thus far, efforts to prognosticate some of the most cost-intensive individual outcomes in health care – risks of hospitalization, LTCF admission, emergency department use, and mortality have been constructed through a lens of medical morbidity. Tools to prognosticate these outcomes have often focused on the details of past hospitalizations as well as their current and past diagnoses (12,13). Health strategies have similarly focused on these factors to determine an individual's care needs within the community (8,10). While medical comorbidities are valuable in prognosticating patient health needs, a

growing literature suggests that assessing functional capacity and supports that are needed to maintain independence may be a more important predictor of further health care usage including hospitalization and LTCF admission (14,15). Using function, instead of disease burden, as the basis of prognosticating health care needs is a sensible proposition: an individual's capacity to cope with their medical comorbidities is driven by how much it impacts their capacity to function in day-to-day life, and they often present for further care when they feel that they are unable to care for themselves due to the impact of their disease on their function. Despite evidence of its potential value in prognosticating outcomes and systems planning, several factors have likely contributed to a lack of consideration of function in risk stratification efforts (14-16). Many instruments designed to prognosticate future health care needs are built upon administrative databases where measurements of function are not always included, or the data does not provide meaningful information concerning functional status.

Hospital admissions and discharges have been extensively studied using cohorts across several populations and outcomes including re-hospitalization and emergency re-presentation (12,17-19). Admissions represent an ideal time to consider function - acute insults often lead to threats and/or changes in an individual's functional and health status; prognosticating future health needs at discharge can assist in care planning as services can be readily engaged. Discharges are also subject to significant administrative data collection and represent an opportunity to assess function in a standardized fashion for patients before their departure. As such, analysis of function in hospital inpatients allows for a comprehensive understanding of how function and changes in function across admission may influence longer term health care outcomes.

1.2 The case for function in inpatient acute care

The basic activities of daily living (ADLs) are 'the fundamental skills typically needed to manage basic physical needs' and are necessary to provide self-care within one's own home; they include

hygiene, dressing, toileting, transferring, mobilizing, and eating (20). These basic ADLs (bADLs) are further elaborated upon with the instrumental ADLs (iADLs), which are the activities needed to perform to live independently within the community such as managing finances, transportation, and preparing food. One of the most impactful consequences of aging is the changes that lead to a loss of function, which occur in the form of the progressive loss of iADLs initially, then bADLs as they become more impaired and dependent on others for support in their day-to-day life. Loss of capacity to carry out ADLs is associated with impaired quality of life, increased health care use and cost, and mortality (16,20).

While some in the community are able to engage with resources that allow them to remain within the community despite increasing functional dependence, many present to hospital with unmet functional needs, often in the context of acute medical decompensation. This may represent either an acute insult that they will hopefully recover from, or a decline to a level such that their community support structures are insufficient. Those who present with a double burden of medical and functional issues often experience complicated admissions; those with greater dependency in their bADLs and iADLs had both longer hospital stays and more physician clinical visits as outpatients (21). As they occur when one decompensates, hospital admissions are often the index point of contact with health care through which an individual's function is measured (as well as comorbidities or other factors that may assist in understanding their current health status) and their expected trajectory as they continue to age. Hence, the admitted inpatient represents someone with vulnerability in both their health and function, where the impact of deterioration in their health and functional status can be easily measured and studied to better understand impacts on future health care consumption.

When individuals are discharged from hospital, the goal is for this to occur when they are at their 'baseline' or expected future functional status. This may be: 1) better than when they were previously if some un-recognized chronic process can be addressed, 2) restoration to their baseline functional status, 3) deteriorated due to an irrevocable impact of acute illness on their health,

recognition that their actual functional capacity was much lower than previously assumed or assessed, or 4) ultimately their death. Functional status at discharge may result in being able to return to previous health and function in the community, require additional supports, and/or place them at higher risk of having more health care requirements (including hospitalization or ED presentations), or require LTCF admission to support them. Effective measurement of function during admission allows for planning a patient's likely destination based on their functional trajectory, as well as addressing other expected health risks (e.g. pressure ulcers, falls, continence concerns). This may include the supports they need in the community, whether or not they can remain in the community, or if they are so impaired that they are approaching the end of life.

For this thesis, a structured literature review was performed to capture existing knowledge concerning the relationship between function during acute inpatient admissions, as well as the impact of functional status on post-discharge in relation to hospital admissions, emergency presentations, admission to a LTCF, and mortality. PubMed was searched using the algorithm '((function) OR (ADL) OR (activity of daily living)) AND (discharge) AND ((mortality) OR (death) OR (readmission) OR (emergency) OR (long-term) OR (long term) OR (nursing facility))'.Searches using permutations of the same terms was also used in Google Scholar, and relevant experts were consulted for appropriate other papers.

1.3 Function in the clinical context

Clinically, the functional impact of disease has been used to determine what therapies one may qualify for in particular diseases (such as the New York Heart Association (NYHA) functional class in heart failure (22) or the functional independence measure (FIM) in stroke (23)), how they are responding to their current treatment regimen (such as the health assessment questionnaire in rheumatoid arthritis (24)), and their prognosis based on their burden of disease (as in cancer care (25)). These scales

measure functional burden based on the how much cardinal symptom of the disease impacts them as a surrogate measure of their function (e.g. dyspnoea in heart failure and fatigue in cancer) .

While these measures have been validated internally for clinical purposes within the disease of interest, and are regarded as standards to determine the severity of disease, they do not use a harmonized perspective of function (they are constructed around the limitation of functional capacity due to symptom burden rather than function itself), they require different sets of measurements and questions in order to be determined (without necessarily having standardized measures of measurement), and the scales used cannot be compared across diseases. Moreover, given that they are designed to be used in individual diseases, they cannot be used across populations, do not assist with understanding care requirements in order to function at home, and do not differentiate between limitations in iADLs versus bADLs, which each cause different types of limitations upon an individual, and different impacts on quality of life (20).

These concerns speak to the need for standardized measures of function that allow for understanding the burden of disease across these populations (see section 1.4) and the need for a measurement of function that can be used across all populations. Furthermore, in order to understand how to provide appropriate care planning for these individuals, the definition of function needs to be re-considered as a marker of individual health status and care requirements, rather than just as a surrogate for disease activity.

1.3.1 The Influence of function at discharge on post-hospital outcomes

Post-discharge, functional changes have been well-linked to increased care needs. A prospective study of 551 adults aged over 70 that measured function two weeks before admission, at admission, and at discharge, found that those who had a functional decline either before admission that did not recover or had a decline in hospital, were much more likely (OR 3.19, 95% confidence interval (CI) 1.46-6.96 and

2.77, 95% CI 1.29-5.96 respectively) to require admission to LTCF on discharge or within 30 days of discharge (26). Similarly, a systematic review of fourteen papers looking at factors associated with various outcomes related with hospitalization found that functional status was a predictor of mortality, discharge destination (e.g. LTCF vs the community), and re-admission, as were impaired cognition, burden of comorbidities (measured as either disease burden or polypharmacy), admission diagnosis, and age (16). Specific to LTCF admission, requiring assistance with three or more ADLs (OR 3.25, 95% CI 2.59-4.09), having cognitive impairment (2.54, 1.43-4.51), and prior LTCF admission (used for patients in the post-acute setting in some countries, OR 3.47, 1.88-6.37) were most predictive (15). It is likely that individuals who suffer functional decline are one of the key drivers of demand for LTCF. Accordingly, it was demonstrated in Ontario that between 2013 and 2018 there was an increase from 79 to 86% of LTCF residents requiring support with their ADLs (27).

1.4 Standardized measurement of function

Given the clear linkage between functional decline and other outcomes, it is surprising to see that assessments of function are not part of standard patient data collection to prognosticate patient outcomes. One important contributor to this is the creation of many different instruments that approach the measurement of function from different perspectives (Table 1).

Table 1: Commonly used measures of basic ADLs, their characteristics, reliability, and validity. Adapted from (28).

	ADL Rating Scale	Barthel Index	Donaldson ADL Evaluation Form	Katz Index of ADL	Kenny Self-Care Evaluation	Physical Self-Maintenance Scale	PULSES Profile
Purpose							
Descriptive	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Predictive	No	Yes	No	Yes	Yes	No	No
Evaluative	Yes	Yes	Yes	No	Yes	Yes	Yes
Utility							
Format	Performance	Performance	Performance	Performance	Performance	Staff Report	Staff report
Population	Adult Rehabilitation	Adult Rehabilitation	Adult Rehabilitation	Gerontology	Adult Rehabilitation	Gerontology	Adult Rehabilitation
Completion Time	1-2 hr	1 hr	1-2 hr	1-2 hr	1 hr	15 mins	15-20 mins
Reliability							
Internal	Poor	Poor	Poor	Excellent	Poor	Excellent	Poor
Observer	Excellent	Excellent	Poor	Good	Poor	Excellent	Excellent
Test-retest	Poor	Excellent	Poor	Poor	Poor	Poor	Excellent
Validity							
Content	Good	Excellent	Poor	Good	Good	Good	Excellent
Construct	Poor	Excellent	Poor	Excellent	Excellent	Good	Good
Responsiveness	Poor	Good	Good	Excellent	Good	Poor	Poor
Overall Utility	Fair	Excellent	Poor	Good	Fair	Good	Good

While these are generally well-designed tools individually, they are optimized across separate cohorts, parameters, and intents. They also often require significant time investment, collateral history, and an individual who can complete a relatively intensive assessment process, rendering it difficult to include in routine collection measures. Two commonly used tools are the Barthel Index of Activities of Daily Living and the Katz Index of Independence in Activities of Daily Living, each of which measure function from different perspectives (29). Both seek to quantify independence in ADLs. Katz does so in a purely binary fashion of independent or not (and treats continence as a bADL but does not include walking), whereas Barthel uses an ordinal scale of independence, occasionally needing help, or dependent (and also includes stairs and continence). Both scales demonstrate good external validity, although Katz has higher demonstrated internal consistency while Barthel has better test-retest values (likely reflecting that Barthel requires a less dichotomous assessment). Unfortunately, both require training to perform and can be intensive to gain a full history; they also cannot be directly compared as they are scored differently and have different end assessments of functional status. Furthermore, both

are blunt severity scales that do not meaningfully inform the ways in which one is functionally impaired, or how much the need for help impacts day-to-day function with a particular ADL.

The idea of standardizing and facilitating information gathering and dissemination concerning functional status (as well as all other aspects of an individual's characteristics and health burden – symptom burden, comorbidities, demographics, etc.) was initially embraced in the 1990s with the development of the international Resident Assessment Instruments (interRAI) tools to be used in LTCF settings (30,31). The philosophy of a universal data language was recognized as being of value to assess different settings of care in addition to multiple different patient populations or health facilities. From there, interRAI was expanded to become an approach that harmonized domains of assessment, methods of data collection, and information that could be used across all settings of care including acute care settings, LTCFs, and the community. The data collected from these instruments can be used in multiple contexts including clinical care, administration, reporting, research, and policy analysis (32).

While each interRAI instrument provided interchangeable data outputs, they were also designed to be used in a given context and built with consideration as to the unique circumstances in which each tool would be used. Within the acute care setting, the interRAI Acute Care (AC) instrument was developed and released in 2006, designed to be administered by nurses to assess older adults admitted to an acute care hospital and to be completed quickly (10-15 minutes) without additional supports beyond the basic equipment available within an average facility (30,33). It collects data concerning functional status, cognitive function, concerns around care provision, support systems, and the assessed individual's burden of incontinence, pain, weight loss, balance, and nutrition concerns.

Within the interRAI AC, functional status is assessed using the RAI ADL measure (an instrument that, as expected, is deployed in other interRAI instruments). The RAI ADL measure uses a similar set of bADLs (bathing, personal hygiene, walking, toilet transfers, toilet use, bed mobility, and eating) as other indices, and function is measured using an ordinal severity scale that defines dependence based on both

the amount of support required as well as the frequency with which the support must be used in order to complete that ADL (Table 2).

Table 2: Severity scale used within the RAI ADL measure to assess the performance and functional status of an individual. Adapted from (34,35).

Score	Performance (as an aggregate of all performances of the activity in a 24-hour period)
0	Independent: no assistance, set-up, or supervision in any episode
1	Set-up help only: article or device provided or placed within reach but no episode with supervision or physical assistance.
2	Supervision: oversight/cueing 3+ times -OR- oversight/cueing 1+ time and physical assistance 1-2 times
3	Limited assistance: guided manoeuvring of limbs 3+ times -OR- combination of guided manoeuvring and more help 1-12 times
4	Extensive assistance: weight-bearing support 3+ times by 1 helper where person still performs 50% or more of subtasks
5	Maximal assistance: weight-bearing support 3+ times by 2+ helpers -OR- weight-bearing support for more than 50% of subtasks
6	Total dependence: full performance by other(s) during entire period
8	Activity did not occur during entire period

The scores for each ADL can then be converted into aggregate metrics that can inform the expected level of dependence and likely setting of care that the individual may require (36). While being a more complex method of assessment than others, the RAI ADL measurement demonstrates high test-retest reliability and inter-rater reliability (with 71% demonstrating $\kappa > 0.6$) (33). These tools have been found to be effective in assessing functional status on inpatients, and indeed have found similar results to previously reported research concerning changes in function over the course of admission (18). Early comparisons of disease-specific functional measures to the InterRAI approach suggest that the use of a model derived from interRAI functional assessment items can accurately predict functional outcomes within patients with heart failure, and may actually be superior to the NYHA in terms of functional needs and care planning (37).

1.5 Inpatient functional status and post-discharge outcomes

While function has been widely used to describe the characteristic of cohorts (38), measure their disability over time (39), and demonstrate changes seen with hospitalization (40), there has been little dedicated analysis of how function can effectively prognosticate outcomes in the post-discharge setting. This is an area of great interest for health care planning and great fear for individuals who do not wish to return to hospital. Much of this is likely driven by the previously highlighted lack of standardized measurements of functional status within the inpatient setting, which, while having been remedied in the last decade, has not been evenly and consistently applied across acute inpatient settings for evaluation. While there have been multiple efforts to study how common factors drive adverse post-discharge outcomes, these have not undergone analysis that provides clear contextualization of functional elements or allows for comparative consideration of the association of a given risk across multiple outcomes.

1.5.1 Functional changes during acute inpatient admissions

Studies that compared individuals across their functional status pre-admission (typically defined as functional status two weeks pre-admission through direct or collateral interviews), at admission, and at discharge demonstrate three patterns: 1) individuals who improve (e.g. required assistance pre-admission due to the burden of illness and then become independent when well), 2) individuals who have a stable functional status, and 3) individuals whose functional status declines. Literature suggests that between 30-60% acute hospital inpatients decline, approximately 10-20% improve, and the remainder are unchanged. The most consistent risk factor associated with declining function compared to other outcomes is increasing age (19,40,41); other factors include delirium, newly diagnosed or pre-existing cognitive impairment, cancer, and decreased social activity (42).

The majority of studies have looked at the interval between pre-morbid and discharge function; those that continued to follow up patients post-discharge demonstrated a strong linkage between functional status at discharge and outcomes post-discharge, (16,26,43). A study of a cohort of 559 older Israeli adults by Tonkikh et al compared the impact of pre-morbid function to in-hospital decline (44), and found that bADL decline (as measured on the Barthel index) was associated with increased re-admission (OR 1.32, 1.02-1.72); however it did not improve a model that sought to predict 30 day re-admission compared to a model that included function measured at discharge. A subgroup analysis of those who had the top 10% decline in function also did not improve the performance of the model. Across a cohort of 2279, where one third had suffered a loss in at least one of their ADLs, it was found that at 12 months only 30.1% of those who lost an ADL returned to baseline whereas 67% of those at baseline maintained their function; similar findings were seen for mortality where at 12 months there was 41.3% and 17.8% mortality respectively (OR 3.26, 2.68-3.95) (45).

1.5.2 Emergency Department presentation

No studies were found that specifically analysed post-discharge Emergency Department (ED) re-presentations; but some studies that address risks of ED re-presentations for those in the community have included previous hospital admissions as a covariate. These studies most commonly frame re-presentation risk with a person-level characteristic model that proposed three domains driving health services use: 1) predisposing characteristics (attitude and demographics), 2) enabling characteristics (access to care and support), and 3) needs for care (morbidity, functional impairment, and cognitive impairment) (46). Studies have identified a large number of risk factors associated with representation, including rurality, primary care access, previous hospitalizations, cognitive impairment, multimorbidity, sensory impairment, and nutrition concerns as factors (47). Function has been less consistently studied as a predictor, and in some studies was non-significant (48). However, in studies where it was

considered, it was often collected as survey-based or interview-based questions that collect perceived deficiencies in ADLs rather than as a standardized measurement of the individual.

Within the studies that considered function, it was found to be a predictor as part of models that predict presentations, though given the stochasticity of presenting to an ED, the models were generally poorly able to discriminate risk (0.75 in a logistic models, r^2 0.55 in multivariable linear modelling (49-51)). As an independent predictor with $p<0.01$ in linear modelling, function demonstrated OR 1.17 (95% CI 1.02-1.34) for a deficiency (self-perceived) of one to two bADLS and 1.75 (1.44-2.11) for three or more bADLs. Further models have recognized that function is likely an important consideration, but noted that many retrospective studies have difficulty including functional data without the cohort including it from an a priori perspective (52).

1.5.3 Re-hospitalizations

Two systematic reviews were found that analysed studies that predict hospital re-admission risk – one in 2011 by Kansagara et al and one in 2016 by Zhou et al that updated previous findings. Kansagara et al looked at re-hospitalization at any time point, whereas Zhou et al only considered 28 or 30 day. Furthermore, the former only looked at patients discharged from general acute care hospitals and did not look at subgroups or specific diseases (14,53). These reviews captured tools that predicted re-hospitalization across international inpatient cohorts, and demonstrated multiple factors including existing medical diagnoses, previous use of medical services, demographics, and social determinants of health which as potential predictors across the models with variable magnitudes of effect.

In Kansagara et al, measures that included previous usage of medical services as well as measurements of functional status were the most effective predictors of outcomes (14). An area under the receiver operator curve (AUROC) of 0.83 to predict re-hospitalization at 30 days was generated, although this was only on a derivation cohort of 700 individuals aged over 65 using data that was able to

be primarily collected. When considered across wider sets of administrative data, there was a much lower rate of discriminability to predict hospitalization across various time points to 1 year, with AUROC between 0.60 and 0.65 (a tool derived using Canadian data had an AUROC of 0.68 (12)). While 26 trials were included in the analysis, 14 did not consider functional considerations, 6 included function in the model building process, and only 2 included function as a covariate (including the trial which demonstrated the highest AUROC). For the 2 where function was included in the model, both measured function on an ordinal scale where the individual was asked how functionally independent they perceived they were (54,55). Of those that considered (but did not include) function in the final model, Barthel was used in one model (56) (n=168), and others used subjective measures of function (12,57), or considered iADLs either without bADLs or as equal to bADLs (58,59). Overall, the only trial that used an adequate method of assessing function had a small number of patients and used summative, aggregate scores to measure outcomes.

Within the Zhou study, the highest AUROC for older hospital patients was 0.876, seen with a model that built a scoring system using age, length of stay, and comorbidities using a national registry of patients aged 50 years or older who were hospitalized in Spain (the score was derived from a cohort of 999 086 patients and validated on 510 588) (53,60). Four trials were included in the analysis that considered function that demonstrated AUROCs of 0.661-0.728; three of these did not indicate how they determined that a patient had functional dependency and the fourth only considered this based on the severity of the stroke. Three studies also looked at rehospitalizations within a specific group, but only one considered re-hospitalization for older individuals for diseases of any cause (but only studied 227 individuals of whom 24 were re-admitted) (61-64). Of note, the analysis did not include the analysis by Tonkikh et al that demonstrated an AUROC of 0.81 for 30 day discharge (though this was also a study of a smaller cohort) (44).

Studies published after the systematic reviews further considered two subpopulations of older adults that are heavy resource users: those with heart failure and those who had undergone surgery. In a cohort of 113 Japanese patients with heart failure, it was found that motor FIM on discharge, but not on admission, was predictive of re-hospitalization, but the Charlson comorbidity index and other comorbidities were not associated with re-admission. Other associated findings were lower body mass index, decreased hemoglobin, and NYHA class (for which there would be some expected collinearity with the FIM) (65). Analysis of ADLs suggested that impairment of all bADLs except for eating (continence was also not associated with re-admission risk). These findings are recognized as indicators of both functional decline and frailty contributing to poor outcomes. The analysis of patients who had undergone surgery performed a secondary analysis on the National Surgical Quality Improvement Program Geriatric Surgery Pilot Project collected conventional demographics, comorbidities, and surgically relevant variables that included preoperative functional status classified as 'independent', 'partially dependent', or 'dependent for ADLs' as well as if their place of residence (66). Of the 5077 individuals included (those who underwent orthopaedic surgery or were already totally dependent were excluded), 26.6% suffered loss of function, 32.0% decreased mobility, and 46% either needed additional assistance or was discharged to a non-home destination. Loss of independence as well as requiring additional services were associated with higher risk of re-admission (1.7, 1.4-2.2 and 1.4, 1.3-1.7 respectively).

Within Canada the Length/Acuity/Comorbidity/ED (LACE) index and the Hospital Admission Risk Prediction (HARP) program were developed for similar purposes - the prediction of thirty day re-admission or death to highlight high risk individuals and provide appropriate interventions - and have been widely deployed (12,67). Both tools were constructed using a similar approach to many others; these were longitudinal, retrospective, opportunistic cohorts constructed from databases of hospital admissions that considered individual age, comorbidities, hospital characteristics (length of stay,

admission location, resource use), and previous care usage (ED visits and previous hospitalizations), though the method of score construction with each tool differs. LACE considered, but did not include, function as a variable (if the individual had dependency in one or more ADLs, although how dependency was assessed was unclear), whereas HARP looked at relative dependency on others for income rather than individual functional status assessment. Both demonstrated moderate AUROC of 0.711/0.694 for the derivation/validation cohorts in LACE and 0.678 and 0.705 for one- and fifteen-month risks of re-admission.

1.5.4 Admission to Long-Term Care Facilities

While function has not been as readily included in measures to predict ED re-presentation and re-hospitalization, there have been more comprehensive efforts to quantify and include functional considerations in studies that predict admission to LTCF. Both systematic reviews and meta-analyses of studies that looked at data exclusive to the United States demonstrated that when there is increased dependency in bADLs or iADLs there were higher risks of admission to long term care (although in the systematic review of 77 studies across 12 databases, only studies of 9 databases included information concerning function (15,16,68).

Both syntheses demonstrated that for those in the community, as well as acute inpatients, any impairment in ADLs was associated with an OR of 1.11 (95% CI 1.07-1.16), loss of independence of 1-2 ADLs vs 0 ADLs OR 2.45 (2.02-2.97), and impairment of 3 or more ADLs was associated with an OR of 3.25 (2.59-4.09). The only other covariates identified with an OR of 2 or greater were cognitive impairment (2.54, 1.43-4.51), prior LTCF admission (3.47, 1.88-6.37), and four or more errors on the short portable mental status questionnaire (2.33, 1.80-3.00) (15,16). These findings were confirmed by a study of outcomes in 823 inpatients aged 70 years or older, for whom function was measured as a binary variable of independent/dependent, which found that dependence in one to three bADLs was

associated with an OR of 3.32 (1.30-8.47), four to five ADLs an OR of 9.90 (4.03-24.39), and six ADLs an OR of 14.93 (6.02-37.04) for admission to a LTCF at 90 days (69).

These studies collected their data from individual data collection methods including telephone and individually completed surveys/assessments, and to the date of analysis, there were no studies that used standardized administrative datasets or the InterRAI system to assess function. A single study published after these reviews in 2011 did consider the use of interRAI-derived measures of function in prognosticating opportunity to be discharged back to their native community setting vs other destinations, based on the Method for Assigning Priority Levels (MAPLe) in acute care tool(70). The MAPLe tool uses a decision tree approach to prognosticating risk of admission to a LTCF on an ordinal scale of low to very high based on cognitive concerns and ADLs as documented in other interRAI assessments. When applied to a cohort of 1 156 individuals acutely admitted to hospital in Denmark, Finland, Iceland, Norway, Sweden, and Canada 2000 – 2001, the scale demonstrated that a lower risk MAPLe score was associated with increased odds of being discharged home. Between pre-morbid, admission, and discharge scores, the discharge score was found to have the greatest prognostic value ('low risk' score OR 19.11, 7.31-50.00 and 49.98, 15.27-163.63 for a destination of home, for Nordic and Canadian hospitals respectively) and score at admission was the least indicative. While this study suggests a robust role for function, it only considered covariates for age and whether or not their hospitalization was an acute exacerbation of an existing diagnosis, an old diagnosis, or both; there was no effective stratification by comorbidities or other covariates.

1.5.5 Mortality

Across multiple studies which measured ADLs on various scales, increasing burden of functional disability was found to be a strong predictor of mortality in older adults both during hospitalization and post-discharge, alongside increasing age, illness severity, and comorbidities (16,71,72). A study of older

patients admitted to hospitals in Italy found that those with moderate ADL dependency (Barthel index ≥20 and <40) had a Hazard Ratio (HR) 2.89 (1.72-4.9) for mortality, and severe ADL dependency (Barthel <20) HR 3.54 (2.19-5.84); 75% of individuals who died in the community need assistance with ADLs in the last month of their life (43). A study of 823 individuals aged 70 or greater in the United States similarly found dependency of four to five ADLs was associated with an OR of 1.91 (1.15-3.17) with 1 year mortality and OR 4.44 (2.69-7.35) for dependency in all 6 ADLs; these risks were markedly increased for inpatient mortality with OR 5.24 (1.12-24.39) and OR 13.70 (3.13-58.82) respectively (69). Similar studies of patients in Spain demonstrated OR 4.89 (3.29-7.26) for 6 month mortality with a Barthel Index <65, and found other important predictors in pressure ulcers OR 4.19 (2.56-6.87), polypharmacy OR 2.20 (1.62-3.00), and malnutrition OR 3.73 (2.30-6.05) (73).

Three studies sought to predict mortality, with two of them predicting it in the elderly. A small study of 207 hospitalized patients was able to predict mortality at 6 months with an AUROC of 0.66 using measures of IADL impairment, a mini mental state exam (MMSE) score <20, and/or a geriatric depression scale score >7/30, with two factors associated with RR 2.5 (1.8-3.6) (74). A second smaller study found loss of independence to be a significant covariate in a multivariable linear regression predicting mortality and length of stay (75). A larger scale, Canadian derived predictor of mortality at one year across all adult acute inpatients, which demonstrated an ROC AUC of 0.923 (0.922-0.924), included age, diagnosis, admitting service during index admission, and place of premorbid residence, but did not assess function likely due to it being unavailable within the derived administrative datasets used (13).

1.6 This study: Studying function and post-discharge outcomes through secondary data

It is clear that functional status is an important predictor of adverse outcomes for those who are being discharged from acute hospital admissions in terms of risk of admission to LTCFs and mortality. Its

role in re-hospitalization and ED presentations was less clear due to inconsistent inclusion, measurement, and analysis, but existing data suggested it was of less importance in prognosticating these outcomes as compared to LTCF admission or mortality. Given that functional status has been well connected to post-discharge outcomes, it is curious that it is not collected more regularly to assist clinically in individual prognostication as well as in system wide planning for the anticipated burden of hospital usage and LTCF admission. Furthermore, there has yet to be analyses that comparatively address the role of function across these outcomes to understand where this data may be of the greatest benefit. With an increasing burden of comorbidity, the relationship between function and outcomes in individuals with chronic disease would be of tremendous benefit as this data would allow for targeting those who are most vulnerable. Indeed, with these chronic diseases becoming both an increase priority and burden within the health care system (76,77), understanding the functional burden of Ontarians will allow for better planning of health care delivery.

1.6.1 Pragmatic opportunities in the measurement of function

The development of the interRAI instruments has allowed for accurate, pragmatic, and automatic assessment of function to be included in the base information collected for individuals with each health care encounter. Indeed, such data was collected recently with the deployment of the Health Outcomes for Better Information and Care (HOBIC) initiative, which sought to assess and collect data concerning nursing-sensitive patient conditions for the purposes of data collection and reporting as well as facilitating and standardizing transitions of care (78). Assessments of these items was performed on patient admissions and discharges from hospital inpatient visits. The HOBIC tool was deployed in both Manitoba and Ontario; data concerning HOBIC was collected from 1 March 2006 to 30 June 2015 as part of a pilot and trial implementation that was used with a goal of integrating HOBIC into routine inpatient nursing documentation.

While the routine collection of HOBIC data has yet to be completely introduced into practice, the data previously collected is available, along with a substantial number of data sets, at the Institute for Clinical Evaluative Sciences (ICES), a central repository of health administrative data for Ontario, Canada (79). These administrative datasets include both basic information (e.g. hospitalizations, outpatient visits) and dedicated cohorts (e.g. people living with HIV), many of which are updated regularly, but some only for dedicated periods of time based on funding and priorities. HOBIC data has undergone descriptive analysis and had some measures analyzed (78,80). Information concerning functional outcomes, however, has yet to be scrutinized to demonstrate whether or not routine nursing-driven data collection of functional status information is as reliable as dedicated tools. This data represents a novel opportunity to assess this data, to provide a comprehensive analysis of what the functional status of older Ontarians is when they experience episodes of acute care in hospitals, and to contextualize and comparatively analyze how functional status impacts post-discharge outcomes.

2 Objective, Research Questions, and Hypotheses

This study aims to perform a secondary analysis of the pre-existing HOBIC database within ICES to create a retrospective cohort that informs the role that functional status, in comparison to more conventional covariates including demographics, morbidity, and admission characteristics, plays in understanding the risk of post-discharge hospital ED re-presentation, hospital re-admission, LTCF admission, and mortality. Specifically, the study seeks to answer the following research questions.

1) For a cohort of patients aged 65 or older, acutely admitted to a hospital in Ontario 2008-2016 captured within ICES data, what are the demographics, functional characteristics, comorbidities, and previous health service usage trends of the cohort?

    Hypothesis: The cohort will demonstrate characteristics similar to those demonstrated in census data as well as similar cohorts in other western countries.

2) For the identified cohort, what is the value of functional status measurements in predicting ED-representation, hospitalization, LTCF admission, and mortality at 30 and 180 days when adjusted for comorbidities, demographics, and health service usage?

    Hypothesis: Function will be a significant predictor across all outcomes, but will be the most prognostic in assessing future risk of LTCF admission or death

3) Secondary objective: within the cohort, what is the comparative impact of function across the above outcomes for individuals with various high-prevalence, high-morbidity chronic diseases including heart failure, chronic obstructive pulmonary disease, asthma, diabetes, hypertension, epilepsy, stroke, injurious falls, delirium, and dementia?

    Hypothesis: For disease processes where symptom burden or the nature of the resultant impairment is associated with ADLs, such as delirium and heart failure, functional status measures will have a greater association with the above outcomes than in other conditions.

3 Methods

3.1 Study Design & Settings

This was a retrospective observational cohort study that analyzed outcomes concerning hospital inpatients in Ontario, Canada between 2008 and 2016. It was reviewed and approved by the Hamilton Integrated Research Ethics Board, approval number 5629-C. It is reported in accordance with the format endorsed by the Strengthening the Reporting of Observational Studies (STROBE) Initiative (81).

3.2 Data Sources & Measurement

The analytic cohort for this study was constructed from several databases housed at ICES. Linkage across databases was able to be achieved by contact with any aspect of health care linked through an individual's ICES Key Number, an anonymized but unique individual key number (IKN) across all databases (82). The cohort was initially selected from available individuals within the discharge abstract database (DAD) and the HOBIC database. The DAD contains information concerning each acute inpatient hospital admission including details of stay, comorbidities recorded at discharge, and discharge destination.

The HOBIC database is a repository for information collected through the HOBIC initiative, for which the primary output was the completion of the HOBIC assessment tool at admission and at discharge by nurses who were trained in it's administration (34). The HOBIC tool was used to assess individuals across four domains: functional status (measured as continence and ADLs), symptom burden, person safety, and therapeutic self-care. The first three domains were assessed using interRAI AC assessments, the RAI ADL measure, RAI continence measure, pain RAI scale, and the RAI measures of falls and pressure ulcers respectively. Function was assessed using the RAI ADL scale (detailed in section 1.4) for each ADL and continence based on the frequency with which the individual has urinary incontinence. Pain, fatigue, dyspnea and nausea were assessed based on if they were absent, present

with moderate activities, present with minimal activities, or present at rest; pain was also assessed using a visual analogue severity scale that assesses pain intensity from zero to ten along a line. Safety was assessed by the number of falls sustained within the last ninety days and, if present, the severity of any pressure ulcers that may have occurred. While these items have not been assessed for their psychometric validity within the HOBIC assessment specifically, they have been extensively assessed with the development of the interRAI AC, where each has a demonstrated $\kappa > 0.6$ indicating substantial inter-rater agreement both of specific populations and across different care settings (post-acute care, LTCFs, home care, palliative care) and consistent across national settings (31,33).

The final domain, therapeutic self-care, assessed a patient's insight into their conditions and perceived capacity to self-manage their burdens of disease, was constructed by Sidani & Doran (83). This domain was introduced as a *de novo* item in acute care with a view that such information could help nurses empower patients prior to discharge to avoid preventable admissions (34). Self-care items were selected based on identified activities that were critical for an individual to recognize, address, and remedy in order to manage one's burden of chronic disease. They include measures addressing understanding and appropriate use of medications, recognizing and managing burdens of symptoms, insight into how their burden of disease impacts day-to-day life, and knowing how to get help when needed. They were assessed as a series of plain language questions designed to be readily understood, where the respondent rated their knowledge on a Likert-like scale of zero to five, with zero representing no knowledge at all of how to answer the question and five indicating that the respondent very much knew how to respond to the question. The self-care scale was found to have low redundancy and construct validity on testing of the initially-proposed self-care scale, as burden of symptoms and psychological distress were negatively correlated with self-care (83).

Upon selection of the individuals to be included in the cohort from the HOBIC and DAD databases, relevant information concerning individual covariates were found through IKN linkage on

four other databases. These included the Registered Persons Database (RPDB), which collects census data that provides demographic and geographic information for the cohort, the Ontario Health Insurance Program (OHIP) database that provides information concerning the physicians they have seen for care and the frequency with which they have been seen, the National Ambulatory Care Reporting System (NACRS) database which provides information concerning emergency department and outpatient presentations, and the Continuing Care Reporting System (CCRS) database which contains information concerning individuals who are admitted to LTCFs for ongoing care.

3.3 Participants

Participants were selected from the DAD if they were discharged from hospital between the dates that HOBIC data was collected in its database (4 November 2008 to 18 March 2016) and it was demonstrated, via linkage through their IKN, that a HOBIC assessment had been completed for the patient either at admission or discharge (the 'index admission'). While reliability of the collection of InterRAI assessment elements in HOBIC has been previously established, demonstrable variation was seen in how HOBIC data was collected between hospitals in Ontario (78). As such, it was recognized that even with training, unless a sufficient number of HOBIC assessments had been completed, the reliability of the data would be questionable. Thus, to maximize reliability and validity of the assessments, a series of exclusion criteria were applied to the cohort based on how various facilities carried out HOBIC assessments. As HOBIC data was collected by trained nurses, it was thought that each facility for which HOBIC data was available should have a minimum number of completed HOBICs to ensure that the assessors performed them regularly to provide the most reliable results. The criteria used to determine if a facility had completed enough assessments can be seen in Table 3. Only hospitals whose data satisfied all three requirements would have their data included for further analysis.

Table 3: Inclusion criteria applied to each acute care facility to ensure that they had completed a sufficient number of HOBICs both consistently and reliably to be included in the cohort.

Inclusion Criteria	Rationale
The facility must have completed at least 100 HOBIC assessments during the study period	Each trained facility must have enough patients and completed HOBICs such that those who were trained could complete internally consistent assessments
At least five percent of all patients at the facility must have undergone a HOBIC assessment	The hospital must ensure that HOBIC was well enough deployed that a substantial number of patients were undergoing HOBIC assessments
At least two of three months per quarter must have ≥25% of the average number of monthly HOBICs	There should be no period where there are significantly fewer HOBICs were completed, potentially indicating that key HOBIC assessors were not present at the facility at that time and potentially reducing the quality of the assessments

Upon selecting records of individuals who had HOBIC records from hospitals that satisfied inclusion criteria for HOBIC completion, a set of exclusion criteria were applied to ensure that only the appropriate population was included within the cohort, as summarized in Table 4. Individuals under the age of 65 at the time of their index discharge were excluded in order to select older Ontarians, and, to ensure that they were admitted from the community due to an unplanned need, those who were admitted from a LTCF, those who were admitted electively, and those who were transferred from other hospitals were excluded. To address pre-existing morbidity and those who would have increased hospital use regardless of functional status, those who flagged to be undergoing dialysis or chemotherapy were also excluded.

Table 4: Exclusion criteria applied to individuals admitted to facilities included.

Exclusion Criteria	Rationale
Age <65 on admission	Ensure that only older Ontarians are included
Admitted from LTCF, electively, or from other hospital	Patients had already experienced the key outcome and/or are functionally disabled; transfers/elective may indicate non-acute medical concerns
Undergoing dialysis or chemotherapy	These were individuals who will experience hospital and ED-representation regardless of their functional status
Discharged to LTCF, LTCF wait list, complex care or rehab, palliative care,	Patients were already discharged to an outcome where they are functionally impaired or moribund requiring additional health care services.

A similar approach was applied at discharge, where those who could not be at risk of experiencing any of the panel of outcomes were excluded. As such those who died, were discharged to a LTCF or to a LTCF wait list (as these individuals were deemed to be having already declined to a functional status or did not have sufficient supports that eventuated in them requiring admission to a LTCF), to a complex care facility (as they were not discharged to the community and by definition have escalated care needs), or to a palliative care facility (as they are expected to have end-stage function) were excluded. While many of these individuals (most notably those in LTCFs) were at risk for post-discharge ED or hospital use, they had already been discharged to a specific location due to degradation in their level of function compared to those discharged to the community, and were also excluded. Patients who had multiple admissions were kept within the cohort as each hospitalization could be studied for outcomes separately as the follow up for a given admission was only six months.

3.4 Variable selection and handling

3.4.1 Measurement of Function

The raw RAI ADL scores can be aggregated into several different summary measures of overall functional status, as proposed by Morris, Fries & Morris in 1999, with each measure being found to have different utility (36). A basic scale, the ADL-long form scale, was calculated from the sum of each ADL item score, which was designed to maximize differences between individuals and thus be the most sensitive to changes over time. Analysis of the long form score, however, demonstrated that individual ADLs tend to be lost in a pattern that spanned from early to late loss indicating progressive disability and increased care needs. Based on this, two further tools were proposed: the ADL-short form and the ADL hierarchy. The ADL-short form includes one early loss item (personal hygiene), two from middle stages of functional loss (toileting, locomotion), and one item from late loss (eating); it was designed to provide 'staging' of ADL loss for individuals.

The ADL hierarchy, on the other hand, combined these items into a synthetic hierarchy that gave a global categorical score of zero to six that indicated the overall level of care a given individual required, and was designed to create clinically distinguishable functional phenotypes that separate the usual amount of care required (Figure 1).

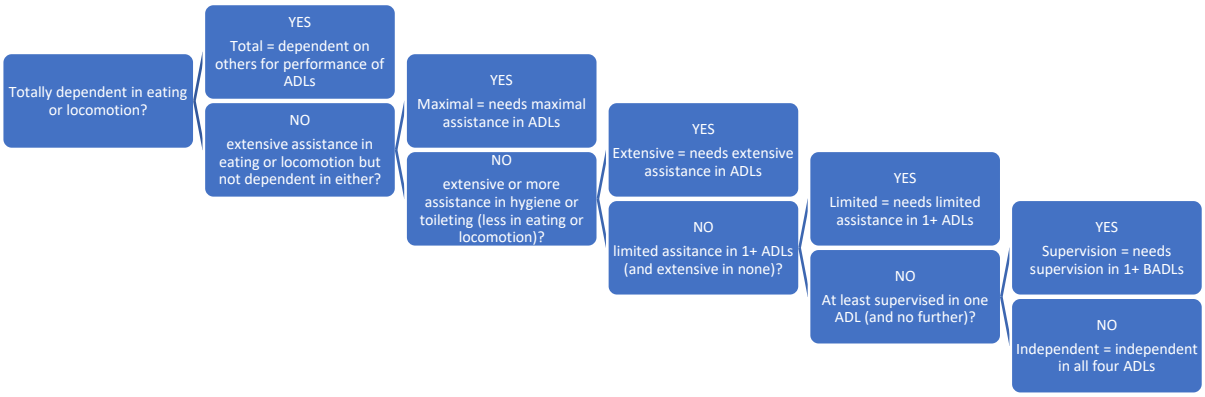

Figure 1: Method of determining the ADL hierarchy, adapted from (36).

The ADL hierarchy has been used most extensively, although all tools are recognized as summative assessments of ADLs when performed with HOBIC/InterRAI (70,84). As this analysis was focused on clinically meaningful outcomes, the ADL hierarchies that were recorded at admission and discharge (AADLH and DADLH respectively) were used as the severity scale of function for analysis, with the long form score used in sensitivity analyses. Only a small number of individuals were discharged as ADL hierarchy rank six, or completely dependent (AADLH = 3335 or 3.54%, DADLH = 1065 or 1.34%). As such those who were hierarchy rank five or six were combined as they were thought to be equally markedly dependent on others to carry out their BADLs and were individually too small to carry out appropriate analysis. Frailty scores, which have been previously derived from similar data (85), were also considered for inclusion; however, these have been previously derived using interRAI AC assessments and there was insufficient data to calculate them using HOBIC. Further, given that frailty metrics are metrics designed to assess one's risk of adverse health events based on comorbidity and functional

status, these findings would be to some extent collinear with the analysis performed and create interpretive ambiguity.

3.4.2 Demographics

Covariates included in the study were largely based on two groups of literature: studies that prognosticated the outcomes in question and studied that looked at outcomes derived from the ICES database in order to understand which variables had demonstrated utility. Four groups of variables, in addition to function, emerged as important considerations: individual demographics, acute admission characteristics (16), previous health service usage such as family physician visits (86-88), and comorbidities (12,77). A lookback period of one year from the index date was included to capture information concerning previous health care consumption behaviour and other health characteristics.

Age and sex were derived from the RPDB; age was classified using five-year age brackets until one age bracket included all aged 90 or more. Whether or not one lived in a rural location and which local health integration network (LHIN, the method by which the health administration in Ontario was recently divided) were derived from the RPDB and included as access to care can be a practical limitation impairing access to primary care or potentially leading to accelerated admission to LTCFs. Rurality was included as a binary categorical variable. Similarly, income quintile as derived based on the average quintile of that postal code was included as a categorical variable as this has previously been demonstrated to impact hospitalization rates (77), possibly due to similar pathways of increased access care as well as potentially increased health literacy (89).

3.4.3 Previous Health Service Usage

Primary care provider usage and continuity has been demonstrably linked to management of chronic diseases, emergency department presentations, and hospitalizations; within Ontario, the

structure of the organization that provides primary care has also been linked to small variations in outcomes (77,86,88,90). The Usual Provider Index (UPI) is the most commonly used measure to demonstrate this linkage; it operates by looking at the fraction of all primary care visits that are provided by the main primary care provider, where a lower UPI indicates less continuity and is associated with increased risk of presenting for further care. It is suggested that this effect is driven by improved management of chronic diseases as well as patient familiarity providing early recognition and potentially early treatment of illness, as well as reducing the need for ED visits by being a preferred care provider (87,91). Data concerning the UPI was derived from primary care visits documented in the OHIP database using the same method previously published for extracting such information from ICES data, however using only a one year lookback period (92).

3.4.4 Patient Admission Characteristics

All factors concerning details of patient admissions were extracted as covariates from the DAD. Length of stay (LOS), functional decline, and outcomes have a clear relationship with re-admission and discharge destination; increased number of ADL difficulties being associated with increased LOS (16,18). Similarly, admission to the intensive care unit (ICU) occurs with an individual who has a more severe illness and would be more prone to functional decline and adverse outcomes (93). Discharge diagnoses were extracted separately (using the dx10code1, the first listed discharge diagnosis) across age brackets and the top ten average discharge diagnoses by number were included as individual variables for independent effects within the regression. Elective surgeries were excluded; having undergone unplanned surgery was considered as a covariate/flag but not included as diagnoses were thought to sufficiently represent major surgical diagnoses that could affect outcomes.

3.4.5 Aggregate Comorbidities

Comorbidity and are well-linked to functional outcomes, with increasing morbidity linked to functional decline though not necessarily further outcomes (94). As such, morbidity was mapped across both quantitative and qualitative axes to ensure it was sufficiently accounted for. In understanding individual burdens of disease, it was impractical to consider every single possible comorbidity as a separate variable, and as such an aggregate measure was used to reflect an individual's overall level of morbidity. Individual comorbidities were considered as both an aggregate measure as well as individual factors. Multiple methods of calculating morbidity have been proposed, two common ones include the Charlson Comorbidity index (CCI) and the Johns Hopkins Adjusted Clinical Group, which create composite scores that measure morbidity based on medical comorbidities, the acuity of their comorbidities, and psychosocial stressors (coded as whether their morbidity was causing limited, recurrent, or persistent impact on their day-to-day function and if it was occurring in a stable or unstable fashion). Both methods have demonstrated comparable prognostic value in predicting mortality in Ontario (95). Given the variables to be extracted within the constructed cohort, it was decided that the CCI could be more readily and accurately constructed using the data, and as such it was used as the dedicated measure of degree of morbidity. The CCI was able to be derived using ICD-10 codes and prefixes listed in the DAD using methods previously described by Quan et al. (96).

3.4.6 Individual Comorbidities

There are several chronic diseases, however, which are highlighted to have an important interplay with function that were also isolated as individual variables both for consideration within the wider analysis as well as subgrouping. These diseases are recognized as two groups: age-related diseases (ARDs), and ambulatory care sensitive conditions (ACSCs). ARDs consist of delirium, dementia, and falls are all diseases that are heavily interrelated with one's functional capacity, with incapacitation

both worsening the burden of disease, and the presence of these comorbidities impacting function and often leading to early hospitalization, placement in long-term care, or death (16,38,39,68). ACSCs, on the other hand, are a list of conditions that have been previously recognized and highlighted by groups including the Canadian Institute for Health Information as chronic diseases that are significant contributors to health care costs and are an increasing burden in an aging country (97); they include asthma, chronic obstructive pulmonary disease, angina, heart failure, hypertension, type II diabetes mellitus, and epilepsy. A separate variable was also created for those with a diagnosis of coronary artery disease as manifest by a history or presenting diagnosis of myocardial infarction, angina, or stable coronary disease, as well as those who presented with either pneumonia or a urinary tract infection.

Whether or not an individual had an ARD or ACSC (using International Classification of Disease edition 10 (ICD-10) coding) was determined from the list of comorbidities that was listed for each individual within their DAD using a modification of the method first illustrated by Hux and Tang (98,99). It was stipulated that the presence of a given disease on a hospital discharge abstract (as listed in the DAD) was sufficient to diagnose a given condition and diagnoses were thus made for the purposes of this analysis through this fashion. Analyses have also extracted diagnoses using serial listings in NACRS; however, given the limited look-back period used within this study it was decided that hospital discharges would only be used to ensure diagnostic accuracy, although this may be associated with under-reporting of comorbidities as it has been previously reported that only approximately 75% of comorbidities listed on DAD compared to those found by independent data abstractors (100). The presence/absence of each disease was included as a binary categorical variable; specific ICD-10 codes used for each disease can be seen in Appendix A.

3.5 Outcome measurement

Preliminary analysis suggested that AADLH and admission functional information was less reliable than that gathered at discharge (see section 4.3.2), and previous literature has indicated that discharge, not admission, functional status is a more important post-discharge consideration (44,70). As such, results are stratified by DADLH; however, admission functional status was considered as a possible class variable for consideration across both *a priori* and parsimonious model builds.

Given that function has been found to variably impact post-discharge ED re-presentation, hospital re-admission, mortality, and LTCF admission, but has not been assessed in comparison across a common cohort, each of these outcome was independently assessed to allow for a comprehensive exploration of the influence of function across different outcomes and different periods of time. Outcomes for emergency re-presentation and hospitalization were considered at both 30- and 180-days (if an individual experienced an event at 30-days they were also included in 180-day outcomes) as these may represent a different group of events. 30-day visits likely more representative of stochastic effects and failed discharges, whereas 180-day visits are more likely to represent a decline in function.

Data concerning ED re-presentation and hospital re-admission were extracted from the NACRS and DAD by linking anonymized individuals to their next health care encounter from the discharge date of their index hospitalization, and, if they had a re-admission or emergency re-presentation, the time-to-event was recorded. The CCRS was used to determine if a patient was either placed on the wait list or admitted to a LTCF. These were treated as equivalent endpoints as they demonstrated that the person had reached sufficient functional- and health-related comorbidity that they were unable to be successfully supported in the community, despite supports available, and were combined as an outcome termed 'LTC readiness.' Finally, whether an individual died and the time to death was extracted from the RPDB.

3.6 Potential Biases

The main bias of concern was representativeness across both hospitals/geography as well as the population contained within the final cohort. In terms of geographic representation, the number of hospitals and their LHINs were analysed for trends as were the temporal variations in when individuals who underwent HOBIC assessments were included in the cohort, and if there were trends in the geography and rurality of those included (101).

3.7 Statistical Methods

3.7.1 Descriptive analysis

Total numbers of those included into and excluded from the cohort as well as those included who had a sufficient quantity of the HOBIC to have an ADL hierarchy completed were tabulated. The number of admissions across both institutions and years included were scrutinized for variability. Within the final cohort, their demographics by age group, sex, LHIN of residence, distribution of admission and discharge ADL scores, AADLHs and DADLHs, UPI, family doctor visits, comorbidities (ARDs and ACSCs), and index admission characteristics (length of stay, admission to ICU, discharge diagnosis) were calculated. Those who had missing data that did not allow for calculation of their ADL hierarchy were included as able for individual variable analysis, but did not undergo imputation or partial inclusion into subsequent analysis. Outcomes were calculated both individually and as a composite of any outcome at 180 days. They were calculated across both the entire cohort as well as stratified by age, DADLH, and a pre-specified group of ACSCs/ARDs that are common and high consumers of health care: CHF, COPD, CAD, delirium, dementia, and injurious falls.

3.7.2 Regression analysis

Internal validity of the data was explored by comparing frequencies of AADLHs and DADLHs, frequencies of changes in hierarchy scores, and linear regression of AADLH, DADLH, and both admission

and discharge long form scores as both univariate and multivariable regressions that controlled for age and sex. These outcomes were then scrutinized for factors that predict changes in discharge status.

DADLH was then analysed as a class variable (on an ordinal scale from zero = completely independently carrying out bADLs to five = maximally or totally dependent to carry out bADLs) using multivariable logistic regression as it was the measurement of an individual's functional status upon their return to the community. The model initially included age, sex, CCI, and length of stay as covariates. Iterative models were then tested and compared to determine if demographics (LHIN, rurality, income quintile), previous health care consumption (UPI, previous family physician visits) comorbidities (ACSCs, ARDs), and combinations thereof influenced DADLH. The following variables were treated as class variables: age group (reference age 65-69), discharge hierarchy (reference hierarchy independent or class zero), income quintile (reference quintile one or highest income), and patient LHIN (the LHIN with the lowest rates of hospital admissions was used as reference). Goodness-of-fit was determined using the AUROC and regression calibration plots stratified by age. The Hosmer-Lemeshow test was not used as it has been demonstrated to be an inappropriate assessment of goodness of fit for large datasets (102), and calibration plots can provide a similarly satisfactory visual assessment of goodness of fit in similar contexts. In the analysis of van Walraven et al, calibration was stratified across risk vigntiles, however, given that this analysis was not optimized across such predictive risk strata, the natural strata used for the analysis were used to illustrate goodness-of-fit (13).

Multicollinearity was assessed via tolerance and variance inflation factor of the regressions performed as linear regressions as well as assessing for a standard error greater than 2.0 for any of the logistic coefficients; collinear variables were either removed or combined as appropriate. The *a priori* models were then assessed in conjunction with the analysis of multicollinearity in order to determine the model that optimized both AUROCs and covariates. Preliminary analysis demonstrated that LTCF was the model with the greatest discriminability (i.e. highest AUROC) and it was used as the outcome in

the initial *a* priori modelling for selection of the appropriate variable set to be used across all other outcomes. Sensitivity analysis was performed using the ADL long form, and individual ADL scores. A secondary sensitivity analysis was completed by comparing the *a priori* analysis was then compared to a best subset selection forward analysis using a method documented by Furnival and Wilson (103) that optimized the selection based on the largest model for which all selected variables were found to be predictive (their OR did not include 1).

For the regression equation identified across each outcome, a subgroup analysis was performed on individuals across the same diagnoses addressed in the descriptive analysis. These were compared to observe for how underlying diseases may influence outcomes.

This analytic process was also completed for time-to-event using survival analysis via a Cox proportional hazard using an iterative approach including similar class variables. Competitive risk models were also performed comparing emergency department re-presentation and admission to hospital as well as comparing LTCF readiness and mortality. Results were compared to that of the logistic regression.

All analyses were completed using SAS version 9.4 (104).

4 Results

4.1 Cohort Construction

Cohort construction is summarized in Figure 2. Across the study period, 10 248 661 records were found in the DAD. Of the 184 hospitals with HOBIC linked data, 53 were included based on the minimum HOBIC criteria laid out in Table 3. Only two discharges from 2006 satisfied these criteria, and were removed to avoid small record numbers that could render the anonymized ICES information identifiable. This initial exclusion removed 85.5% of eligible DAD records. 440 322 remaining entries had any HOBIC assessment items completed at admission and/or discharge. 261 376 (2.55%) were excluded for ineligible admission characteristics (admitted from LTCF, etc), and 39 146 (0.38%) were excluded as they were not discharged to the community. 139 798 or 1.36% of the original records were thus included for final analysis. Of the 145 265 admissions, 19 039 or 13.1% were repeat admissions.

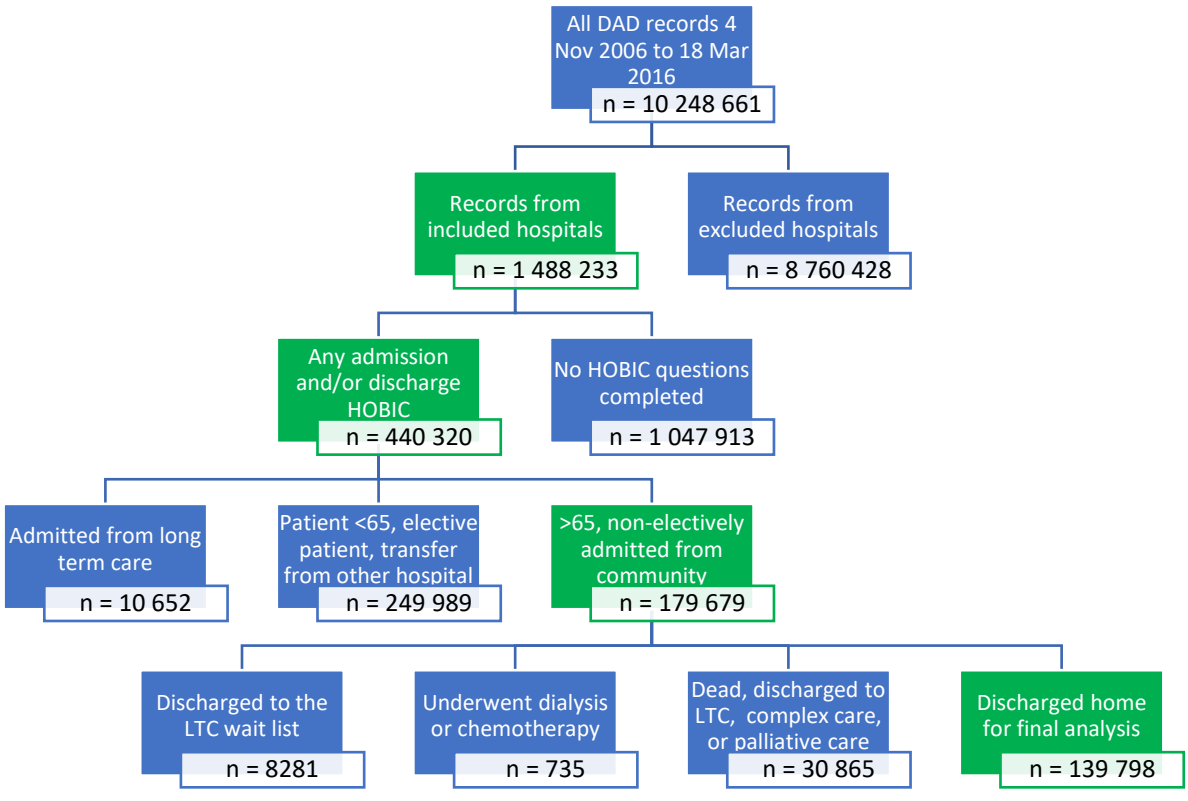

Figure 2: Flowchart demonstrating the creation of the cohort and those included and excluded at each step of cohort creation. Green boxes indicate the portion of the cohort carried forward.

4.2 Cohort validation

Frequency distributions of the cohort across years of admission as well as the LHINs, stratified by both age as well as AADLH and DADLH, were performed to determine if there were any clear distribution asymmetries and can be seen in Appendix B. It was found that there were fewer HOBIC assessments completed during the pilot phases of the HOBIC database 2007 to 2009 (34), as well as at the end of HOBIC in 2015, with the greatest number of HOBICs being completed in 2011 and 2014 (24 310 and 24 986 respectively). The proportion of HOBICs completed across each age group was stable, as was the distribution of both AADLH and DADLH by year. Similarly, analysis of HOBICs completed by month demonstrated consistent numbers of HOBIC assessments completed, though there was a clear increase per month 2006 – 2008 and a clear decrease 2015 – 2016.

After undergoing exclusion, few HOBIC assessments remained for consideration from LHIN 14 in North Western Ontario, which was expected given the rural and remote populations and small hospital bed numbers for which few would have had sufficient HOBIC assessments to meet criteria for inclusion. Several assessments were censored due to concerns of small numbers and potential identification as per ICES protocols (105). When considered across the proportion that lived in rural areas, 18.5% overall were classified as rural. There was a similar distribution across age groups, but there was variation across the number of individuals that lived rurally in each LHIN. The overall rural rate of 18.5% is higher than census data indicating 14% of Ontarians lived rurally in 2011 (106).

4.2.1 HOBIC Completion Rates

Rates of HOBIC completion per assessment item are seen in Table 5. The RAI ADL items were the items most frequently completed across the entire HOBIC assessment. 94 167 (67.4% of cohort) admission records had recorded measurements of the four ADLs required to calculate the ADL hierarchy; 93 417 had all seven ADLs measured (99.2% of ADL hierarchies). On discharge, 79 298 (56.7%

of cohort) ADL hierarchies could be calculated and 78 584 (99.1%) of all DADLH had all seven ADLs measured.

Table 5: Rates of completion of HOBIC items during admission and discharge assessments.

Item	Activity Assessed	Admission HOBIC (%)	Discharge HOBIC (%)
1	**How one takes a bath or shower, including how one transfers in and out of tub/shower and how parts of body are washed**	**89.8**	**93.6**
2	**How one manages personal hygiene including combing hair, brushing teeth, shaving, make-up, and washing face and hands**	**89.9**	**93.5**
3	**How one walks around the same floor**	**89.2**	**93.6**
4	**How one moves on and off a toilet or commode**	**88.4**	**93.3**
5	**How one uses the toilet/commode/bedpan, cleans themselves after use, changes pad, manages ostomy, or adjusts clothes**	**88.5**	**93.4**
6	**How one moves to and from lying position in bed, turns from side to side, and positions themselves in bed**	**89.4**	**93.3**
7	**How one eats and drinks including tube feeds, TPN, etc.**	**87.3**	**93.2**
8	Bladder continence	85.7	93.2
9	Frequency of pain demonstrated in 24 hours	87.7	93.2
10	Intensity of pain demonstrated in 24 hours	82.6	85.8
11	Severity of fatigue within the last 24 hours	87.6	93.5
12	Severity of dyspnea in the last 24 hours	85.6	93.3
13	Severity of nausea in the last 24 hours	85.9	93.0
14	Frequency of falls in the last 24 hours	86.1	91.3
15	Severity of current pressure ulcers	84.6	91.9
16	Patient's knowledge of the medications they take	30.2	30.1
17	Patient's knowledge of why they take their medications	30.1	30.1
18	Patient's capacity to take their medications	30.0	30.0
19	Patient's capacity to recognize symptoms	30.1	29.9
20	Patients understanding of how symptoms relate to their disease	30.1	29.8
21	Patient's knowledge of how to manage symptoms	30.0	29.8
22	Patient's knowledge of how to use symptom management	30.0	29.8
23	Patient's ability to manage their health in general	30.1	29.8
24	Knowing who to contact for help in carrying out ADLs	30.0	29.8
25	Knowing who to contact in a medical emergency	30.0	29.8
26	Self-perceived ability to perform BADLs/IADLs	30.0	29.8
27	Able to adjust regular activities with symptoms	29.9	29.8
29	Family's knowledge of the medications they take	65.5	71.3
30	Family's knowledge of why they take their medications	65.8	71.3
31	Patient's capacity to take their medications	65.3	71.1
32	Patient's capacity to recognize symptoms	65.3	70.9
33	Patient's capacity to manage symptoms	65.2	70.8
34	Ability to carry out every day activities	65.3	71.1
35	Have someone to call for help with every day activities	65.3	71.0
36	Know who to call in a medical emergency	65.0	70.8

4.3 Cohort Characteristics

4.3.1 Co-variables

Demographics, comorbidities, health care utilization, and details of the index admission of the cohort can be seen in Tables 6-9 stratified by both age as well as DADLH. Discharge diagnoses for the index admissions can be seen in Appendix C.

Table 6: Demographics and admission details of the cohort, stratified by age group.

	65-69		**70-74**		**75-79**	
		95% CI		**95% CI**		**95% CI**
N	26 194		26 258		27 800	
Percent female	44.5%	(43.9-45.1)	47.3%	(46.7-47.9)	49.5%	(48.9-50.1)
Income quintile*	3	(2-4)	3	(2-4)	3	(2-4)
Rurality	19.1%	(18.6-19.6)	19.8%	(19.3-20.2)	19.0%	(18.5-19.4)
FP visits	0.87	(0.86-0.88)	0.90	(0.88-0.91)	0.89	(0.88-0.90)
UPI	36.1	(35.9-36.4)	36.0	(35.8-36.3)	36.1	(35.9-36.4)
Admission Length*	4	(2-7)	4	(3-8)	5	(3-9)
Admission <7 days	75.5%	(75-76.1)	73.4%	(72.9-74)	70.0%	(69.5-70.6)
Admitted to ICU	17.9%	(17.5-18.4)	15.9%	(15.5-16.4)	13.9%	(13.5-14.3)
	80-84		**85-89**		**90+**	
N	28 077		20 443		11 026	
Percent female	52.3%	(51.7-52.9)	58.5%	(57.9-59.2)	65.5%	(64.6-66.4)
Income quintile*	3	(2-4)	3	(2-4)	3	(1-4)
Rurality	18.1%	(17.6-18.5)	17.3%	(16.8-17.8)	16.6%	(15.9-17.3)
FP visits	0.87	(0.85-0.88)	0.80	(0.79-0.81)	0.71	(0.70-0.73)
UPI	37.6	(37.3-37.8)	39.5	(39.2-39.8)	43.3	(42.8-43.7)
Admission Length*	5	(3-9)	6	(3-10)	6	(3-11)
Admission <7 days	66.4%	(65.8-66.9)	63.6%	(63-64.3)	60.3%	(59.4-61.2)
Admitted to ICU	11.8%	(11.4-12.1)	9.0%	(8.6-9.3)	6.1%	(5.7-6.6)

* denotes median and interquartile range; FP = family physician, UPI = usual provider index, ICU = intensive care unit.

As seen in Table 6, with increasing age there were a higher proportion of females included in the cohort, though their income quintile, rurality, and LHIN distribution remained similar (Appendix B) (1). Older individuals had a higher UPI, though the number of family physician visits in the year before their index admission decreased with age. Details of admission length demonstrated longer admissions and a

lower proportion of admissions less than seven days as well as decreasing proportions of patients who were admitted to the intensive care unit during the course of their stay.

Table 7: Comorbidities of the cohort, stratified by age group.

	65-69		70-74		75-79	
		95% CI		95% CI		95% CI
Angina	11.4%	(11.1-11.8)	10.0%	(9.6-10)	9.4%	(9-9.7)
Asthma	0.8%	(0.7-0.9)	0.8%	(0.7-1)	1.0%	(0.9-1.1)
CAD	19.4%	(19-19.9)	18.5%	(18-19)	18.0%	(17.5-18.4)
Heart Failure	8.3%	(8-8.6)	10.1%	(9.8-11)	12.0%	(11.6-12.3)
COPD	10.8%	(10.4-11.2)	11.8%	(11.5-12)	12.0%	(11.7-12.4)
Delirium	1.9%	(1.7-2.1)	2.5%	(2.3-3)	3.6%	(3.4-3.8)
Dementia	0.3%	(0.2-0.4)	0.6%	(0.5-1)	1.1%	(1-1.2)
Diabetes	25.3%	(24.7-25.8)	26.1%	(25.6-27)	25.8%	(25.3-26.3)
Injurious Fall	4.8%	(4.6-5.1)	5.4%	(5.1-6)	6.2%	(5.9-6.4)
Hypertension	27.1%	(26.5-27.6)	28.9%	(28.4-29)	30.8%	(30.2-31.3)
Seizure Disorder	0.6%	(0.5-0.7)	0.5%	(0.4-1)	0.4%	(0.3-0.5)
Stroke	2.8%	(2.6-3.0)	3.1%	(2.9-3.3)	3.1%	(2.9-3.3)
CCI*	1	(0-2)	1	(0-2)	1	(0-2)
	80-84		**85-89**		**90+**	
Angina	8.7%	(8.4-9.1)	8.5%	(8.1-8.8)	8.6%	(8.1-9.2)
Asthma	0.6%	(0.5-0.7)	0.8%	(0.7-0.9)	0.7%	(0.5-0.8)
CAD	17.4%	(16.9-17.8)	16.5%	(16-17.1)	15.0%	(14.3-15.7)
Heart Failure	14.8%	(14.4-15.2)	17.0%	(16.5-17.6)	20.3%	(19.6-21.1)
COPD	11.4%	(11.1-11.8)	10.7%	(10.3-11.1)	9.3%	(8.7-9.8)
Delirium	4.7%	(4.5-5)	6.0%	(5.7-6.4)	7.6%	(7.1-8.1)
Dementia	1.7%	(1.5-1.8)	2.1%	(1.9-2.3)	2.2%	(1.9-2.4)
Diabetes	23.1%	(22.6-23.6)	19.3%	(18.8-19.9)	13.9%	(13.3-14.6)
Injurious Fall	7.6%	(7.3-7.9)	9.9%	(9.5-10.3)	12.0%	(11.4-12.6)
Hypertension	32.2%	(31.6-32.7)	31.9%	(31.3-32.5)	32.7%	(31.8-33.5)
Seizure Disorder	0.4%	(0-0)	0.4%	(0-0)	0.2%	(0-0)
Stroke	3.2%	(3.0-3.4)	3.0%	(2.8-3.2)	2.8%	(2.5-3.2)
CCI*	1	(0-2)	1	(0-2)	1	(0-2)

* denotes median and interquartile range. CAD = coronary artery disease, COPD = chronic obstructive pulmonary disease.

The burden of comorbidities, as presented in Table 7, demonstrates that the burdens of CAD and COPD decreased with age while heart failure became an increasingly common diagnosis. Dementia, delirium, and injurious falls became increasingly common with age, with 7.6% of those 90+ having an episode of delirium associated with their admission. Hypertension and diabetes were common across the population, though diagnoses of diabetes decreased substantially in those aged 85 and older.

Seizure disorders, stroke, and asthma were uncommon across the cohort. Comparatively, however, the CCI did not substantially change across age groups. Discharge diagnoses further indicated that ACSC-related diagnoses were the most common discharge diagnoses for the index admission across both age and ADL hierarchy, with CHF, CAD, and COPD-related diagnoses the most common, reflecting the overall burden of disease.

Table 8: Demographics and admission details of the cohort, stratified by discharge ADL hierarchy.

	Independent		**Supervision**		**Limited Assistance**	
		95% CI		**95% CI**		**95% CI**
N	52 265		6 152		10 923	
Percent female	48.6	(48.2-49)	56.1	(54.8-57.3)	57.4	(56.5-58.3)
Income quintile*	3	(2-4)	3	(2-4)	3	(1-4)
Rurality	22.5	(22.2-22.9)	17.8	(16.8-18.7)	19.8	(19.1-20.6)
FP visits	0.97	(0.96-0.98)	0.86	(0.83-0.88)	0.75	(0.74-0.78)
UPI	37.5	(37.4-37.7)	37.4	(36.9-38)	37.3	(36.9-37.7)
Admission Length*	4	(2-7)	6	(3-10)	6	(3-11)
Admission <7 days	77.8	(77.5-78.2)	63.3	(62.1-64.5)	60.2	(59.3-61.1)
Admitted to ICU	13.7	(13.4-14)	14.1	(13.2-15)	12.6	(12-13.3)
	Extensive Assistance		**Maximal Assistance**		**Totally Dependent**	
N	2 484		3 255		4 219	
Percent female	52.8	(50.9-54.8)	56.8	(55.1-58.5)	54.5	(53-56)
Income quintile*	3	(1-4)	3	(2-4)	3	(1-4)
Rurality	23.3	(21.6-25)	23.5	(22.1-25)	16.4	(15.2-17.5)
FP visits	0.64	(0.6-0.67)	0.54	(0.51-0.58)	0.47	(0.44-0.5)
UPI	38.0	(37.1-38.9)	39.0	(38.2-39.7)	38.5	(37.8-39.2)
Admission Length*	7	(3-13)	8	(4-12)	7	(4-15)
Admission <7 days	55.7	(53.8-57.7)	58.8	(47.1-50.5)	52.1	(50.6-53.6)
Admitted to ICU	10.1	(9-11.3)	11.4	(10.3-12.5)	13.7	(12.6-14.7)

* denotes median and interquartile range; FP = family physician, UPI = usual provider index, ICU = intensive care unit.

When considered across DADLH, as seen in Table 8, there was a mild increase in the proportion of females in the lower function group; demographic characteristics demonstrated a lower proportion of those who were completely independent at discharge lived rurally however income quintile and LHIN were similarly distributed. UPI was also consistent, with a decreasing average number of visits to the family doctor in the year leading up to the index admission. Admission length was shorter for those who

only needed supervision in carrying out their ADLs and increased as one became more dependent with a similarly decreased proportion of those with an admission length of less than seven days. There was a relatively consistent of those who were admitted to the intensive care unit.

Table 9: Comorbidities of the cohort, stratified by discharge ADL hierarchy.

	Independent		Supervision		Limited Assistance	
		95% CI		95% CI		95% CI
Angina	10.8	(10.5-11.0)	8	(8.4-8.7)	6.7	(6.2-4.2)
Asthma	0.8	(0.8-0.9)	0.9	(0.7-1.1)	0.7	(0.5-0.8)
CAD	19.5	(19.1-19.9)	15.8	(14.9-16.7)	13.4	(12.7-14.0)
Heart Failure	12.0	(11.7-12.2)	15.9	(15-16.8)	15.4	(14.8-16.1)
COPD	10.9	(10.7-11.2)	10.9	(10.1-11.7)	11.9	(11.2-12.5)
Delirium	1.9	(1.8-2.0)	6.2	(5.6-6.8)	5.9	(5.5-6.4)
Dementia	0.4	(0.4-0.5)	2	(1.7-2.4)	1.6	(1.4-1.9)
Diabetes	21.7	(21.4-22.1)	24.5	(23.5-25.6)	24.1	(23.3-24.9)
Injurious Fall	3.3	(3.1-3.4)	8.9	(8.2-9.6)	11.5	(10.9-12.1)
HTN	28.3	(27.9-28.7)	32.8	(31.6-34)	27.2	(26.4-28.0)
Seizure Disorder	0.3	(0.2-0.3)	0.6	(0.4-0.7)	0.6	(0.4-0.7)
Stroke	2.0	(1.8-2.1)	2.7	(2.3-3.2)	2.5	(2.2-2.8)
Charlson Index*	1	(0-2)	1	(0-2)	1	(0-2)
	Extensive Assistance		**Maximal Assistance**		**Totally Dependent**	
Angina	5.7	(4.8-6.6)	4.6	(3.9-5.4)	4.7	(4.1-5.4)
Asthma	0.8	(0.5-1.2)	0.7	(0.4-1.0)	0.9	(0.6-1.2)
CAD	12.2	(11-13.5)	11.2	(10.1-12.3)	10.5	(9.6-11.5)
Heart Failure	15.9	(14.5-17.4)	15.2	(13.9-16.4)	12.6	(11.6-13.6)
COPD	11.2	(9.9-12.5)	11.0	(10.0-12.1)	8.3	(7.4-9.1)
Delirium	9.4	(8.3-10.6)	8.7	(7.8-9.7)	9.5	(8.6-10.3)
Dementia	3.6	(2.9-4.4)	3.4	(2.8-4.1)	3.7	(3.2-4.3)
Diabetes	26.1	(24.4-27.9)	24.9	(23.4-26.4)	27.4	(26.1-28.8)
Injurious Fall	9.4	(8.2-10.5)	15.1	(13.9-16.3)	13.8	(12.7-14.8)
HTN	26.8	(25.0-28.5)	30	(28.4-31.6)	32.6	(31.2-34.0)
Seizure Disorder	0.6	(0.6-0.9)	0.4	(0.4-1.0)	0.7	(0.5-1.0)
Stroke	2.8	(2.1-3.4)	4.1	(3.4-4.8)	6.1	(5.4-6.8)
Charlson Index*	1	(0-2)	1	(0-2)	1	(0-2)

* denotes median and interquartile range. CAD = coronary artery disease, COPD = chronic obstructive pulmonary disease.

Table 9 demonstrates that heart failure and COPD were consistent across DADLH, though CAD decreased as one became more functionally dependent. Delirium, dementia, injurious falls (ARDs), and strokes similarly increased, though they were more common in those who were independent than those

who required supervision. Diabetes and hypertension were consistent across the population, affecting 22-26% and 27-32% respectively; asthma and seizure disorders continued rare across the population. With worsening functional status, however, the median Charlson comorbidity status did not change.

4.3.2 Functional status

Table 10: Individual bADLs and ADL summary scores across admission and discharge, stratified by age.

		65-69		70-74		75-79	
	bADL	**Mean**	**95% CI**	**Mean**	**95% CI**	**Mean**	**95% CI**
Admission	**Bathing**	1.74	(1.7-1.77)	1.83	(1.8-1.87)	2.06	(2.03-2.1)
	Hygiene	1.20	(1.17-1.23)	1.33	(1.31-1.36)	1.59	(1.56-1.62)
	Walking	1.26	(1.23-1.29)	1.40	(1.37-1.43)	1.69	(1.66-1.72)
	Toilet Transfer	1.24	(1.21-1.27)	1.40	(1.37-1.43)	1.66	(1.63-1.7)
	Toileting	1.06	(1.03-1.09)	1.20	(1.18-1.23)	1.46	(1.43-1.49)
	Bed Mobility	0.71	(0.69-0.73)	0.82	(0.8-0.85)	1.03	(1-1.05)
	Eating	0.86	(0.83-0.88)	0.89	(0.86-0.92)	1.01	(0.98-1.03)
	ADL long form	7.99	(7.82-8.16)	8.83	(8.65-9.01)	10.42	(10.24-10.6)
	ADL Hierarchy	0	(0-2)	0	(0-3)	0	(0-4)
Discharge	**Bathing**	0.83	(0.8-0.85)	0.97	(0.94-1)	1.20	(1.17-1.23)
	Hygiene	0.54	(0.52-0.56)	0.67	(0.65-0.7)	0.88	(0.85-0.9)
	Walking	0.55	(0.53-0.58)	0.68	(0.65-0.7)	0.84	(0.82-0.87)
	Toilet Transfer	0.47	(0.45-0.49)	0.58	(0.55-0.6)	0.73	(0.7-0.75)
	Toileting	0.40	(0.38-0.42)	0.51	(0.48-0.53)	0.64	(0.62-0.66)
	Bed Mobility	0.30	(0.28-0.32)	0.39	(0.37-0.41)	0.51	(0.49-0.53)
	Eating	0.21	(0.19-0.22)	0.27	(0.26-0.28)	0.34	(0.33-0.36)
	ADL long form	3.27	(3.15-3.38)	4.03	(3.9-4.16)	5.11	(4.97-5.25)
	ADL Hierarchy*	0	(0-0)	0	(0-0)	0	(0-1)
		80-84		**85-89**		**90+**	
Admission	**Bathing**	2.33	(2.29-2.36)	2.66	(2.62-2.7)	3.18	(3.13-3.23)
	Hygiene	1.85	(1.82-1.88)	2.22	(2.18-2.25)	2.72	(2.67-2.77)
	Walking	1.99	(1.96-2.02)	2.40	(2.36-2.43)	2.88	(2.83-2.93)
	Toilet Transfer	1.95	(1.92-1.98)	2.32	(2.28-2.35)	2.79	(2.74-2.84)
	Toileting	1.73	(1.7-1.76)	2.08	(2.04-2.12)	2.56	(2.51-2.62)
	Bed Mobility	1.24	(1.22-1.27)	1.59	(1.56-1.63)	2.03	(1.99-2.08)
	Eating	1.14	(1.11-1.16)	1.30	(1.26-1.33)	1.64	(1.6-1.69)
	ADL long form	12.17	(11.98-12.35)	14.52	(14.29-14.74)	17.76	(17.44-18.07)
	ADL Hierarchy	1	(0-4)	2	(0-4)	2	(1-5)
Discharge	**Bathing**	1.48	(1.45-1.51)	1.90	(1.86-1.94)	2.52	(2.47-2.57)
	Hygiene	1.15	(1.13-1.18)	1.57	(1.54-1.61)	2.17	(2.13-2.22)
	Walking	1.11	(1.08-1.14)	1.47	(1.44-1.5)	2.02	(1.97-2.08)
	Toilet Transfer	0.98	(0.95-1)	1.31	(1.27-1.34)	1.87	(1.82-1.92)
	Toileting	0.87	(0.85-0.9)	1.19	(1.15-1.22)	1.73	(1.68-1.78)
	Bed Mobility	0.69	(0.67-0.71)	0.94	(0.91-0.97)	1.42	(1.37-1.47)
	Eating	0.46	(0.44-0.47)	0.65	(0.63-0.67)	0.99	(0.95-1.03)
	ADL long form	6.68	(6.53-6.84)	8.99	(8.79-9.2)	12.71	(12.4-13.02)
	ADL Hierarchy*	0	(0-2)	1	(0-2)	2	(0-3)

* denotes median and interquartile range

Table 11: Individual bADL and ADL summary scores across admission and discharge, stratified by DADLH.

		Independent		Supervision		Limited Assistance	
	bADL	**Mean**	**95% CI**	**Mean**	**95% CI**	**Mean**	**95% CI**
Admission	**Bathing**	1.52	(1.50-1.55)	2.94	(2.86-3.02)	3.02	(2.96-3.07)
	Hygiene	0.97	(0.96-0.99)	2.13	(2.07-2.20)	2.42	(2.36-2.47)
	Walking	0.98	(0.96-1.00)	2.45	(2.38-2.52)	2.66	(2.61-2.72)
	Toilet Transfer	0.96	(0.94-0.98)	2.37	(2.30-2.45)	2.54	(2.49-2.60)
	Toileting	0.80	(0.79-0.82)	2.01	(1.94-2.08)	2.21	(2.16-2.27)
	Bed Mobility	0.50	(0.48-0.51)	1.41	(1.35-1.47)	1.66	(1.61-1.71)
	Eating	0.64	(0.62-0.66)	1.44	(0.14-1.51)	1.44	(1.38-1.49)
	ADL long form	3.36	(6.25-6.47)	14.79	(14.39-15.20)	16.04	(15.81-16.36)
	ADL Hierarchy*	0	(0-2)	2	(0-4)	2	(1-5)
Discharge	**Bathing**	0.40	(0.39-0.41)	1.81	(1.78-1.84)	2.69	(2.67-2.72)
	Hygiene	0.089	(0.086-0.091)	1.17	(1.15-1.19)	2.45	(2.43-2.47)
	Walking	0.033	(0.032-0.035)	1.67	(1.65-1.69)	2.12	(2.1-2.14)
	Toilet Transfer	0.040	(0.037-0.043)	1.08	(1.06-1.11)	1.68	(1.65-1.7)
	Toileting	0.019	(0.018-0.020)	0.80	(0.77-0.82)	1.43	(4.41-1.46)
	Bed Mobility	0.028	(0.026-0.020)	0.53	(0.51-0.55)	1.08	(1.06-1.11)
	Eating	0.032	(0.030-0.033)	0.40	(0.38-0.42)	0.62	(0.63-0.66)
	ADL long form	0.64	(0.63-0.65)	7.46	(7.37-7.55)	12.1	(12-12.2)
	Δ from AADLH*	0	(-2-0)	-1	(-3-1)	-3	(0-1)
		Extensive Assistance		**Maximal Assistance**		**Totally Dependent**	
Admission	**Bathing**	3.69	(3.58-3.81)	4.03	(3.94-4.11)	4.65	(4.57-4.73)
	Hygiene	3.22	(3.11-3.33)	3.52	(3.43-3.61)	4.09	(4.00-4.17)
	Walking	3.16	(3.05-3.28)	4.06	(3.97-4.15)	4.74	(4.66-4.83)
	Toilet Transfer	3.19	(3.07-3.31)	3.99	(3.89-4.08)	4.62	(4.53-4.70)
	Toileting	2.95	(2.83-3.07)	3.68	(3.58-3.78)	4.31	(4.22-4.40)
	Bed Mobility	2.27	(2.17-2.38)	2.83	(2.84-3.02)	3.68	(3.59-3.76)
	Eating	1.81	(1.7-1.92)	2.19	(2.09-2.29)	3.25	(3.15-3.35)
	ADL long form	20.38	(19.7-21.05)	24.53	(23.99-25.06)	29.37	(28.86-29.88)
	ADL Hierarchy*	3	(2-5)	4	(3-5)	5	(4-5)
Discharge	**Bathing**	4.27	(4.22-4.32)	4.13	(4.09-4.18)	4.89	(4.84-4.94)
	Hygiene	4.21	(4.16-4.26)	3.90	(3.85-3.94)	4.59	(4.54-4.65)
	Walking	2.17	(2.13-2.22)	4.25	(4.23-4.27)	5.68	(5.64-5.71)
	Toilet Transfer	2.59	(2.53-2.66)	4.12	(4.09-4.16)	5.17	(5.12-5.21)
	Toileting	2.68	(2.60-2.75)	3.82	(3.77-3.88)	4.88	(4.82-4.93)
	Bed Mobility	1.68	(1.61-1.74)	3.12	(3.06-3.18)	4.16	(4.10-4.22)
	Eating	0.92	(0.89-0.96)	1.78	(1.73-1.84)	3.27	(3.20-3.35)
	ADL long form	18.52	(18.31-18.74)	25.12	(24.90-25.33)	32.65	(32.37-32.93)
	Δ from AADLH*	0	(-2-1)	0	(-1-1)	0	(0-1)

* denotes median and interquartile range

Functional status across individual ADLs and summary measures at both admission and discharge are seen in Tables 10 and 11. On admission, Individual ADL scores increased (there was more disability) across each age group (sum of ADLs 7.99 (7.82-8.16) for those 65-69, 17.76 (17.44-18.07) in

those 90+) across all ADLs with a corresponding increase in ADL hierarchy. Individuals were most likely to require assistance with bathing and were most independent with eating and bed mobility. On discharge, there was a decrease across all individual ADLs and the corresponding sum of ADLs and ADL hierarchy. Bathing and eating remained the ADLs across which there was the most and least dependence respectively.

When considered across DADLH, there was a similar increase in ADLs with bathing the most and eating the least dependent of ADLs across both admission and discharge. In considering the changes across ADL hierarchy, two main patterns were seen – for those who were maximally or totally dependent on assistance, there was minimum change in ADL long form score and ADL hierarchy; for those who required any level of support between supervision and extensive assistance, there was an overall improvement in both ADL long form as well as the ADL hierarchy. Overall, those who were discharged as maximally or totally dependent had a higher degree of ADL dependence than those in the highest age group. Similar to age, however, individuals had the highest average degree of dependence in bathing and the lowest in eating.

4.3.3 Admission and Discharge ADL Hierarchies

Table 12: Cross-tabulated admission ADL hierarchy and discharge ADL hierarchy.

		AADLH							
		0	**1**	**2**	**3**	**4**	**5**	**Unk**	**Total**
DADLH	**0**	20269	2095	3342	1169	945	3373	21072	**52265**
	1	849	554	642	209	298	836	2764	**6152**
	2	1454	360	1561	368	670	1476	5034	**10923**
	3	184	71	207	233	226	363	1200	**2484**
	4	139	57	241	124	524	688	1482	**3255**
	5	155	29	147	65	244	1568	2011	**4219**
	Unk	22475	3351	6192	2545	3965	9904	12068	**60500**
	Total	**45525**	**6517**	**12332**	**4713**	**6872**	**18208**	**45631**	**139798**

Unk = unknown

Table 13: Change in ADL hierarchy between admission and discharge stratified by admission ADL hierarchy.

		Change in ADL hierarchy at discharge											
		-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**	**Unknown**
AADLH	0						20269	849	1454	184	139	155	22475
	1					2095	554	360	71	57	29		3351
	2				3342	642	1561	207	241	147			6192
	3			1169	209	368	233	124	65				2545
	4		945	298	670	226	524	244					3965
	5	3373	836	1476	363	688	1568						9904

The relationships between admission and discharge hierarchies are seen in Tables 12 and 13. Of the 94 167 admission ADL hierarchy records, 45 525 or 48.3% were independent at admission; of the 79 298 discharge ADL hierarchy records, 52 265 or 66.0% were independent at discharge. Comparing across changes in ADL hierarchy between admission and discharge, 36.5% had some improvement in their ADLs, 54.0% had no change in their ADL hierarchy, and 9.5% had further functional impairment. The most common admission ADL hierarchy ranks were complete independence, followed by combined dependence/total dependence and needing limited assistance. The most common discharge ADL hierarchy ranks were complete independence, needing limited assistance, and needing supervision. Those with the most impaired functional status on admission (combined rank five, dependence/total dependence) were the most likely to remain disabled, with 1 568 or 15.8% remaining the same functional status on discharge, though 3 373 or 34.1% were assessed as being completely independent at discharge. As the most frequent ADL hierarchy rank seen at discharge was complete independence, regardless of one's admission functional hierarchy, it was suggested that the admission hierarchy data collected was likely artificially lowered as it reflected function at admission rather than at baseline.

Table 14: Correlation matrixes between ADL long form (LF) and ADL hierarchy scores at admission and discharge when controlled for age and sex.

Admission ADL LF	1.00			
Age	0.22	1.00		
Sex	0.07	0.12	1.00	
Discharge ADL LF	0.56	0.27	0.06	1.00
	AADL LF	Age	Sex	DADL LF

AADLH	1.00			
Age	0.18	1.00		
Sex	0.06	0.12	1.00	
DADLH	0.47	0.25	0.06	1.00
	AADLH	Age	Sex	DADLH

Correlations between admission ADL long form scores and ADL hierarchies can be seen in Table 14. Sex was found to have a low degree of correlation with both long form scores and hierarchies; age was moderately correlated in both cases; ADL long form correlations had a high degree of correlation whereas hierarchies were only moderately correlated (an expected finding given the increased granularity of long form scores). When examined as a multivariable linear correlation with the score, age, and sex, there was no appreciable change in the correlation.

4.4 Outcomes

As seen in Table 15, with increasing age, an increasing proportion of the cohort experienced any and all outcomes, with similar trends seen for those with increasing DADLH (Table 16) and thus functional impairment. 49.7% of those 65-69 had any outcome of ED presentation, hospital re-admission, death, or wait list/admission to LTCF, increasing to 66.6% of those aged 90 or older. The majority of this outcome was composed of ED presentations, although with increasing age it became increasingly comprised by death or wait list/admission to LTCF. Overall, admission/wait list to LTCF occurred more than ten times more frequently in those 90+, and happened in 19.4%. The proportion of those who experienced the outcome between those at 30 vs 180 days was relatively unchanged.

When considered across discharge ADL rank, similar trends were seen, though higher rates of outcomes were seen in those who were discharge as functionally independent compared to those who were discharged as requiring supervision (rank 1). Similar trends across composite outcomes, death, and LTCFs were seen, though those discharged as being completely dependent on ADL hierarchy were more likely to die.

Table 15: Outcomes stratified by age group.

Outcome	days	n	%	95% CI	n	%	95% CI
			65-69			**70-74**	
Any outcome	180	13028	49.7	(49.1-50.3)	13634	51.9	(51.3-52.5)
Re-admission	30	2963	11.4	(11.0-11.8)	3273	12.6	(12.2-13.0)
Re-admission	180	7077	27.0	(26.5-27.6)	7592	28.9	(28.4-29.5)
ED presentation	30	5453	21.0	(20.5-21.5)	5741	22.1	(21.6-22.6)
ED presentation	180	11488	43.9	(43.3-44.5)	12038	45.8	(45.2-46.4)
Death	180	2157	8.2	(7.9-8.6)	2446	9.3	(9.0-9.7)
LTCF readiness	180	471	1.8	(1.6-2.0)	699	2.7	(2.5-2.9)
			75-79			**80-84**	
Any outcome	180	15256	54.9	(54.3-55.5)	16234	57.8	(57.2-58.4)
Re-admission	30	3580	13.1	(12.7-13.5)	3659	13.2	(12.8-13.6)
Re-admission	180	8463	30.4	(29.9-31.0)	9075	32.3	(31.8-32.9)
ED presentation	30	6062	22.1	(21.6-22.6)	6212	22.5	(22.0-23.0)
ED presentation	180	13282	47.8	(47.2-48.4)	14083	50.2	(49.6-50.7)
Death	180	3026	10.9	(10.5-11.3)	3398	12.1	(11.7-12.5)
LTCF readiness	180	1440	5.2	(4.9-5.4)	2294	8.2	(7.8-8.5)
			85-89			**90+**	
Any outcome	180	12532	61.3	(60.6-62.0)	7340	66.6	(65.7-67.5)
Re-admission	30	2786	13.9	(13.4-14.4)	1559	14.6	(13.9-15.2)
Re-admission	180	6934	33.9	(33.3-34.6)	3902	35.4	(34.5-36.3)
ED presentation	30	4653	23.2	(22.6-23.8)	2607	24.3	(23.5-25.1)
ED presentation	180	10705	52.4	(51.7-53.0)	6001	54.4	(53.5-55.4)
Death	180	2855	14.0	(13.5-14.4)	2041	18.5	(17.8-19.2)
LTCF readiness	180	2603	12.7	(12.3-13.2)	2143	19.4	(18.7-20.2)

Table 16: Outcomes stratified by discharge ADL hierarchy.

Outcome	days	n	%	95% CI	n	%	95% CI
			Independent			**Supervision**	
Any outcome	180	26479	50.7	(50.2-51.1)	3585	58.3	(57-59.5)
Re-admission	30	5666	10.9	(10.6-11.2)	868	14.3	(13.4-15.2)
Re-admission	180	19079	31.5	(31.2-31.9)	2059	33.5	(32.3-34.6)
ED presentation	30	11133	21.4	(21-21.7)	1476	24.2	(23.1-25.4)
ED presentation	180	24174	46.3	(45.8-46.7)	3185	51.8	(50.5-53.0)
Death	180	3980	7.6	(7.4-7.8)	804	13.1	(12.2-13.9)
LTCF readiness	180	1323	2.5	(2.4-2.7)	567	9.2	(8.5-9.9)
			Limited Assist			**Extensive Assist**	
Any outcome	180	6708	61.4	(60.5-62.3)	1718	69.2	(67.3-71)
Re-admission	30	1728	16.1	(15.4-16.8)	429	17.7	(16.2-19.2)
Re-admission	180	3902	35.7	(32.3-34.6)	969	39	(37.1-40.9)
ED presentation	30	0.2771	25.7	(24.9-26.6)	681	27.9	(26.2-29.7)
ED presentation	180	5868	53.7	(52.8-54.7)	1441	58.0	(56.1-60)
Death	180	1749	16.0	(15.3-16.7)	512	20.6	(19-22.2)
LTCF readiness	180	1201	11.0	(10.4-11.6)	471	19.0	(17.4-20.5)
			Maximal Assist			**Dependent**	
Any outcome	180	2264	69.6	(68.0-71.1)	2978	70.6	(69.2-72.0)
Re-admission	30	562	18.0	(16.7-19.3)	687	17.5	(16.3-18.7)
Re-admission	180	1275	39.2	(37.5-40.8)	1581	37.5	(36.0-38.9)
ED presentation	30	819	26.3	(24.7-28.9)	951	24.2	(22.9-25.6)
ED presentation	180	1765	54.2	(52.5-55.9)	2111	50.0	(48.5-51.5)
Death	180	765	23.5	(22.0-25.0)	1108	26.3	(24.9-27.6)
LTCF readiness	180	656	20.2	(18.8-21.5)	744	17.6	(16.5-18.8)

Appendix D demonstrates that there was consistency amongst outcomes across years, and also demonstrates changes in outcomes across subgroups. When considered by disease, there were higher rates of ED re-presentation and hospital re-admission for individuals diagnosed with heart failure, COPD, and CAD. Those diagnosed with CHF were more likely to die, and all had similar rates of admission/wait list to LTCF. Those who suffered from dementia or delirium had similar rates of ED presentation, re-hospitalization, and death with higher rates of admission/wait list to LTCF. Those who suffered injurious falls had lower rates of ED-presentation or hospitalization, but also demonstrated increased wait list/admission to LTCF. These outcomes were similarly distributed by both age and discharge ADL hierarchy across all groups and subgroups.

4.5 Logistic Regression Analysis

4.5.1 Model Selection

Results of the *a priori* model selection process can be seen in Appendix E. Model 1, containing only age, comorbidity, discharge hierarchy, sex, and admission length already demonstrated an AUROC of 0.81 (0.80-0.81); the addition of other demographic variables or relevant comorbidities both marginally improved the discriminability as seen in models 2 and 3. The addition of most common discharge diagnoses to the baseline variables, as demonstrated in model 4, did not improve the model, though adding discharge diagnoses to comorbidities marginally numerically improved the discriminability of the model (0.82 (0.81-0.82), model 5). Superior discrimination was seen when demographics, comorbidities, and discharge diagnoses were used collectively in models 5, 6, and 7 (ROC both 0.84, 0.83-0.85).

When compared across tolerance and VIF, however, there was increased VIF amongst comorbidities and discharge diagnoses. To minimize multicollinearity in the model, and, given the minimal iterative benefit of discharge diagnoses to the model, they were removed from the model and included in comorbidities as seen in model 6. While this removed some non-ACSC diagnoses in the form of the common infections, pneumonia and urinary tract infections, this did not otherwise impair the model, and as such comparison across a priori models used these covariates.

4.5.2 Model Performance

Table 17: Univariate and multivariable analysis for ED re-presentation and re-hospitalization. AUROC for re-presentation 0.62 (0.62 - 0.63), re-hospitalization 0.64 (0.63 - 0.65).

	ED Presentation 180 days				Hospitalization 180 days			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Demographics								
Age 70-74*	1.08	(1.05-1.12)	1.11	(1.05-1.18)	1.10	(1.06-1.14)	1.07	(1.00-1.15)
Age 75-79*	1.17	(1.13-1.21)	1.19	(1.12-1.26)	1.18	(1.14-1.23)	1.16	(1.08-1.24)
Age 80-84*	1.29	(1.25-1.33)	1.33	(1.25-1.42)	1.29	(1.24-1.34)	1.27	(1.18-1.36)
Age 85-89*	1.41	(1.36-1.46)	1.43	(1.34-1.54)	1.39	(1.33-1.44)	1.33	(1.23-1.44)
Age 90+*	1.53	(1.46-1.60)	1.61	(1.48-1.76)	1.48	(1.41-1.55)	1.46	(1.33-1.61)
Sex (F v M)	0.96	(0.94-0.98)	0.99	(0.95-1.03)	0.86	(0.84-0.88)	0.86	(0.82-0.90)
Income Quintile 2 **	0.91	(0.88-0.94)	0.93	(0.88-0.98)	0.94	(0.91-0.98)	0.97	(0.91-1.04)
Income Quintile 3 **	0.89	(0.86-0.92)	0.90	(0.84-0.95)	0.97	(0.93-1.00)	0.96	(0.90-1.03)
Income Quintile 4 **	0.85	(0.82-0.88)	0.89	(0.84-0.94)	0.92	(0.89-0.96)	0.95	(0.89-1.02)
Income Quintile 5 **	0.83	(0.81-0.86)	0.88	(0.83-0.93)	0.90	(0.97-0.93)	0.98	(0.92-1.05)
South East LHIN §	1.29	(1.23-1.37)	1.28	(1.15-1.41)	0.96	(0.91-1.02)	0.95	(0.85-1.07)
Champlain LHIN §	2.08	(1.82-2.37)	1.91	(1.61-2.27)	1.30	(1.13-1.49)	1.38	(1.14-1.67)
NSM LHIN §	1.18	(1.12-1.24)	1.23	(1.13-1.34)	1.13	(1.07-1.19)	1.22	(1.10-1.34)
North East LHIN §	1.81	(1.69-1.95)	2.05	(1.77-2.37)	1.41	(1.31-1.52)	1.57	(1.34-1.84)
North West LHIN §	1.54	(1.02-2.31)	1.00	(0.36-2.79)	1.41	(0.92-2.15)	0.73	(0.20-2.68)
Eerie St Clair LHIN §	1.21	(1.13-1.30)	1.43	(1.22-1.68)	1.05	(0.97-1.14)	1.01	(0.83-1.21)
South West LHIN §	1.76	(1.66-1.86)	1.86	(1.69-2.05)	1.10	(1.04-1.17)	1.25	(1.12-1.40)
WW LHIN §	1.06	(1.01-1.12)	1.16	(1.06-1.27)	0.91	(0.87-0.97)	0.98	(0.88-1.09)
HNHB LHIN §	1.19	(1.14-1.25)	1.14	(1.03-1.26)	1.22	(1.16-1.28)	1.19	(1.06-1.33)
Central West LHIN §	1.08	(1.01-1.16)	1.10	(0.97-1.24)	1.12	(1.04-1.21)	1.24	(1.09-1.42)
Toronto Central LHIN §	1.19	(1.12-1.25)	1.15	(1.05-1.26)	1.20	(1.13-1.27)	1.07	(0.97-1.19)
Central LHIN §	1.12	(1.06-1.19)	1.18	(1.06-1.31)	1.17	(1.1-1.24)	1.26	(1.12-1.41)
Central East LHIN §	1.22	(1.17-1.28)	1.16	(1.06-1.26)	1.12	(1.06-1.17)	1.02	(0.93-1.13)
Rural	1.27	(1.24-1.31)	1.11	(1.05-1.17)	0.96	(0.92-0.98)	0.88	(0.83-0.94)
Functional Status								
Supervision AADLH §§	1.23	(1.17-1.30)	1.10	(1.01-1.19)	1.28	(1.21-1.35)	1.13	(1.04-1.23)
Limited AADLH §§	1.30	(1.25-1.35)	1.13	(1.07-1.20)	1.41	(1.35-1.47)	1.15	(1.07-1.23)
Extensive AADLH §§	1.32	(1.25-1.41)	1.16	(1.06-1.27)	1.39	(1.3-1.48)	1.15	(1.04-1.28)
Maximal AADLH §§	1.32	(1.26-1.39)	1.18	(1.09-1.29)	1.55	(1.47-1.64)	1.23	(1.12-1.35)
Dependent AADLH §§	1.08	(1.04-1.11)	1.08	(1.01-1.15)	1.30	(1.25-1.35)	1.10	(1.02-1.17)
Supervision DADLH §§	1.24	(1.18-1.32)	1.15	(1.06-1.24)	1.35	(1.28-1.43)	1.24	(1.14-1.35)
Limited DADLH §§	1.34	(1.29-1.41)	1.12	(1.06-1.19)	1.49	(1.43-1.56)	1.22	(1.14-1.31)
Extensive DADLH §§	1.61	(1.48-1.74)	1.10	(0.98-1.24)	1.82	(1.58-1.87)	1.13	(0.99-1.29)
Maximal DADLH §§	1.38	(1.28-1.48)	1.12	(1.01-1.25)	1.73	(1.61-1.86)	1.32	(1.18-1.48)
Dependent DADLH §§	1.16	(1.09-1.24)	1.05	(0.95-1.16)	1.61	(1.51-1.72)	1.42	(1.28-1.58)
Admission Characteristic & Health Service Use								
ICU admission	0.94	(0.92-0.97)	0.91	(0.85-0.97)	0.91	(0.88-0.94)	0.92	(0.85-0.99)
Admission Length of Stay	1.00	(1.00-1.00)	1.00	(1.00-1.01)	1.00	(1-1.01)	1.01	(1.00-1.01)
Usual Provider Index	0.37	(0.36-0.39)	0.41	(0.37-0.44)	0.37	(0.35-0.39)	0.49	(0.44-0.55)
Family Physician visits	1.04	(1.03-1.06)	1.11	(1.09-1.13)	0.91	(0.9-0.93)	0.97	(0.94-0.99)
Comorbidities								
CCI	1.16	(1.15-1.17)	1.14	(1.12-1.15)	1.23	(1.23-1.24)	1.22	(1.20-1.24)
Angina	1.05	(1.01-1.08)	1.03	(0.94-1.13)	0.88	(0.85-0.92)	0.86	(0.77-0.95)
CAD	1.06	(1.04-1.09)	0.99	(0.92-1.07)	0.97	(0.94-1.00)	0.92	(0.85-1.00)
Heart Failure	1.57	(1.52-1.62)	1.15	(1.08-1.22)	1.75	(1.69-1.8)	1.22	(1.14-1.30)
COPD	1.41	(1.37-1.46)	1.12	(1.05-1.19)	1.42	(1.38-1.47)	1.06	(0.99-1.13)
Delirium	1.22	(1.15-1.28)	1.12	(1.00-1.25)	1.22	(1.16-1.29)	0.96	(0.85-1.08)
Dementia	1.06	(0.96-1.16)	0.90	(0.75-1.08)	1.12	(1.01-1.24)	0.93	(0.76-1.14)
Diabetes	1.19	(1.15-1.23)	0.95	(0.90-1.00)	1.27	(1.23-1.32)	0.89	(0.84-0.94)
Injurious Falls	0.69	(0.65-0.74)	0.74	(0.68-0.80)	0.63	(0.59-0.68)	0.67	(0.60-0.74)
Hypertension	0.92	(0.89-0.95)	0.89	(0.85-0.93)	0.89	(0.86-0.92)	0.87	(0.83-0.92)
Seizure	1.38	(1.18-1.63)	0.79	(0.70-0.91)	1.25	(1.06-1.48)	0.67	(0.58-0.79)
Stroke	0.72	(0.67-0.76)	1.52	(1.11-2.09)	0.73	(0.68-0.78)	0.89	(0.62-1.29)

* compared to Age 65-59; ** compared to the 1st (lowest) income quintile; § compared to the Peel LHIN; §§ compared to an independent ADL hierarchy; NSM = North Simcoe Muskoka, WW = Waterloo Wellington, HNHB = Hamilton Niagara Haldimand Brandt.

Table 18: Univariate and multivariable analysis for ED re-presentation and re-hospitalization. AUROC for LTCF readiness 0.84 (0.83 - 0.85), death 0.79 (0.79 - 0.80).

	LTCF 180 days				Death 180 days			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Demographics								
Age 70-74*	1.49	(1.33-1.68)	1.35	(1.06-1.70)	1.15	(1.08-1.22)	1.17	(1.04-1.33)
Age 75-79*	2.98	(2.69-3.32)	2.42	(1.95-2.99)	1.36	(1.28-1.44)	1.40	(1.24-1.57)
Age 80-84*	4.86	(4.39-5.37)	3.32	(2.70-4.08)	1.53	(1.45-1.62)	1.65	(1.46-1.85)
Age 85-89*	7.97	(7.21-8.81)	4.62	(3.76-5.68)	1.81	(1.71-1.92)	1.91	(1.68-2.16)
Age 90+*	13.18	(11.89-14.60)	6.96	(5.63-8.62)	2.53	(2.37-2.70)	2.47	(2.14-2.84)
Sex (F v M)	1.47	(1.41-1.54)	1.13	(1.03-1.23)	0.79	(0.76-0.82)	0.73	(0.68-0.78)
Income Quintile 2 **	0.83	(0.78-0.88)	0.86	(0.76-0.97)	1.03	(0.98-1.08)	1.03	(0.93-1.13)
Income Quintile 3 **	0.78	(0.74-0.83)	0.79	(0.70-0.91)	1.05	(1.00-1.10)	1.00	(0.90-1.11)
Income Quintile 4 **	0.68	(0.84-0.73)	0.76	(0.66-0.87)	0.98	(0.93-1.04)	1.00	(0.90-1.11)
Income Quintile 5 **	0.69	(0.64-0.73)	0.79	(0.70-0.91)	0.97	(0.92-1.02)	0.92	(0.83-1.03)
South East LHIN §	1.78	(1.58-2.00)	1.82	(1.40-2.36)	1.48	(1.35-1.61)	1.35	(1.12-1.63)
Champlain LHIN §	2.32	(1.84-1.93)	2.25	(1.56-3.24)	1.74	(1.44-2.11)	1.47	(1.11-1.96)
NSM LHIN §	2.13	(1.92-2.36)	2.60	(2.06-3.30)	1.34	(1.24-1.45)	1.49	(1.26-1.76)
North East LHIN §	1.47	(1.26-1.72)	1.84	(1.24-2.74)	1.42	(1.27-1.59)	1.85	(1.42-2.40)
North West LHIN §	0.74	(0.23-2.33)	-	-	0.84	(0.39-1.82)	1.35	(0.26-7.15)
Eerie St Clair LHIN §	1.37	(1.17-1.60)	1.15	(0.70-1.89)	1.34	(1.19-1.50)	1.17	(0.86-1.60)
South West LHIN §	1.64	(1.45-1.85)	2.00	(1.54-2.59)	1.60	(1.46-1.75)	1.36	(1.13-1.64)
WW LHIN §	1.59	(1.42-1.78)	1.77	(1.38-2.27)	1.22	(1.13-1.33)	1.28	(1.08-1.53)
HNHB LHIN §	1.54	(1.38-1.71)	1.70	(1.29-2.23)	1.36	(1.26-1.48)	1.60	(1.32-1.94)
Central West LHIN §	1.26	(1.07-1.49)	1.85	(1.35-2.53)	1.41	(1.25-1.58)	1.31	(1.04-1.64)
Toronto Central LHIN §	1.31	(1.16-1.49)	1.07	(0.83-1.38)	1.27	(1.16-1.39)	1.28	(1.07-1.52)
Central LHIN §	1.54	(1.36-1.74)	1.49	(1.14-1.97)	1.29	(1.18-1.42)	1.29	(1.06-1.57)
Central East LHIN §	1.95	(1.76-2.15)	1.72	(1.36-2.18)	1.40	(1.30-1.51)	1.35	(1.15-1.60)
Rural	0.96	(0.91-1.02)	0.97	(0.86-1.10)	1.16	(1.11-1.21)	1.05	(0.96-1.16)
Functional Status								
Supervision AADLH §§	2.66	(2.37-2.99)	1.84	(1.53-2.23)	1.52	(1.40-1.66)	1.25	(1.09-1.44)
Limited AADLH §§	4.18	(3.84-4.54)	2.09	(1.82-2.41)	2.03	(1.91-2.16)	1.34	(1.20-1.48)
Extensive AADLH §§	5.44	(4.90-6.05)	2.96	(2.48-3.53)	2.07	(1.90-2.27)	1.22	(1.04-1.42)
Maximal AADLH §§	7.52	(6.89-8.20)	2.48	(2.12-2.91)	2.82	(2.63-3.02)	1.52	(1.34-1.73)
Dependent AADLH §§	4.64	(4.30-5.00)	1.92	(1.66-2.22)	2.02	(1.91-2.13)	1.18	(1.06-1.31)
Supervision DADLH §§	3.91	(3.53-4.33)	2.08	(1.78-2.42)	1.82	(1.68-1.98)	1.49	(1.31-1.69)
Limited DADLH §§	4.76	(4.39-5.16)	2.47	(2.19-2.80)	2.31	(2.18-2.46)	1.77	(1.61-1.96)
Extensive DADLH §§	9.01	(8.04-10.10)	3.82	(3.20-4.54)	3.15	(2.84-3.49)	2.30	(1.95-2.72)
Maximal DADLH §§	9.72	(8.78-10.76)	3.67	(3.13-4.32)	3.73	(3.42-4.07)	2.64	(2.29-3.05)
Dependent DADLH §§	8.24	(7.49-9.08)	3.28	(2.78-3.87)	4.32	(4.01-4.66)	4.28	(3.75-4.89)
Admission Characteristics & Health Service Use								
ICU admission	0.55	(0.51-0.60)	0.72	(0.60-0.86)	0.78	(0.74-0.83)	0.76	(0.67-0.86)
Admission Length of Stay	1.03	(1.03-1.03)	1.02	(1.02-1.02)	1.00	(1.00-1.01)	1.00	(1.00-1.00)
Usual Provider Index	1.59	(1.45-1.75)	1.23	(1.01-1.49)	0.44	(0.40-0.48)	0.57	(0.48-0.67)
Family Physician visits	0.71	(0.68-0.73)	0.88	(0.84-0.93)	0.68	(0.66-0.70)	0.78	(0.75-0.82)
Comorbidities								
CCI	1.05	(1.04-1.07)	1.01	(0.98-1.04)	1.52	(1.50-1.53)	1.64	(1.61-1.67)
Angina	0.52	(0.48-0.58)	0.75	(0.58-0.97)	0.77	(0.73-0.82)	0.90	(0.76-1.07)
CAD	0.59	(0.55-0.63)	0.90	(0.75-1.08)	0.83	(0.79-0.87)	0.80	(0.71-0.92)
Heart Failure	1.22	(1.15-1.29)	1.04	(0.91-1.18)	2.03	(1.95-2.11)	1.21	(1.11-1.33)
COPD	0.96	(0.90-1.02)	1.06	(0.92-1.22)	1.59	(1.52-1.67)	1.02	(0.92-1.12)
Delirium	3.63	(3.39-3.89)	2.26	(1.94-2.63)	1.15	(1.06-1.25)	0.68	(0.57-0.82)
Dementia	6.40	(5.76-7.11)	3.23	(2.58-4.05)	1.16	(1.00-1.34)	0.68	(0.51-0.91)
Diabetes	1.01	(0.94-1.08)	1.12	(1.00-1.26)	1.16	(1.10-1.22)	0.54	(0.50-0.59)
Injurious Falls	2.22	(2.03-2.43)	1.12	(0.97-1.29)	0.55	(0.49-0.62)	0.51	(0.43-0.60)
Hypertension	0.97	(0.91-1.03)	0.91	(0.82-1.01)	0.72	(0.68-0.75)	0.70	(0.64-0.76)
Seizure	1.24	(0.93-1.66)	1.43	(1.12-1.83)	0.93	(0.71-1.20)	0.41	(0.31-0.53)
Stroke	1.97	(1.80-2.17)	1.02	(0.54-1.90)	0.69	(0.62-0.77)	0.82	(0.46-1.45)

* compared to Age 65-59; ** compared to the 1st (lowest) income quintile; § compared to the Peel LHIN; §§ compared to an independent ADL hierarchy; NSM = North Simcoe Muskoka, WW = Waterloo Wellington, HNHB = Hamilton Niagara Haldimand Brandt.

As seen in Table 17, ED re-presentation and hospital re-admission, as compared to LTCF readiness and death, demonstrated much lower and similar discriminability. When considered across unadjusted and adjusted odds, there was some general decrease in the magnitude of individual risks (as expected when adjusting for covariates); however, there were some variability depending on the LHIN that the individual lived in. Of note, there was a significant increase in the odds of re-presenting to the ED and a numeric increase in the odds of re-hospitalization. All functional metrics were lower in magnitude in adjusted versus unadjusted analyses. In the adjusted analyses, all levels of functional impairment on admission (compared to an AADLH of independent) were associated with some degree of increased odds of experiencing the outcome, though it was similar risk (1.08 – 1.18), with similar findings for DADLH. The covariate that was most protective against future emergency/hospital encounters was an increased UPI; the odds were higher with increasing numbers of family doctor visits within the preceding six months.

An increased CCI was also associated with increased risk of both outcomes, although more so for hospital re-admission (1.22, 1.20 – 1.24 for re-admission vs 1.14, 1.12 – 1.15 for ED re-presentation). Across individual comorbidities, those diagnosed with seizure were less likely to re-present for either outcome; those with heart failure and COPD were more likely to re-present to ED and those with heart failure had higher odds of hospital re-admission. Higher income quintile was consistently associated with fewer ED re-presentations but not hospitalizations. When compared to Peel LHIN, which had amongst the lowest rates of health care use, all other LHINs had higher ED re-presentation rates with those in North East LHIN having the highest odds, there was more heterogeneity in hospital re-admissions, though again North East LHIN had the highest odds.

Multivariable analysis demonstrated much better performance in discriminating those who died or were LTCF ready at 180 days (ROC 0.79, 0.79 - 0.80 and 0.84, 0.83 - 0.85 respectively), as seen in Table 18. Compared to ED and hospital re-exposure outcomes, both age and function displayed more

marked decreases in magnitude with univariate vs. multivariable analysis; comorbidities were largely unchanged with the exception of dementia and injurious falls; only injurious falls became non-significant on adjustment. On multivariable analysis, increased age and functional impairment were associated with marked increased risk in either outcome; with those aged 90+ having OR 2.47 (95% CI 2.14 - 2.84) of dying and OR 6.96 (5.63 - 8.62) for requiring a LTCF. Increased DADLH was similarly associated with complete dependence demonstrated OR 4.28 (3.75 - 4.89) for death, and OR 3.28 (2.78-3.87) for LTCF readiness, although the greatest odds of LTCF readiness were seen in those requiring extensive assistance (3.81, 3.20 - 4.54). Increased AADLH was also associated with increased odds of dying or being LTCF ready, but the odds were lower than the DADLHs; in the setting of LTCF readiness the greatest risk was again seen in those with an AADLH requiring extensive supports (2.96, 2.48 – 3.53).

Similar to hospital exposure outcomes, an increased income quintile had lower odds of either death or LTCF readiness at 180 days; being female was associated with lower odds of both hospital and mortality outcomes but greater odds of LTCF readiness, likely associated with increased survival. Furthermore, LHINs demonstrated variable rates of both LTCF readiness and mortality, with North Simcoe Muskoka associated with the greatest odds of LTCF readiness (2.60, 2.06 – 3.30) whereas North East LHIN was most associated with mortality (1.85, 1.42 – 2.40). Similar to hospital re-exposure outcomes, ICU admission was associated with lower rates of both LTCF readiness and mortality; however unlike other outcomes increased UPI was associated with increased odds of LTCF readiness (1.23, 1.01 – 1.49), and for both LTCF readiness and mortality, more family physician visits were associated with lower risk of both outcomes.

An increasing Comorbidity index was also clearly associated with increased mortality risk (OR 1.63, 1.6-1.66 per unit CCI increase) but was not associated with an increase in LTCF readiness (1.01, 0.98 – 1.07). Across individual comorbidities, delirium and dementia were both associated with much higher odds of LTCF readiness (2.26, 1.94 – 2.63 and 3.23, 1.94 – 2.63 respectively), seizure with a

smaller effect, and other comorbidities with an equivocal effect. Across mortality, heart failure was the only disease associated with increased risk (1.21, 1.11 – 1.33) whereas others were associated with lower odds of death.

Goodness of fit calibration charts can be seen in figure 3. All analyses demonstrated that the results of the analysis were closely matched to actual outcomes across each age group.

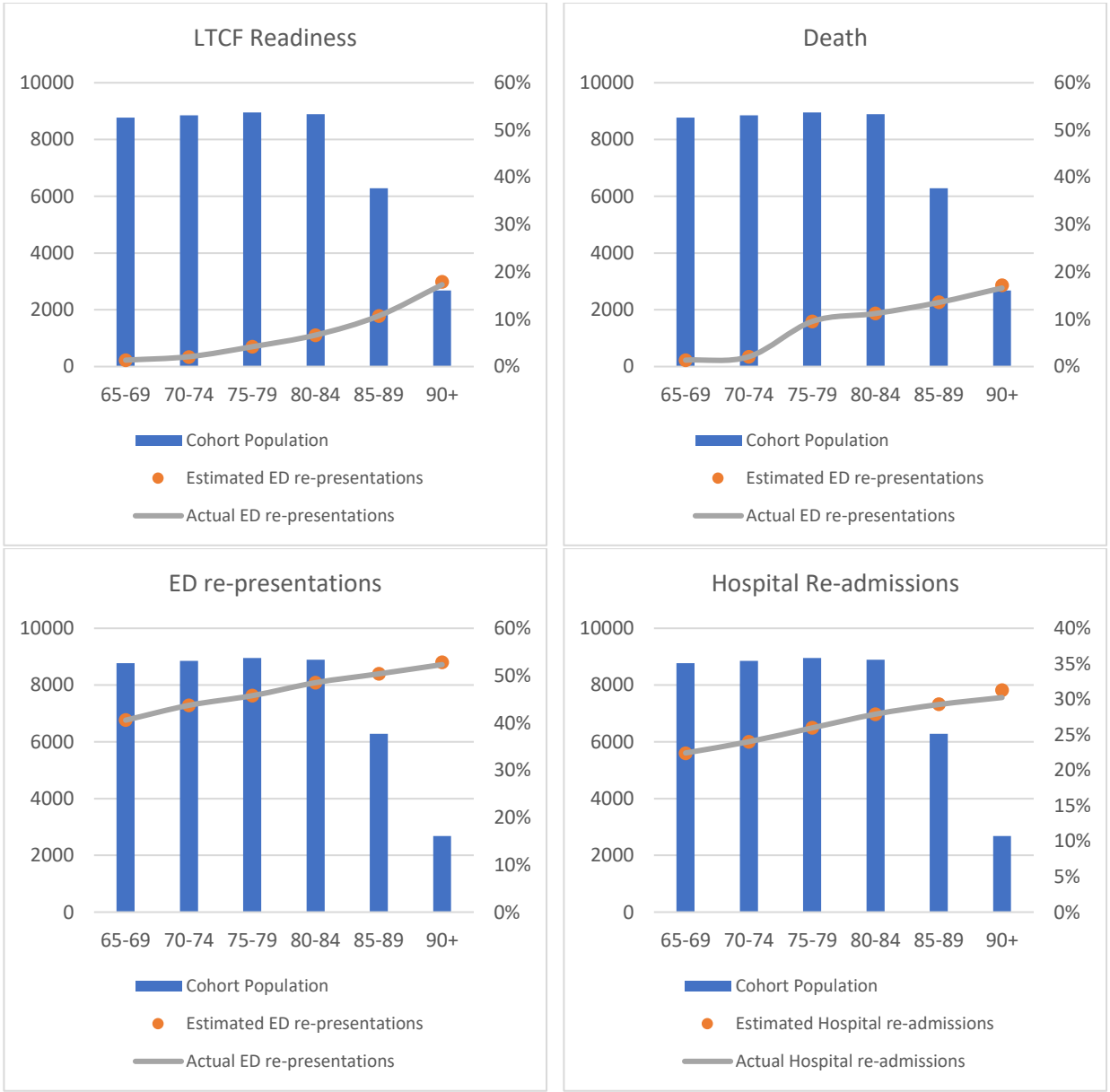

Figure 3: Calibration plots demonstrating population size per age group, actual event rate at 180 days for each outcome, and estimated event rate based on regressions.

4.5.3 Subgroup Analysis

The *a priori* model was further considered across subgroup outcomes in Appendix F. For ED re-presentations and hospital re-admission, similar AUROCs were seen as when the analysis was performed across the entire cohort, although the greatest discriminability was seen for those with dementia (0.70, 0.65-0.75 and 0.70, 0.65-0.74 respectively). Further, there was a similar (though lower magnitude) increase in the odds of experiencing the outcome with increasing age and variability depending on one's LHIN, with North East LHIN also being largely most associated, noting a marked association for those with a history of delirium (6.86, 1.83-25.79). Functional status also had essentially no relationship with either ED-representation or re-hospitalization, nor did admission characteristics, though UPI continued to be a protective factor. Finally, when considered with other comorbidities, each subgroup except for delirium had significantly increased odds of ED re-presentation with increasing CCI, though this relationship was not also seen for those who were re-hospitalized.

Across LTCF readiness and mortality, there was higher variability in AUROC that was, on average, similar; however for those with CAD, an AUROC of 0.88 (0.86-0.90) was achieved for 782 individuals; for mortality the greatest discriminability was seen for those with dementia (0.86, 0.81-0.91). Age had larger associations with each outcome for each disease except for dementia for those who were LTCF ready; there was only a consistent relationship for those who died in those with a history of CAD or heart failure. AADLH was variably associated with both LTCF readiness and death with a trend towards increasing odds of experiencing the outcome with increasing disability; the relationship was more clearly demonstrated with DADLH with the greatest magnitudes of association seen for injurious falls and CAD for LTCF admission (again more so with a DADLH of requiring extensive/maximal supports); for those who died such an increasing relationship was only clearly seen with CAD, heart failure, and COPD whereas with injurious falls, dementia, and delirium there was only a demonstrable increase in those who were completely dependent. Increased UPI was associated with lower risk of death in those with

heart failure and COPD, but no other diseases; similar trends were seen for FP visits though a benefit was also seen for dementia and CAD. Similar to ED re-presentation and hospital re-admission, comorbidities did not appear to have a demonstrable impact on individual disease subgroups with two exceptions: the diagnosis of CAD in other subgroups was consistently associated with increased odds of death, and a diagnosis of delirium in those with dementia or vice versa was associated with higher odds of LTCF placement.

4.5.4 Sensitivity Analyses

Variables selected using best forward subsets to construct a parsimonious model are seen in Table 2 of Appendix E, and demonstrated that discharge hierarchy was the most predictive single variable for requiring LTCF (ROC 0.73, 0.72-0.74). Subsequent variables added followed those suggested by the *a priori* model including age, delirium, or dementia, though admission length was not seen to have strong association within the *a priori* analysis. Table 3 demonstrates the utility of the parsimonious the model with increasing variables; models were analysed until 12 variables (single and/or class variables) were used where the addition of LHIN as a categorical variable rendered rurality as an insignificant variable. Within the parsimonious model, similar associations were seen with outcomes, with age and DADLH continuing to be the most strongly associated with requiring a LTCF.

Further sensitivity analysis compared outcomes when individual ADL measurements or sum of ADL hierarchy. When the discharge ADL hierarchy was replaced with either the sum of the discharge ADL assessment scores or the individually assessed discharge ADLs in the *a priori* model, it was found that the regressions had similar discriminability, 0.84 (0.84-0.85) and 0.83 (0.83-0.84) respectively, to the original *a priori* models. Other covariates were not substantively changed.

4.6 Survival Analysis

Results of the survival analysis and the competitive survival analysis can be seen in Table 18. Results were similar to those seen with logistic regression analysis. Increasing age was associated with demonstrably increased hazard of LTCF readiness as well as slight increases in death, ED re-presentation, and hospital re-admission. Conversely, there were consistent decreases across these three outcomes compared to death with increased income quintile. AADLH was only demonstrably associated with LTCF readiness, and this was accentuated in competitive analyses confirming that function is most closely associated with LTCF readiness. DADLH was associated with increased hazard of both death and LTCF readiness but had a relatively flat association with both ED re-presentation and re-hospitalization.

Finally, across comorbidities, increased CCI was associated with increased hazard of ED re-presentations, hospital re-admission, and death, but not LTCF readiness. Those who were diagnosed with heart failure had increased hazard for ED re-presentation, hospital re-admission, and death at 180 days; however, other diseases did not show such clear associations. The competitive survival analysis demonstrated that a history of injurious falls, seizure, and delirium and dementia all favoured LTCF readiness over death. The associations between delirium and dementia and LTCF admission were the strongest associations seen across comorbidities (HR 2.03, 1.78-2.30 and 2.69, 2.26-3.22 respectively).

Table 18: Results of Cox proportional hazard model using *a priori* variables for each individual outcome at 180 days as well as a competitive survival model of admission to LTCF vs. mortality at 180 day.

	ED 180		Hosp 180		LTCF 180		Death 180		LTCF vs. Death 180	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Demographics & Health Service Use										
Age 70-74*	1.09	(1.04-1.14)	1.06	(0.99-1.12)	1.35	(1.07-1.70)	1.15	(1.03-1.29)	1.32	(1.04-1.68)
Age 75-79*	1.13	(1.08-1.19)	1.13	(1.07-1.20)	2.36	(1.92-2.90)	1.32	(1.18-1.47)	2.26	(1.82-2.80)
Age 80-84*	1.23	(1.18-1.29)	1.22	(1.15-1.29)	3.25	(2.66-3.96)	1.53	(1.38-1.70)	3.14	(2.55-3.86)
Age 85-89*	1.28	(1.22-1.35)	1.26	(1.18-1.34)	4.32	(3.54-5.27)	1.66	(1.48-1.85)	4.16	(3.37-5.12)
Age 90+*	1.38	(1.30-1.47)	1.37	(1.27-1.49)	6.03	(4.92-7.40)	2.11	(1.87-2.39)	5.52	(4.44-6.85)
Sex (F v M)	0.98	(0.95-1.00)	0.87	(0.84-0.90)	1.12	(1.03-1.21)	0.77	(0.73-0.82)	1.15	(1.05-1.25)
Income Quintile 2 **	0.94	(0.90-0.98)	0.97	(0.92-1.03)	0.88	(0.78-0.98)	1.01	(0.92-1.10)	0.87	(0.77-0.98)
Income Quintile 3 **	0.92	(0.89-0.96)	0.96	(0.91-1.02)	0.81	(0.72-0.91)	1.01	(0.92-1.10)	0.79	(0.69-0.89)
Income Quintile 4 **	0.92	(0.88-0.96)	0.96	(0.91-1.02)	0.77	(0.68-0.87)	1.01	(0.92-1.11)	0.76	(0.66-0.87)
Income Quintile 5 **	0.91	(0.87-0.95)	0.97	(0.92-1.03)	0.82	(0.73-0.93)	0.91	(0.83-10.00)	0.81	(0.71-0.92)
South East LHIN §	1.31	(1.17-1.48)	1.01	(0.86-1.19)	1.12	(0.70-1.79)	1.19	(0.90-1.57)	1.11	(0.67-1.82)
Champlain LHIN §	1.24	(1.16-1.34)	0.98	(0.88-1.08)	1.77	(1.39-2.25)	1.33	(1.12-1.56)	1.64	(1.26-2.13)
NSM LHIN §	1.63	(1.45-1.82)	1.35	(1.16-1.57)	2.10	(1.51-2.94)	1.49	(1.16-1.91)	1.97	(1.38-2.81)
North East LHIN §	1.20	(1.12-1.28)	1.21	(1.11-1.31)	2.47	(1.98-3.07)	1.41	(1.22-1.64)	2.20	(1.73-2.80)
North West LHIN §	1.68	(1.52-1.85)	1.48	(1.29-1.68)	1.72	(1.19-2.48)	1.73	(1.37-2.19)	1.54	(1.03-2.31)
Eerie St Clair LHIN §	1.09	(0.49-2.42)	0.80	(0.26-2.47)	-	-	1.51	(0.38-6.08)	-	-
South West LHIN §	1.58	(1.47-1.70)	1.23	(1.11-1.35)	1.92	(1.51-2.45)	1.35	(1.15-1.60)	1.80	(1.38-2.35)
WW LHIN §	1.15	(1.07-1.23)	1.00	(0.92-1.10)	1.71	(1.36-2.16)	1.26	(1.08-1.47)	1.60	(1.25-2.06)
HNHB LHIN §	1.15	(1.06-1.24)	1.20	(1.09-1.33)	1.65	(1.28-2.12)	1.58	(1.34-1.87)	1.61	(1.22-2.12)
Central West LHIN §	1.09	(1.00-1.19)	1.22	(1.09-1.37)	1.77	(1.32-2.38)	1.30	(1.06-1.58)	1.56	(1.13-2.14)
Toronto Central LHIN §	1.12	(1.05-1.20)	1.07	(0.98-1.17)	1.08	(0.85-1.38)	1.26	(1.07-1.47)	1.03	(0.79-1.33)
Central LHIN §	1.16	(1.07-1.25)	1.23	(1.12-1.36)	1.45	(1.12-1.87)	1.25	(1.05-1.49)	1.42	(1.08-1.87)
Central East LHIN §	1.14	(1.07-1.22)	1.04	(0.95-1.13)	1.68	(1.34-2.09)	1.30	(1.13-1.51)	1.56	(1.22-1.99)
Rural	1.08	(1.03-1.12)	0.91	(0.86-0.96)	0.98	(0.88-1.10)	1.05	(0.97-1.14)	1.02	(0.91-1.16)
Functional Status										
Supervision AADLH §§	1.07	(1.01-1.13)	1.11	(1.03-1.20)	1.82	(1.52-2.17)	1.21	(1.07-1.36)	1.93	(1.59-2.33)
Limited AADLH §§	1.11	(1.06-1.16)	1.14	(1.08-1.21)	2.07	(1.81-2.37)	1.30	(1.19-1.42)	2.15	(1.86-2.49)
Extensive AADLH §§	1.12	(1.05-1.20)	1.13	(1.04-1.23)	2.75	(2.34-3.23)	1.19	(1.04-1.36)	2.91	(2.44-3.47)
Maximal AADLH §§	1.13	(1.07-1.20)	1.19	(1.10-1.29)	2.41	(2.08-2.79)	1.39	(1.25-1.56)	2.48	(2.10-2.93)

Dependent AADLH §§	1.05	(1.00-1.10)	1.08	(1.02-1.14)	1.95	(1.69-2.23)	1.14	(1.03-1.25)	2.04	(1.76-2.38)
Supervision DADLH §§	1.12	(1.06-1.18)	1.22	(1.14-1.31)	2.08	(1.80-2.40)	1.45	(1.30-1.62)	2.08	(1.78-2.42)
Limited DADLH §§	1.11	(1.06-1.16)	1.21	(1.15-1.28)	2.44	(2.17-2.74)	1.68	(1.54-1.83)	2.51	(2.21-2.84)
Extensive DADLH §§	1.14	(1.05-1.24)	1.18	(1.06-1.32)	3.58	(3.06-4.19)	2.14	(1.86-2.46)	3.45	(2.90-4.11)
Maximal DADLH §§	1.19	(1.11-1.28)	1.40	(1.28-1.53)	3.43	(2.96-3.97)	2.47	(2.19-2.79)	3.39	(2.88-4.00)
Dependent DADLH §§	1.19	(1.11-1.28)	1.54	(1.41-1.67)	3.04	(2.61-3.53)	3.65	(3.27-4.08)	3.03	(2.56-3.59)
Admission Characteristics & Health Service Use										
ICU admission	0.94	(0.90-0.99)	0.93	(0.88-0.99)	0.73	(0.62-0.87)	0.77	(0.69-0.86)	0.74	(0.62-0.89)
Admission Length of Stay	1.00	(1.00-1.00)	1.00	(1.00-1.01)	1.01	(1.01-1.01)	1.00	(1.00-1.00)	1.01	(1.01-1.01)
Usual Provider Index	0.51	(0.48-0.55)	0.54	(0.50-0.60)	1.20	(1.00-1.42)	0.61	(0.53-0.70)	1.25	(1.04-1.51)
Family Physician visits	1.07	(1.06-1.09)	0.95	(0.94-0.97)	0.89	(0.85-0.93)	0.79	(0.76-0.82)	0.89	(0.84-0.94)
Comorbidities										
CCI	1.12	(1.11-1.13)	1.21	(1.19-1.22)	1.01	(0.98-1.04)	1.48	(1.46-1.50)	1.01	(0.98-1.04)
Angina	1.02	(0.95-1.09)	0.88	(0.80-0.96)	0.77	(0.60-0.98)	0.91	(0.78-1.06)	0.75	(0.58-0.97)
CAD	0.98	(0.93-1.03)	0.94	(0.88-1.00)	0.91	(0.77-1.08)	0.84	(0.75-0.94)	0.93	(0.78-1.12)
Heart Failure	1.08	(1.04-1.13)	1.17	(1.11-1.23)	1.04	(0.92-1.16)	1.21	(1.12-1.31)	0.99	(0.87-1.12)
COPD	1.04	(0.99-1.08)	1.03	(0.98-1.09)	1.07	(0.94-1.22)	1.03	(0.95-1.12)	1.08	(0.94-1.24)
Delirium	1.05	(0.97-1.13)	0.95	(0.86-1.05)	2.03	(1.78-2.30)	0.72	(0.62-0.84)	2.09	(1.82-2.40)
Dementia	0.90	(0.79-1.03)	0.93	(0.79-1.10)	2.69	(2.26-3.22)	0.76	(0.59-0.98)	2.81	(2.31-3.42)
Diabetes	0.93	(0.89-0.96)	0.88	(0.84-0.92)	1.11	(0.99-1.23)	0.61	(0.57-0.66)	1.10	(0.98-1.23)
Injurious Falls	0.78	(0.73-0.83)	0.69	(0.63-0.75)	1.12	(0.98-1.27)	0.54	(0.46-0.63)	1.20	(1.05-1.36)
Hypertension	0.90	(0.88-0.93)	0.88	(0.84-0.92)	0.94	(0.86-1.03)	0.73	(0.68-0.78)	0.95	(0.86-1.05)
Seizure	0.80	(0.72-0.88)	0.69	(0.60-0.79)	1.30	(1.04-1.62)	0.46	(0.36-0.58)	1.34	(1.05-1.71)
Stroke	1.23	(1.00-1.51)	0.88	(0.64-1.19)	1.13	(0.66-1.96)	0.78	(0.47-1.30)	1.09	(0.60-1.96)

* compared to Age 65-59; ** compared to the 1st (lowest) income quintile; § compared to the Peel LHIN; §§ compared to an independent ADL hierarchy; NSM = North Simcoe Muskoka, WW = Waterloo Wellington, HNHB = Hamilton Niagara Haldimand Brandt.

5 Discussion

This study provides the first in-depth analysis of how secondary data from the HOBIC database can be used to assess functional status during acute inpatient admissions and understand how it, in comparison to covariates including demographics, comorbidities, and admission characteristics, impacts ED re-presentations, hospital re-admissions, LTCF readiness, and mortality at 180 days. Through this analysis, it is clear that functional status can both be readily assessed and appears to have validity when analysed as secondary data, and is amongst the most important predictors of LTCF readiness and mortality, although it has less impact on ED re-presentation and hospital re-admissions.

5.1 HOBIC Data & Representativeness

5.1.1 Cohort Derivation

It was found that, even with what were thought to be liberal criteria to ensure intra-hospital reliability, the vast majority of both hospitals and HOBIC assessments were deemed ineligible on the grounds of having not completed at least 100 HOBIC assessments. 184 hospitals (Ontario is listed to have 141 hospital corporations and 262 sites in 2018 (107)) were initially identified in the DAD as having discharged patients during the time period of the cohort, of which 129 or 70.1% had completed HOBICs and 58 or 31.5% of all hospitals had more than 100 HOBICs.

Only 5 hospitals were excluded for having fewer than 5% of their discharges having been assessed by HOBIC; indeed, for hospitals included, an average of 39.9% of discharges had completed a HOBIC, and no hospitals were wholly excluded by date. These results are consistent with previously published ICES descriptive analyses of the HOBIC data, which indicates in larger hospitals that approximately 45% of discharges receiving a HOBIC assessment and in smaller hospitals approximately 85% were assessed (78). The criteria further led to skew in the geographic distribution of the cohort; after additional exclusions, only 93 records from North West LHIN (0.07% of total cohort) and 985 from

Champlain (0.71% of total cohort) were included and represented 1.94 and 9.38% of the population respectively; Central East and North Simcoe Muskoka were over-represented as 18.9% and 12.0% of the cohort despite being only 11.9% and 3.9% of the population at this time, respectively.

Given this, lower population LHINs and smaller hospitals were under-represented within the cohort, despite having higher rates of HOBIC completion. 18.5% of the cohort was, however, classified as living rurally, which is consistent with overall estimates of 20% of Ontario's population living rurally in 2011 (108), indicating that patients who presented to the included hospitals were similar to that of the general population. While this analysis was performed on a cohort who was 1.3% of all available discharges within the DAD, the cohort appears similar to the major populations of Ontario. The results of this analysis should be applied carefully, however, to those who live remotely and present to smaller hospitals for care, who are a group who are even more vulnerable to adverse outcomes and whose risk profile may be seen here.

5.1.2 Functional Status

Administrative datasets have been used to document the functional status and changes between admission and discharge for individuals in LTCFs given the development and regular employment of InterRAI for such purposes (31,85,109). There has yet to be any such data reported from administrative datasets. A smaller prospective cohort of older adults admitted to three acute care hospitals in Australia used InterRAI instruments for data collection (where individuals with scores of 2 or greater, corresponding to requiring supervision or more, being categorized as requiring assistance for that ADL) demonstrated that 65.3% required assistance with walking, 56.2% required assistance with toilet transfer, and 49.3% required assistance with hygiene on admission (18). Within the cohort, only bathing was found to require supervision or greater assistance on average (2.18, 2.17-2.20), which was not recorded within the Australian cohort; walking, toilet transfer, and hygiene were similarly the ADLs

that sequentially required the highest levels of assistance (1.81, 1.77, and 1.70 respectively). These changes appropriately scaled with age and DADLH.

On discharge, 79.2% of the cohort had improvements in their ADL hierarchy and only 3.1% had declined, with the greatest changes seen in the same ADLs. The most common outcome seen was that individuals with any functional impairment were discharged as functionally independent, with 52 265 or 37.3% of all known discharge hierarchies discharged as completely independent (only 32.6% of admissions were independent). While there was overall an almost complete ADL hierarchy rank improvement on discharge, this may under-represent the improvement given that bathing was the bADL for which there was the greatest change, and was not included in any of the hierarchies developed by Morris et al, though the improvement in the long form ADL score was similar (5.17 absolute difference or 46.2% improvement) (36). These changes in individual ADLs similarly reflect those within the Australian cohort; an improvement was also seen, there was an absolute reduction of 26.4%, only 33.5% had an ADL limitation on discharge using the short ADL scale. Across all bADLs, bathing demonstrated the greatest dependency at 51.7%, and the ADLs most improved were walking, and toilet transfer, and hygiene similarly improving 24.3, 23.9, 20.7% respectively. Other data had not recorded outcomes across individual ADLs, however two other cohorts in the United States demonstrated 11-20% improvements in function on discharge (26,41).

5.2 Correlating Admission & Discharge Function

5.2.1 Admission ADLs

Based on the above findings concerning both Canadian demographics and Australian measures of function using InterRAI in similar environments, the cohort appeared to demonstrate face external validity. Given the patterns across admission and discharge seen above, and that admission functional status has been indicated as a strong predictor of discharge status, it was curious that there was such a

low correlation between admission and discharge measures of function. The weak to moderate association between AADLH and ADL scores and discharge, as well as the overwhelming trend towards improvement between admission and discharge, suggest that there was a bias towards recording function on admission as worse than it actually was. It is likely the data was collected concerning an assessment completed at that time while the patient was acutely unwell and experiencing their greatest degree of functional impairment, rather than assessing their true level of premorbid function.

Indeed, one cohort demonstrated that 43% were below their baseline function on admission to hospital, and artificially worsen their functional status (41). To overcome this, baseline information must be garnered from an interview with the patient (who may not be able to provide such information) or from the patient's caregiver (who may not be available, or the patient may not have any caregiver), given that the information can't be obtained by a present functional assessment. From a clinical perspective, decreased function on admission assessments likely represents a surrogate marker of a more severe illness or an illness that has more impact on functional outcomes, such as a stroke, rather than be perfectly correlated to discharge outcomes, although patients may be admitted due to functional decline leading to decompensation of social support structures. It is also important to note that in other analyses that have considered admission and inpatient/discharge functional status as well as post-discharge outcomes, admission outcomes were not as strongly associated to post-discharge outcomes, indicating that it may not be as important information to collect (44,70).

This leads to admission functional status being a partial but less determining factor in understanding outcomes, likely conferring the individual's degree of baseline risk. To properly treat admission function would require addressing the confound of home support structures (which would both impact the likelihood of admission as well as the durability of discharge) as well as have better understanding of whether function at admission, for a given individual, was recorded in HOBIC reflective of baseline function or an admission functional status. A limitation of secondary data, however, is that it

can be difficult to know the fidelity and accuracy with which the primary data is collected, as data collectors in these contexts are usually doing so as a part of routine care rather than with the goal of maximizing accuracy of recording. Given this, admission measures of functional status were treated as a covariable that may be predictive of outcomes and reflective of both a mix of baseline function, admission function, and home support structures that could not be meaningfully differentiated. This makes it less clinically meaningful or interpretable, both as a concept and in comparison to discharge functional status, which led to the decision to treat it as part of the groups of a priori variables as well as one of the variables available for selection within the parsimonious selection algorithm, but not a strata across descriptors or outcomes. Based on this, future implementation of functional measures may be best deployed at discharge. This is both consistent with both the results of this analysis as well as other suggesting that discharge function is a consistent measure of post-discharge outcomes and also reduces the additional work that may be required in adding functional assessments to future inpatient care (43).

5.2.2 DADLH vs discharge-long form score

A second consideration concerning the selected measurement of function was the use of the DADLH vs the ADL-long form score. As an exploratory analysis across the data, the goals were to understand if administrative measurements of function are valid and reliable, and to understand which outcomes function is related to, and did so from a clinical perspective. Common diagnoses important to both clinicians and administrators were used as subgroups, and the ADL hierarchy used separated functional status into clinically meaningful phenotypes: individuals who were independent, individuals who could likely live in a retirement home or with family but still attend to their BADLs, individuals who would need some community supports, individuals who would need extensive family and/or community supports, and individuals who have LTCF-level assistance requirements (regardless of those who would be supported at home or in the community).

This choice of the long ADL hierarchy vs. the sum of ADL scores allowed for such phenotyping, though without potentially providing additional discriminability or sensitivity of the larger number of categories. The hierarchy was built using a specific construct of a limited set of the ADLs that, while observed by Morris et al. to reflect the natural progression of functional decline in the long term care setting, may not necessarily reflect the decline seen in hospitalized patients or assemble measurements of function into strata that are most prognostic for the outcomes addressed in this study (36). Building such a construct may be of demonstrable utility (and results suggest that this would indeed be a fruitful endeavour) but is beyond the scope of this study.

The ADL hierarchy considered personal hygiene as the first ADL lost, followed by toileting, walking, and eating; of note, bathing was not considered as an ADL for development of the hierarchy. When compared against raw scores, changes in ADLs appeared to be relatively evenly distributed on descriptive analysis across age groups as each increased with age and functional status; when considered as individual BADL scores, however, bathing and hygiene were found to be associated with increased odds of admission to LTCF compared to other individual ADLs (and was of equivalent discriminability with a c-statistic of 0.83, 0.89-0.84). This is consistent with hygiene as a predictor early within the constructed ADL hierarchy. However, given that subsequent analyses were not considered based on changes in one's independence in their hygiene, it is more difficult to elucidate the effect of other ADLs. When total ADL scores were used for the sensitivity analyses, they a similar c-statistic (0.84, 0.84-0.85 vs 0.84, 0.83-0.85).

Overall, the ADL hierarchy is equally valid and predictive of outcomes and had the advantage of clinical utility. The lack of inclusion of bathing as an ADL within the hierarchy, however, which was found to be predictive within this analysis and was also the ADL that was first and most rapidly declined across both age and DADLH strata, which may reflect that bathing and hygiene are multicollinear in early loss, or that it merits further considerations (and indeed in a retrospective cohort of older adults with

heart failure, bathing was found to be a single bADL associated with increased re-admission risk (65)). This indicates that it would be useful to trial re-deriving the hierarchy with bathing data, or in building a measure of function specific to these outcomes (compared to those previously studied) bathing may be an important consideration.

5.3 Outcomes

5.3.1 ED re-presentation and hospital re-admission

The most common outcome seen was ED re-presentation, despite this being the most poorly characterized post-discharge outcome for older adults within the literature. Both ED re-presentations and hospital re-admission demonstrated increases across both increasing age and dependency, though those with maximal functional dependence had a higher rate of outcomes compared to those aged 90+ - 70.6% of those who were functionally dependent vs 66.6% of those 90+ had any outcome. While the overall number of individuals who re-presented to ED or were re-admitted to hospital differed, there were similar proportions of both between 30 (21-24.3%) and 180 days (44-49%) and regression analyses demonstrated similar covariate impact (discussed below). Despite these frequent outcomes, there continued to be generally poor predictiveness of either event (AUROC 0.62, 62-63 and 0.64, 0.63-0.65 for ED-representation and re-hospitalization respectively), similar to other literature (14). Overall, these data demonstrate similar trends as previously published, but through their functional status could allow for more phenotypically distinct groups of individuals for understanding risk. Indeed, age alone is a poor method of stratifying frailty as it can be subject to effect such as the healthy survivor bias, and functional status may represent a more accurate measure of one's true health needs and vulnerability.

Trends across subgroups (seen in Appendix D, tables 1 and 2) were found to be equally revealing, with markedly higher rates of ED re-presentations and re-hospitalizations seen in those with CHF and COPD. Those with CHF and COPD had higher rates of ED-representation and re-hospitalization

compared to those of similar age as well as those with similar levels of function. Canadian literature has suggested a 16.1% 30 day and 46.7% 1-year re-admission rate for heart failure using an ICES cohort with similar dates; international literature has demonstrated re-hospitalization rates of 30-40% at 30 days and 45-50% at 180 days for heart failure (110-112). Within this cohort, the rates of both of these were higher in those 90+ as well as in those who were functionally dependent, which is in line with previous indications that age and NYHA heart failure class are further risk factors for re-admission (65,110). Overall, this suggests that within the context of re-presenting for care, age and function are of similar impact, however ED re-presentation and hospital re-admission are highly stochastic processes and purely clinical variables may not be as high yield as questions concerning health behaviour, such as the insight-based questions seen in HOBIC. Across CAD in the elderly there has been little study in the literature for outcomes across this wide grouping of the population, though within this analysis there were similar outcomes compared to the whole cohort, suggesting that the disease itself does not present as much risk. (Indeed, within regression analyses angina, the one component that would have a functional component, was not considered an important covariate).

Similarly, COPD saw increasing risks of re-admission with both increased age and functional impairment, though neither was statistically higher than the other; while there were numeric trends towards an increase, only those 85 or older were statistically more likely to re-present to ED (with no change in hospital admission) whereas there were no functional differences across all groups, which likely reflected lower numbers of individuals with known COPD who completed a DADLH assessment. Literature has suggested across the whole population a 35.1% COPD-specific re-admissions at 90 days and 17.3% all cause re-admissions at 30 days, with age as the greatest risk for re-admission (113,114). Curiously, literature has suggested decreasing rates of COPD-specific hospitalization with increased age whereas all hospitalizations here were increased (115). Given that there were more deaths in those with

COPD, this may reflect healthy survivor bias, or that the impact of COPD on admission decreases compared with other morbidities with age.

The literature around re-admission/re-presentation for dementia, delirium, and falls are not as well developed. A systematic review of studies of specific populations with dementia suggested a 17.8-29.8% 30-day re-admission rate and 40% 90 day re-admission rate, within this analysis, similar rates were seen across both statistics (116). Similar findings with delirium have been seen, which aligns with the notion that delirium is likely a surrogate of morbidity and frailty, which stratifying across age and functional status likely addresses and indicates that delirium is unlikely to be a purposeful variable within analyses for emergency department use and hospitalization (117).

When considered across hospitalization and emergency department use, this study provided a helpful epidemiological overview of rates across individuals by age, function, and common comorbidities. It demonstrates that while increasing age and function are both indicative of higher risk of health care use, they are no more predictive of other events as seen with previous difficulty predicting these events. This suggests either that stochasticity is the main driver of such events or that individual behaviours that are not as adequately measured by this administrative data may be important covariates, and indeed efforts to reduce re-admissions for these individuals have been frustratingly un-productive. Subgroup analyses also did not demonstrate that one disease had more impact on function, suggesting that it is the morbidity of the disease itself that drives re-presentation, and perhaps function would be better considered from the perspective of one's ability to self-manage. Previous systematic reviews of emergency department use have indeed indicated that morbidity as well as primary care access and prior hospital use are important determinants, which are not captured within these stratifications of the data (47). Indeed, current efforts that have shown success focusing on patient engagement and behaviour rather than a purely function or morbidity based approach (118).

5.3.2 LTCF readiness

Compared to health care access patterns, the functional data provided much more insight into the variability of admissions to long-term care based on comorbidities. Across all outcomes, age and increasing functional burden demonstrated similar discriminability of LTCF risk; 2.5% (2.4-2.7) of those who were functionally independent and 1.8% (1.6-2.0) of those 65-69 were LTCF ready at 180 days; 17.6% (16.5-18.8) of those who were functionally dependent for ADLs and 19.4% (18.7-20.2) of those 90+ had the same outcome Curiously the highest rate of LTCF was for those who were maximally dependent (20.2%, 18.8-21.5 were LTCF ready at 180 days), though this was not statistically separate. When compared to the increasing odds ratios for death (3.28, 2.78-3.87 for LTCF readiness and 4.28, 3.75-4.89 for death), as well as the marked increase in mortality (for those requiring maximal or more assistance it was over 20%), suggests that death became an important competing outcome at these levels of disability, also seen with attenuating risk and attenuating odds in the competitive survival model. It is worth noting, however, that these older and more frail individuals were at much higher baseline risk of LTCF readiness, given the unadjusted ORs of 8.24-9.72 for those with extensive or more dependence.

When compared across subgroups, rates of LTCF readiness were much higher for subgroups previously seen to have higher risk of requiring the level of care provided at a LTCF. Across CHF, COPD, and CAD, the rates of requiring LTCF were similar to background In the literature it has been suggested that these three diseases do have some positive impact on LTCF admission, likely due to functional disability; however they are not compelling drivers of requiring LTCF care (112,119,120). Those with dementia, delirium, and falls demonstrated much higher rates of LTCF readiness, consistent with the literature indicating the impact of cognition itself, and these diseases are important drivers of outcomes. Previous literature demonstrates that these conditions are likely the greatest predictors of LTCF readiness and, similar to other conditions, age and function simply provide some stratification of this

risk (121-123). It is important to note, however, that while low numbers were seen in this study, this likely markedly under-represents the number of individuals with dementia. Thus, studies of mortality have shown that dementia is historically under-reported on death certificates and discharge abstracts, with only 2% of those 85+ being documented as having dementia despite data indicating a prevalence of 37%, suggesting that only approximately 5% of cases of dementia are documented (124,125). A similar cause is also suspected for low rates of recorded strokes, where epidemiologic studies have estimated the burden to be twice what was seen in this cohort (126).

5.3.3 Mortality

Similar to LTCF readiness, there was an increase in mortality across both age and DADLH. However mortality was more clearly discriminated across functional groups than across age with 18.5% (18.7-20.2) of those 90+ dying within 180 days of discharge and 26.3% (24.9-27.6) of those who were functionally dependent This is consistent with previous literature indicating the impact of impaired function prognosticating mortality (69,73), and analogous with other functional measures such as the Palliative Performance scale used in oncology (25). Further, as highlighted above, with decreasing functional independence, it was seen that death became a more competitive outcome with LTCF readiness when one required more than extensive levels of supports. Across subgroups, however, there was marked divergence in outcomes between age and functional status.

Across age, those with heart failure demonstrated higher rates of mortality than the native population; when stratified by function, however, 36.3% (32.2-40.5) of those with CHF and 36.4% (31.3-41.5) of those with COPD who were functionally dependent had died within 180 days. While there is clear increased mortality for those post-discharge with COPD or CHF, this study was able to further stratify vulnerability and the interdependence between these two diseases and function (112,113). Similarly, those with CAD and heart failure also demonstrated augmented risk. While previous data has

suggested that age was the higher predictor of poor outcomes in those wise with acute coronary syndrome (ACS), this analysis suggests that in those with CAD (the vast majority of which are diagnosed via cases of ACS), the functional impairment is likely the main driver of this decline (127).

The ARDs – dementia, delirium, and falls – are well documented as prognosticators of death post discharge (125,128-130). There was a similar increase in mortality with lower functional status in those with dementia, however those with a history of falls and delirium were only found to be at background levels of risk, though this was only assessed across 92 and 36 individuals respectively. Given that a history of falls was considered as the covariate rather than the discharge diagnosis of a fall, and most literature assesses those who were discharged post-fall, they are likely a group at no increased risk having survived the period of increased risk and been rehabilitated from the fall. Similarly, delirium has been found to place individuals at increased risk of in-hospital mortality independent of function (131); post-discharge analyses have not considered function as a potential driver of poor outcomes and delirium may simply be a surrogate marker for this that is accounted for in this analysis (128).

5.4 Regression Analysis

When comparing model development strategies, both age and discharge function emerged as the co-dominant variables driving LTCF readiness, with delirium and dementia being the other greatest predictive factors. When initial analysis demonstrated that LTCF readiness had the highest AUROC, it was used to determine the variable set that would be used for regressions in order to determine more and less purposeful variables. Within the a priori model, the only variables that were removed for collinearity was a diagnosis of a given disease at discharge and demonstrated that most variables at play had some impact on outcomes.

It was initially thought that similar predictors would also be seen using the parsimonious model, and indeed, the earliest included variables in predicting LTCF readiness was the individual's DADLH,

followed by delirium, dementia, and admission characteristics, which were indicators of the impact of the admission diagnosis on the patient's function and concordant with the a priori model. When considered across the iteratively constructed parsimonious models (Appendix E, Table 3), however, the addition of these variables did not demonstrably change the discriminability of the model, nor did the magnitude of effect that hierarchy or age had on outcomes change. It was expected that the addition of such impactful variables would either impact other variables or discriminability, but these comorbidities were only seen in 5-20% of individuals within the cohort (an under-representation). It is likely that across each individual the impact was distributed and became less significant, and suggests that stratifying across major subgroups would impact the discriminability of the model, which was indeed seen, though these impacts were small and more apparent across cardiorespiratory diseases (Appendix F). It is important to note that within such a volume of analyses that some of these associations happened by chance, and that no associations were large in magnitude nor did many of the ORs depart from unity, suggesting that the comorbidities as covariables did not contribute significantly to the analysis. Finally, the observation that the addition of LHIN to the models led to rurality becoming a non-significant predictor of outcomes suggested some interaction between these terms. Given the variable rurality of individuals from each LHIN this was an expected finding, and suggests that geography is an important non-modifiable factor in driving these outcomes.

When considered across ED re-presentation and hospital re-admission, markedly different parsimonious models were seen with age, comorbidities, UPI, and demographics serving as the greatest predictors of outcomes and function was added as the eighth variable. Overall, a broad and comprehensive set of covariates was considered within this analysis, with the goal of being able to understand the comparative drivers of these common outcomes, and results that were similar, though not as optimized, as tools such as HOMR and LACE were obtained (12,13). Given that the goal of this study was exploratory rather than explanatory, this outcome is unsurprising. It was clear, however, that

the covariates demonstrated markedly different utility across outcomes, and that these outcomes are fundamentally different, and are driven by fundamentally different patient factors. As such, while a few general factors can be seen across regressions, each outcome – and the role of function in driving outcomes – should be considered differently.

5.4.1 Global effects observed

Across all groups, a few things were found to consistently predict outcomes. Compared to DADLH, AADLH was consistently weakly but significantly associated with the outcomes, consistent with preliminary analyses of the relationship between each, but was maintained and did not demonstrate collinearity indicating, that both pre- and post-morbid function are contributors. A similarly consistent functional trend, with the exception of in those who were dying, was to see increasing risk of a given outcome with increasing functional dependence until they were maximally or totally dependent. Those who are maximally or totally dependent are unable to independently carry out many of bADLs, and if living alone and receiving government services and not able to safely remain, they are unlikely to continue to be supported and are found to be LTCF ready. While not recorded here, these individuals are highly likely to be living in the community with caregivers and may wish to avoid LTCF admission and remain at home, hence there is a blunted response despite their dependency. Alternatively, as highlighted above, their risk of mortality may have competitively lowered their odds of LTCF readiness being an outcome they could experience.

ICU admission was generally protective from experiencing any of the outcomes, which likely represents a healthy survivor bias given that older persons who are admitted to ICU are more likely to die (16,132). With increasing age, there was a smaller proportion of the cohort who was admitted to the ICU reflecting that such measures were not concordant with their goals of care; this protective factor is likely more reflective of excluding individuals who died during their index admission. A second

generally protective factor was the usual provider index, suggesting that improved continuity of care reduces hospital usage both in general and across many chronic diseases. Of note, however, there were increased odds of being LTCF ready, which may also correlate with patient-centred care – by having a trusted medical provider, patients and caregivers may be more willing to admit or accept that they need to present to an increased level of care when they have a health care provider who they trust and believe has their best interests, though this has yet to be formally studied in other contexts.

When compared against the logistic regression, survival analysis bore similar results and did not appear to meaningfully inform changes in outcomes. The competitive analysis did partially address the interplay between function and age, suggesting that increasing age drove more LTCF readiness, whereas functional dependency beyond requiring extensive supports see mortality as a more prevalent outcome This is similar to changes in the raw outcomes seen in Tables 15 and 16.

5.4.2 ED re-presentation and hospital re-admission

As discussed previously, not only were the covariates considered here much less predictive of either re-presenting to the ED or requiring hospitalization, the models also demonstrated much poorer overall discriminability; both outcomes had an extremely similar profile. Compared to LTCF readiness and mortality, age was a relatively minor contributor to an individual's risk, and functional impairment had an inconsistent effect seen more prominently at the extremes of dependency. CCI, CHF, and COPD were all small positive predictors of risk with individuals highly morbid (high CCI) having markedly increased risk. The UPI and family visits indicated that those who had a consistent family physician who understood their chronic disease, but did not need to see them too frequently, was the most protective factor against re-presenting to care, consistent with what was previously seen (86). Indeed, demographic and community factors were most predictive of care with an OR up to 2.05 (1.77-2.37) for

North East LHIN compared to Mississauga/Hamilton, which was both one of the populations with the least health care exposure.

These results suggest that age and function have a small effect on ED presentations and hospital admissions and have a similar impact on outcome as comorbidities. Underlying morbidity and/or behaviour that is not measured by these covariates, however – such as medication compliance, appropriateness of therapy, engagement in lifestyle interventions, polypharmacy – are likely more important drivers, as suggested by other exploratory analyses (47). Two studies that previously included function in models that address re-admission that demonstrated higher discriminability both suggested that function are important measures; both used a metric similar to that of this analysis in the form of an interviewer or patient-rated Likert scale of overall function (54,55). In the study by Coleman et al (ROC 0.83), an approach similar to that used within LACE where function was a part of the model but was not significant, and included more administrative data and survey information concerning the patient's individual health status. The analysis of Smith et al (ROC 0.66) found any decline in function to be of similar utility as seen in this analysis (OR 1.73, 95% CI 1.27-1.36). Both studies used much smaller study populations than seen here (n= 4 245, n= 1 404).

These analyses further suggest that including more information concerning non-clinical features of a patient's health status, including community supports, access to care, perceptions of care, and health care utilization (previous hospitalizations, previous LTCF admission) are more important determinants of these outcomes. This would benefit from further analysis as well as possible inclusions of information in the HOBIC database concerning patient/caregiver insights into health status and self-care capabilities. Function appears to play some role, but it may be the supports for one to function independently in the community rather than the level of disability itself that are stronger determinants of risk for re-admission and ED re-presentation.

5.4.3 LTCF Readiness

Regressions concerning LTCF readiness demonstrated better discriminability and confirmed the central nature of function within these outcomes. Indeed, increasing DADLH and age were the greatest odds of being LTCF ready, followed by a history of delirium or dementia. While these were not found to be collinear, given the interplay between the increasing burden of the ARDs and age as well as their significant impact on function, there variables are inter-related. Other major comorbidities and the CCI were not significantly associated with an increased risk, which is congruent with previous studies and meta-analyses demonstrating the clear impact of function and dementia on risk (15,68,123). Similar results were seen between LHINs in terms of increased odds of being LTCF ready, with geography leading to as much as a 160% increase in the odds of being LTCF ready for those in North Simcoe Muskoka as compared to those in Mississauga Hamilton. That the model demonstrated good discriminability also suggests that patient specific factors, rather than home care supports, address the majority of one's risk of being LTCF ready.

When stratified by designated comorbidities, the model that considered those with CAD demonstrated an AUROC of 0.88 (0.86-0.90), with the impact of age and DADLH magnified compared to the cohort both as a whole and other diseases. That this population was better able to be discriminated compared to those with CHF and COPD, for whom their functional impairment is more often used as a tool to stratify the severity of their disease, was unexpected. It is possible that burden of CAD, however is a reflection risk factors that increase risk of cerebrovascular disease and subsequent stroke, and can also be contributed to by an individual's general morbidity, suggesting that it may simply be a surrogate for disease burden, however this was not clearly demonstrated as the CCI would be expected to be lower within those in CAD compared to others. For CAD, however, age is one of the greatest risk factors and, given the increased impact of age within this population, it may be that CAD is an under-recognized contributor to functional limitations and impaired functional status for those who age.

When considering CHF and COPD, the model was less successfully able to discriminate compared to the cohort (AUROC 0.8, 0.78-0.82 and 0.80, 0.78-0.83 respectively), though both age and DADLH continued to be some of the most important associations, and dementia was associated with a much higher odds of being LTCF ready in those with COPD. A further differentiating factor was that diabetes was associated with increased odds for those with COPD. This is generally consistent with findings that individual patient behaviours that that regulate one's capacity to manage the day to day burden of these disease, which has been partially reflected by the ADL hierarchy, however inclusion of patient questions addressing therapeutic self-care HOBIC would provide further insight into the matter.

For those with dementia, on the other hand, the impact of function and age was markedly diminished. Given that dementia was one of the comorbidities which most increased the odds of LTCF readiness across the entire cohort, these factors likely suggest that it is the individual's community supports that influence whether they would require LTCF. It is has been previously shown that factors such as family, formal caregivers, and burnout are key drivers of LTCF readiness in the community, which is not recorded within HOBIC data (10). Many of these individuals, however, do require home care supports given that their caregivers have difficulty providing all their ADLs; those who receive such supports through government services (estimated to be 62.2% of home care services) are recorded through the RAI home care database at ICES (133). These factors could be incorporated into this dataset that would allow for a more granular analysis of factors that lead to transitions from the community to LTCFs in Ontario.

For a history of other ARDs – injurious falls and delirium – similar findings were seen to those with COPD and CHF where function and age were drivers of admission. For those with a history of delirium, ICU was a strong protective factor against LTCF readiness and there was marked variability in geographic outcomes. Similar to CHF and COPD, while these conditions do have an interplay with function, it did not appear that they were unique subgroups to analyse. It may have been of use to look

at them as discharge diagnoses as should the falls or delirium be resolved, they would have a lesser impact on outcomes than at the index admission.

5.4.4 Mortality

Similar trends were seen in modelling mortality at 180 days from the index admission as to LTCF readiness, with a similarly fair discriminability seen within the model and subgroup models. Increasing function and age were both the factors associated with the highest odds of suffering the outcome; unlike other outcomes those who were completely dependent were of consistently higher risk of dying than those of less functional dependency. While, in considering other outcomes, the impact of one's functional dependency can be partially compensated by the supports of those around them, and indeed it is highly unlikely that anyone who was maximally or totally dependent is living independently. As such, those who were totally dependent who were less likely to go to hospital or long-term care likely include some who were palliative but miscoded within the data as well as some for whom they would prefer not to present to such facilities.

Dying, however, is a consequence that is much more difficult to buffer in comparison, and progressive functional decline increases one's risk of death and leads to this increasing risk with progressive functional dependency. A further association with morbidity (the CCI was associated with the highest odds of mortality compared to other outcomes) confirms that with worsening burdens of disease and worsening function, one approaches end of life regardless of income and with less dependency on geography. In comparison to the covariates used with the more accurate HOMR tool (13), there was less information concerning the nature of the index admission, but the utility of function within this context was well demonstrated and suggests that future efforts to prognosticate mortality should consider including data concerning functional dependence which can now be successfully derived using administrative data.

Across subgroups there was general homogeneity across factors of outcomes. Of note, those with dementia were at higher risk across age and function, which is unsurprising given the life limiting impact of dementia (129). The lower impact of geography and income also suggest that the key prognosticators of mortality are function and one's burden of disease compared to other factors that can be important with LTCF readiness or presenting to a hospital or ED.

5.5 Strengths

This study allowed a novel exploration of the role of function when understanding outcomes in older Ontarians. In addition to demonstrating novel findings concerning the role of function as well as other covariates across a span of clinically meaningful outcomes, the cohort demonstrated consistency of characteristics, outcomes, and relationships seen in other cohorts, as well as limitations in using cohort data (i.e. recording of diagnoses of dementia). This external validation suggests that these databases are reliable, and both can and should be considered when understanding outcomes for older individuals. The study also provides nuanced information across what variables areas are central to understanding the likelihood of experiencing a given outcome, which has been a subject of previous individual analyses but not from such a comprehensive nor comparative perspective. It also highlights that there are potential geographic disparities in many of these outcomes and suggests that further exploration of the factors that drive these outcomes may prove fruitful. However, given the limitations by which the cohort was created, was not appropriate to consider within this context.

In addition to validating the difficulty of prognosticating hospital re-admission and ED re-presentation, the present analysis equally demonstrates that with such functional data, one can prognosticate with reasonable accuracy how likely one is to be LTCF ready within 6 months of discharge, information that is valuable for both health system planning as well as family planning. This study was not designed to optimize such a prognostication model, but with optimization and validation, it suggests

that such a model could prove fruitful and potentially of similar calibre to other recently published models (134). Finally, this study demonstrates that administrative databases that measure functional data can be used to provide informative analyses and, where measured, this study provides a framework through which future big data analyses of function can be completed. As with all databases, however, how the data is collected is key, and indeed the variability between the AADLH and DADLH indicates that careful consideration of such methods is key to allowing for proper interpretation of outcomes.

5.6 Weaknesses

As highlighted within the methods, there are limitations to using administratively derived databases for such studies. The asymmetry of geographic data within the database suggests that this data may be less valid for those who live rurally or in less populated LHINs, which were selected against by the minimum HOBIC completion criteria initially within the methods. Geography by regions is itself a blunt instrument, as convenience of access to primary care has been highlighted as a factor that drives ED presentations. Including more detailed geographic and socially contextual factors may allow for better prediction of hospital-based outcomes which has been partially collected within HOBIC and may deserve further analysis for consideration in future use. This concern, however, extends to LTCF readiness, where vulnerability is often partially accounted for by the vulnerability of their support structures – if a caregiver's health deteriorates or if there is a material change in circumstances, the individual may be LTCF ready through circumstances that are not related to their clinical status. The goal of this study, however, was to understand the role of function within and prognosticate such outcomes using readily available clinical data, and given the success with which this was able to be achieved without optimization, it suggests that this may be a relatively minor contributor to such

outcomes, and indeed hospital admission may be the index event that reveals this need (and these individuals were excluded from the database).

A specific concern highlighted within this study that was that the diagnosis of dementia was likely under reported, alongside other comorbidities, in discharge summaries. The limited fashion by which comorbidities were accrued within the cohort confirms that discharge summaries within the DAD are likely a non-ideal method by which cohorts can be measured and that the burdens of diseases are likely significantly under-recorded unless they meaningfully contributed to the individual's admission, especially with temporary detriments such as injurious falls. (For example, 92.9% of those who were listed to have falls had it listed as the primary discharge diagnosis and 87.1% of those with CHF). For those where it is listed, it may indicate a particularly severe case of the disease or number of events, rendering the individual more susceptible to being LTCF ready or returning to a health care facility and overestimating risk. Other methods that have used multiple methods of validating a diagnosis likely serve not just as a means of ensuring that a diagnosis is appropriately applied, but also to capture all who actually have the diagnosis (77). Indeed, while generally externally valid, a large vulnerability of these databases is ensuring that data can be internally validated, and within this data it is impossible to clinically correlate, and careful methods of ensuring sufficient recording could reinforce these results. This would likely counteract the limitations of there being limited numbers of individuals with a given diagnosis; there are many more older Ontarians with dementia than were represented here.

6 Conclusion

This study demonstrates that measurement of function meaningfully informs the likelihood of LTCF readiness and mortality for older Ontarians discharged from hospital, whereas ED re-presentation and hospital re-admission are inherently less clearly prognosticated using function or associated administratively derived clinical covariates. It demonstrates that secondary data concerning function can be effectively used in studies, and that this data could be more widely considered as it can be of equal if not greater utility than clinical covariates. Future studies to validate these findings, optimize models, and better compare and contextualize function against other chronic diseases (e.g. NYHA classification of heart failure) would be of potential demonstrable utility for health service planning.

7 List of Abbreviations

AADLH - Admission ADL Hierarchy Rank

ACS – Acute Coronary Syndrome

ACSC – Ambulatory care sensitive conditions

ADL – Activity of daily living

ARD – Age-related disease

AUROC – Area under the Receiver Operator Curve

bADL – Basic activity of daily living

CAD – Coronary Artery Disease

CCI – Charlson Comorbidity Index

CCRS – Continuing Care Reporting System

CHF – Congestive Heart Failure

COPD – Chronic Obstructive Pulmonary Disease

DAD – Discharge Abstract Database

DADLH – Discharge ADL Hierarchy Rank

ED – Emergency Department

FIM – Functional Independence Measure

HARP – Hospital Admission Risk Prediction

HOBIC – Health Outcomes for Better Information and Care

iADL – Instrumental activity of daily living

ICD-10 – International Classification of Disease version 10

ICES – Institute for Clinical Evaluative Sciences

IKN – Individual Key Number

interRAI – international Resident Assessment Instrument

interRAI AC – international Resident Assessment Instrument for Acute Care

LACE – Length/Acuity/Comorbidity/ED Index

LHIN – Local Health Integration Network

LOS – Length of Stay

LTCF – Long-term care facility

MAPLe – Method for Assigning Priority Levels

NACRS – National Ambulatory Care Reporting System

NYA – New York Heart Association

OHIP – Ontario Health Insurance Program

OR – Odds Ratio

RA – Resident Assessment Instrument

RPDB – Registered Persons Database

STROBE – Strengthening the Reporting of Observational Studies

UPI – Usual Provider Index

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Appendix A: ICD-10 coding for comorbidities

ICD-10 codes associated with comorbidities:

Diagnosis	ICD-10 codes included
Diabetes	E11.0, E11.10, E11.11, E11.20, E11.21, E11.22, E11.23, E11.23, E11.33, E11.40, E11.41, E11.42, E11.50, E11.51, E11.52, E11.60, E11.61, E11.63, E11.64, E11.68, E11.70, E11.71, E11.78, E11.9
Epilepsy / Seizure Disorders	G40.00, G40.10, G40.20, G40.3, G40.30, G40.31, G40.5, G40.50, G40.60, G40.7, G40.9, G40.90, G40.91, G41.0, G41.2, G41.9
Delirium	F05.0, F05.1, F05.4, F05.8, F05.9
Dementia	G30.1, G30.8, G30.9, G31.0, G31.2, G31.8, G31.9
Congestive heart failure	I50.0, I50.1, I50.9, I51.0, I51.3, I51.4, I51.6, I51.7, I51.8, I51.9
Hypertension	I10.0, I10.1, I11, I12, I13
Angina	I20.0, I20.1, I20.80, I20.88, I20.9, I21.0, I21.1, I21.2, I21.3, I21.4, I 21.40, I21.41, I21.42, I21.49, I21.9
Chronic Obstructive Pulmonary Disease	J44.0, J44.1, J44.8, J44.9
Asthma	J45.00, J45.10, J45.90, J45.91
Coronary Artery Disease	I20.0, I20.1, I20.80, I20.88, I20.9, I21.0, I21.2, I21.3, I21.4, I21.40, I21.41, I21.42, I21.49, I21.9, I25.0, I25.10, I25.11, I25.12, I25.13, I25.14, I25.15, I25.19, I25.2, I25.4, I25.5, I25.6, I25.8, I25.9

Code sets were derived from codes used within the data corresponding to disease rather than a priori from existing code sets.

Appendix B: Age and HOBIC distribution by admission year and LHIN

Table & Figure 1: Distribution of admissions by age bracket per year.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
65-69	287	1030	2938	2866	4391	2912	2975	4830	3299	666
70-74	281	1113	3164	3044	4542	2816	2959	4714	3032	593
75-79	325	1354	3438	3366	4860	3001	3047	4715	3078	616
80-84	322	1266	3290	3223	4997	3030	3240	4913	3189	607
85-89	212	926	2326	2380	3632	2193	2319	3626	2357	472
90+	130	396	1070	1065	1888	1214	1339	2188	1442	294

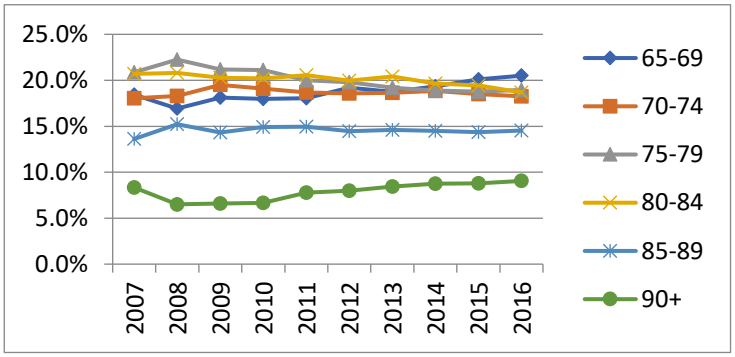
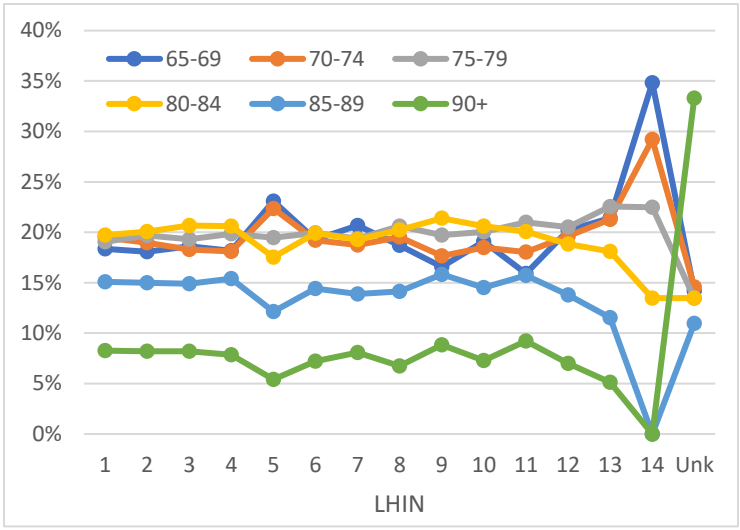


Table 2: Distribution and relative proportion of HOBICs, AADLH, and DADLH by year.

	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016	
Any completed HOBIC																				
	1557		6085		16226		15944		24310		15166		15879		24986		16397		3248	
Admission ADL Hierarchy																				
0	542	57.8%	2348	52.8%	5592	47.1%	5024	47.2%	8532	50.5%	5198	48.8%	5412	49.8%	7445	48.3%	4496	44.8%	936	39.5%
1	41	4.4%	273	6.1%	783	6.6%	754	7.1%	1140	6.7%	768	7.2%	763	7.0%	1081	7.0%	732	7.3%	182	7.7%
2	153	16.3%	582	13.1%	1697	14.3%	1476	13.9%	2228	13.2%	1279	12.0%	1387	12.8%	1996	13.0%	1205	12.0%	329	13.9%
3	38	4.1%	192	4.3%	593	5.0%	548	5.1%	846	5.0%	569	5.3%	536	4.9%	700	4.5%	570	5.7%	121	5.1%
4	71	7.6%	455	10.2%	1067	9.0%	876	8.2%	1206	7.1%	827	7.8%	678	6.2%	939	6.1%	596	5.9%	157	6.6%
5	92	9.8%	601	13.5%	2149	18.1%	1976	18.5%	2946	17.4%	2021	19.0%	2085	19.2%	3250	21.1%	2444	24.3%	644	27.2%
Discharge ADL Hierarchy																				
0	660	65.9%	1706	63.7%	5351	63.3%	6408	65.4%	9692	67.1%	6193	67.9%	6102	68.0%	8984	66.0%	5900	64.1%	1269	63.7%
1	38	4.1%	132	3.0%	665	5.6%	727	6.8%	1057	6.3%	730	6.8%	682	6.3%	1151	7.5%	804	8.0%	166	7.0%
2	143	15.3%	457	10.3%	1240	10.4%	1366	12.8%	2030	12.0%	1166	10.9%	1125	10.4%	1829	11.9%	1296	12.9%	271	11.4%
3	35	3.7%	82	1.8%	277	2.3%	330	3.1%	412	2.4%	272	2.6%	276	2.5%	406	2.6%	321	3.2%	73	3.1%
4	38	4.1%	144	3.2%	395	3.3%	467	4.4%	604	3.6%	368	3.5%	304	2.8%	512	3.3%	336	3.3%	87	3.7%
5	87	9.3%	159	3.6%	532	4.5%	493	4.6%	657	3.9%	396	3.7%	490	4.5%	733	4.8%	545	5.4%	127	5.4%

Table 3 & Figure 2: Distribution of cohort by age group, by LHIN.

LHIN	65-69	70-74	75-79	80-84	85-89	90+	All
Erie St. Clair	804	855	835	865	661	363	4383
South West	1619	1698	1764	1796	1343	734	8954
Waterloo Wellington	2680	2636	2782	2978	2148	1180	14404
HNHB	3264	3250	3563	3702	2768	1408	17955
Central West	956	926	807	727	503	224	4143
Mississauga Halton	2218	2210	2294	2292	1660	830	11504
Toronto Central	2102	1903	1968	1959	1412	820	10164
Central	1775	1853	1956	1919	1340	641	9484
Central East	4366	4656	5198	5637	4172	2326	26355
South East	1802	1747	1891	1945	1370	689	9444
Champlain	157	178	207	198	155	91	986
NSM	3401	3302	3455	3170	2323	1178	16829
North East	878	873	926	743	474	211	4105
North West	31	26	20	12	0		89
Unknown	141	145	134	134	109	331	994



NSM = North Simcoe Muskoka, WW = Waterloo Wellington, HNHB = Hamilton Niagara Haldimand Brant.

Table 4: Admission & Discharge ADL hierarchies per LHIN. Empty cells are suppressed.

LHIN	A0	A1	A2	A3	A4	A5	D0	D1	D2	D3	D4	D5
Erie St. Clair	2275	190	377	189	168	483	874	95	167	40	40	48
South West	4073	602	941	347	729	791	4932	452	698	298	332	249
Waterloo Wellington	5556	878	1389	477	755	1957	5623	810	949	205	243	279
HNHB	3974	612	1117	440	717	1137	5181	659	1045	202	341	350
Central West	1473	117	303	102	120	357	2008	189	411	75	121	195
Mississauga Halton	4125	370	637	165	332	691	5814	470	767	194	279	403
Toronto Central	1793	631	845	346	220	3488	4210	808	1161	236	296	623
Central	2471	514	826	316	416	1678	2880	471	666	157	247	336
Central East	7922	1501	2322	1056	1887	4589	7151	1115	1646	409	631	867
South East	3101	445	1129	481	621	1242	3451	479	1076	216	300	249
Champlain	275	115	199	48	121	113	551	71	124	18	37	35
NSM	6452	352	1810	600	552	1174	7712	392	1833	366	286	428
North East	1775	145	331	113	156	323	1550	112	276	37	64	80
North West	10		0		0	10	32		0		0	0
Unknown	250	45	105	33	76	175	296	29	100	31	36	73

Table 6: Percentage of individuals living rurally by age group

	65-69	70-74	75-79	80-84	85-89	90+	Total
Urban	21 085	20 960	22 406	22 907	16 835	9 180	113 373
	80.9%	80.3%	81.0%	82.0%	82.7%	83.4%	81.5%
Rural	4 983	5 160	5 246	5 046	3521	1 823	25 779
	19.1%	19.8%	19.0%	18.1%	17.3%	16.6%	18.5%

Table 7: Percentage of individuals living rurality by LHIN, 18.5% of individuals in total live rurally.

	1	2	3	4	5	6	7
Urban	4 290	1 777	12 167	16 895	3 562	11 497	11 497
	97.9%	19.9%	84.7%	94.6%	87.3%	100%	100%
Rural	92	7 162	2 201	962	519	4	0
	2.1%	80.1%	15.3%	5.4%	12.7%	0%	0%
	8	**9**	**10**	**11**	**12**	**13**	**14**
Urban	9 056	23 572	4 780	176	12 514	2 225	60
	8.0%	20.9%	50.7%	17.9%	75.1%	54.6%	64.5%
Rural	322	2 753	4658	809	4 158	1 848	33
	3.4%	10.5%	49.35%	82.1%	24.9%	45.4%	35.5%

Appendix C: Most common discharge diagnoses

Table 1: Top ten most common discharge diagnoses and corresponding ICD-10 codes by age group

Diagnosis	ICD-10	#	Diagnosis	ICD-10	#	Diagnosis	ICD-10	#
65-69			**70-74**			**75-79**		
CAD	I2510	1134	CHF	I500	1130	CHF	I500	1406
CHF	I500	908	COPD	J441	1018	COPD	J441	939
COPD	J441	893	CAD	I2510	1002	COPD	J440	831
NSTEMI	I214	868	NSTEMI	I214	750	CAD	I2510	791
COPD	J440	634	COPD	J440	700	NSTEMI	I214	744
PNA	J189	507	PNA	J189	572	PNA	J189	671
Unstable Angina	I200	460	UTI	N390	480	UTI	N390	629
Chest Pain	R074	457	Unstable Angina	I200	381	Syncope	R55	460
Obstruction	K566	384	Chest Pain	R074	380	Unstable Angina	I200	375
Post-op recovery	Z540	382	Obstruction	K566	374	AF	I480	375
80-84			**85-89**			**90+**		
CHF	I500	1825	CHF	I500	1585	CHF	I500	990
COPD	J440	844	PNA	J189	709	PNA	J189	533
COPD	J441	825	UTI	N390	672	UTI	N390	457
PNA	J189	786	NSTEMI	I214	611	NSTEMI	I214	349
NSTEMI	I214	782	COPD	J440	599	COPD	J440	286
UTI	N390	731	COPD	J441	442	Pertrochanteric Fracture	S72100	213
Syncope	R55	538	Syncope	R55	435	COPD	J441	212
CAD	I2510	487	NOF	S72080	323	Syncope	R55	202
GI Bleed	K922	386	AF	I480	293	NOF	S72080	194
Stroke	I639	370	Pertrochanteric Fracture	S72100	291	GI Bleed	K922	164

Table 2: Discharge diagnoses by DADLH.

Diagnosis	ICD-10	#	Diagnosis	ICD-10	#	Diagnosis	ICD-10	#
Independent			**Supervision**			**Limited Assistance**		
CHF	I500	2912	CHF	I500	396	CHF	I500	691
COPD	J441	1795	CAD	I2510	184	PNA	J189	362
NSTEMI	I214	1766	COPD	J441	182	COPD	J440	336
CAD	I2510	1698	UTI	N390	178	COPD	J441	302
COPD	J440	1550	PNA	J189	175	UTI	N390	296
PNA	J189	1314	COPD	J440	140	NSTEMI	I214	212
Syncope	R55	989	NSTEMI	I214	125	CAD	I2510	164
UTI	N390	974	Syncope	R55	118	Syncope	R55	157
Chest Pain	R074	920	Post-op recovery	Z540	86	NOF	S72080	148
Unstable Angina	I200	886	Stroke	I639	85	Post-op recovery	Z540	133

Extensive Assistance			**Maximal Assistance**			**Dependent**		
CHF	I500	154	CHF	I500	206	UTI	N390	250
UTI	N390	107	UTI	N390	140	CHF	I500	153
PNA	J189	102	PNA	J189	112	PNA	J189	136
COPD	J441	75	COPD	J440	105	Pertrochanteric Fracture	S72100	104
COPD	J440	69	NOF	S72080	87	NOF	S72080	101
Dementia	F03	53	Pertrochanteric Fracture	S72100	79	Stroke	I639	88
Renal failure	N179	40	COPD	J441	75	Asp PNA	J690	78
NSTEMI	I214	37	Dementia	F03	57	COPD	J440	77
Delirium	F059	36	Stroke	I639	54	Renal failure	N179	59
Post-op recovery	Z540	34	Non-inj fall	R53	40	Dementia	F03	58

Appendix D: Additional outcome analyses

Table 1: Outcomes distributed by year by total, percentage and 95% confidence interval.

		n	%	95% CI	n	%	95% CI	n	%	95% CI	n	%	95% CI	n	%	95% CI
Outcome	**Days**	**2007**			**2008**			**2009**			**2010**			**2011**		
Any outcome	180	918	59.0	56.5-61.4	3495	57.4	56.2-58.7	8923	55.0	54.2-55.8	8831	55.4	54.6-56.2	13542	55.7	55.1-56.3
Re-admission	30	268	17.7	15.8-19.7	827	13.9	13.1-14.8	2132	13.4	12.8-13.9	2105	13.4	12.9-13.9	3189	13.3	12.9-13.7
Re-admission	180	555	35.6	33.3-38.0	1932	31.8	30.6-32.9	5075	31.3	30.6-32.0	4909	30.8	30.1-31.5	7609	31.3	30.7-31.9
ED presentation	30	351	23.2	21.1-25.4	1351	22.8	21.7-23.8	3555	22.3	21.6-22.9	3554	22.6	21.9-23.2	5353	22.3	21.8-22.9
ED presentation	180	754	48.4	45.9-50.9	2867	47.1	45.9-48.4	7564	46.6	45.8-47.4	7650	48.0	47.2-48.8	11731	48.3	47.6-48.9
Death	180	286	25.4	16.4-20.3	928	24.4	14.3-16.2	2042	23.8	12.1-13.1	1917	24.2	11.5-12.5	2783	24.1	11-11.8
LTCF readiness	180	97	52.9	5.0-7.4	526	50.8	7.9-9.4	1254	50.1	7.3-8.1	1098	51.2	6.5-7.3	1535	51.8	6.0-6.6
Outcome	**Days**	**2012**			**2013**			**2014**			**2015**			**2016**		
Any outcome	180	8546	56.3	55.6-57.1	8720	54.9	54.1-55.7	13852	55.4	54.8-56.1	9250	56.4	55.7-57.2	1947	59.9	58.3-61.6
Re-admission	30	1928	12.9	12.4-13.4	2000	12.8	12.2-13.3	2974	12.1	11.7-12.5	1963	12.2	11.7-12.7	434	13.5	12.4-14.7
Re-admission	180	4698	31.0	30.2-31.7	4753	29.9	29.2-30.6	7434	29.8	29.2-30.3	4969	30.3	29.6-31.0	1109	34.1	32.5-35.8
ED presentation	30	3307	22.1	21.4-22.8	3448	22.0	21.4-22.7	5541	22.5	21.9-23.0	3517	21.8	21.1-22.4	751	23.4	22.0-24.9
ED presentation	180	7465	49.2	48.4-50.0	7597	47.8	47.1-48.6	12167	48.7	48.1-49.3	8100	49.4	48.6-50.2	1702	52.4	50.7-54.1
Death	180	1727	23.8	10.9-11.9	1623	23.6	9.7-10.7	2556	23.7	9.9-10.6	1717	23.0	10.0-10.9	344	24.8	9.5-11.6
LTCF readiness	180	985	52.4	6.1-6.9	1039	50.7	6.2-6.9	1685	51.3	6.4-7.1	1158	52.1	6.7-7.5	273	55.0	7.5-9.4

Table 2: Analysis of select outcomes for dedicated subgroups by age group by total, proportion and 95% confidence interval.

		Heart Failure			COPD			CAD			Dementia			Delirium			Injurious Falls		
	Age	#	%	95% CI	#	%	95% CI	#	%	95% CI	#	%	95% CI	#	%	95% CI	#	%	95% CI
ED re-present 180d	65-69	1166	53.7	51.6-55.8	1500	53.1	51.2-54.9	2202	43.2	41.9-44.6	36	44.4	33.4-55.5	254	51.1	46.7-55.5	409	32.3	29.7-34.9
	70-74	1478	55.5	53.6-57.4	1691	54.4	52.6-56.1	2219	45.8	44.4-47.2	75	44.9	37.3-52.5	322	49.5	45.7-53.4	478	33.7	31.2-36.2
	75-79	1876	56.4	54.7-58.1	1885	56.3	54.7-58.0	2411	48.2	46.8-49.6	153	49.4	43.8-55.0	538	53.9	50.8-57.0	624	36.4	34.2-38.7
	80-84	2446	58.9	57.4-60.4	1820	56.7	54.9-58.4	2598	53.3	51.9-54.7	237	50.7	46.2-55.3	688	52.0	49.3-54.7	826	38.7	36.6-40.7
	85-89	2135	61.3	59.7-62.9	1287	58.8	56.8-60.9	1924	56.9	55.2-58.6	210	49.9	45.1-54.7	662	53.7	50.9-56.5	861	42.7	40.5-44.8
	90+	1381	61.7	59.7-63.7	607	59.4	56.4-62.4	977	59.1	56.7-61.4	127	53.1	46.8-59.5	474	56.5	53.1-59.9	603	45.8	43.1-48.4
Re-admitted at 180d	65-69	812	37.4	35.4-39.4	1019	36.1	34.3-37.8	1174	23.1	21.9-24.2	23	28.4	18.4-38.4	154	31.0	26.9-35.1	192	15.2	13.2-17.1
	70-74	1051	39.5	37.6-41.3	1123	36.1	34.4-37.8	1275	26.3	25.1-27.6	51	30.5	23.5-37.6	218	33.5	29.9-37.2	273	19.3	17.2-21.3
	75-79	1315	39.5	37.9-41.2	1281	38.3	36.6-39.9	1478	29.5	28.3-30.8	94	30.3	25.2-35.5	353	35.4	32.4-38.3	356	20.8	18.9-22.7
	80-84	1778	42.8	41.3-44.3	1273	39.6	37.9-41.3	1628	33.4	32.1-34.7	160	34.3	29.9-38.6	448	33.8	31.3-36.4	487	22.8	21.0-24.6
	85-89	1583	45.5	43.8-47.1	834	38.1	36.1-40.2	1293	38.2	36.6-39.9	152	36.1	31.5-40.7	444	36.0	33.3-38.7	548	27.2	25.2-29.1
	90+	998	44.6	42.5-46.7	404	39.5	36.5-42.5	662	40.0	37.7-42.4	80	33.5	27.4-39.5	325	38.7	35.4-42.0	352	26.7	24.3-29.1
Death at 180 Days	65-69	293	13.5	12.1-14.9	354	12.5	11.3-13.7	245	4.8	4.2-5.4	8	9.9	3.2-16.5	50	10.1	7.4-12.7	57	4.5	3.4-5.6
	70-74	415	15.6	14.2-17.0	401	12.9	11.7-14.1	309	6.4	5.7-7.1	12	7.2	3.2-11.1	51	7.8	5.8-9.9	51	3.6	2.6-4.6
	75-79	535	16.1	14.8-17.3	592	17.7	16.4-19.0	435	8.7	7.9-9.5	30	9.7	6.4-13	111	11.1	9.2-13.1	90	5.3	4.2-6.3
	80-84	791	19.0	17.8-20.2	579	18.0	16.7-19.4	570	11.7	10.8-12.6	66	14.1	11-17.3	158	11.9	10.2-13.7	155	7.3	6.2-8.4
	85-89	763	21.9	20.5-23.3	385	17.6	16.0-19.2	526	15.6	14.3-16.8	53	12.6	9.4-15.8	176	14.3	12.3-16.2	161	8.0	6.8-9.2
	90+	605	27.0	25.2-28.9	224	21.9	19.4-24.5	376	22.7	20.7-24.8	49	20.5	15.3-25.7	164	19.5	16.9-22.2	180	13.7	11.8-15.5
LTCF by 180d	65-69	51	2.3	1.7-3.0	72	2.5	2.0-3.1	38	0.7	0.5-1	20	24.7	15.1-34.3	34	6.8	4.6-9.1	52	4.1	3-5.2.0
	70-74	73	2.7	2.1-3.4	94	3.0	2.4-3.6	70	1.4	1.1-1.8	39	23.4	16.9-29.8	61	9.4	7.1-11.6	69	4.9	3.7-6.0
	75-79	188	5.7	4.9-6.4	188	5.6	4.8-6.4	160	3.2	2.7-3.7	101	32.6	27.3-37.8	162	16.2	13.9-18.5	172	10.0	8.6-11.5
	80-84	330	7.9	7.1-8.8	262	8.2	7.2-9.1	256	5.2	4.6-5.9	147	31.5	27.2-35.7	273	20.6	18.4-22.8	304	14.2	12.7-15.7
	85-89	426	12.2	11.1-13.3	247	11.3	10.0-12.6	336	9.9	8.9-10.9	139	33.0	28.5-37.5	296	24.0	21.6-26.4	419	20.8	19.0-22.5
	90+	390	17.4	15.9-19.0	183	17.9	15.6-20.3	262	15.8	14.1-17.6	79	33.1	27.0-39.1	272	32.4	29.2-35.6	337	25.6	23.2-27.9
Any outcome at 180d	65-69	1299	59.8	57.8-61.9	1624	57.5	55.6-59.3	2426	47.6	46.3-49.0	51	63.0	52.2-73.7	285	57.3	53.0-61.7	477	37.7	35.0-40.4
	70-74	1649	61.9	60.1-63.8	1824	58.7	56.9-60.4	2434	50.2	48.8-51.6	102	61.1	53.6-68.5	366	56.3	52.5-60.1	575	40.6	38.0-43.1
	75-79	2111	63.5	61.9-65.1	2093	62.6	60.9-64.2	2692	53.8	52.4-55.2	203	65.5	60.2-70.8	636	63.7	60.7-66.7	788	46.0	43.7-48.4
	80-84	2748	66.1	64.7-67.6	2059	64.1	62.4-65.8	2894	59.3	58.0-60.7	315	67.5	63.2-71.7	854	64.5	61.9-67.1	1048	49.1	46.9-51.2
	85-89	2424	69.6	68.1-71.1	1457	66.6	64.6-68.6	2180	64.5	62.9-66.1	282	67.0	62.5-71.5	818	66.3	63.7-69.0	1113	55.2	53.0-57.3
	90+	1625	72.6	70.8-74.5	717	70.2	67.3-73.0	1144	69.2	66.9-71.4	184	77.0	71.6-82.4	622	74.1	71.2-77.1	843	64.0	61.4-66.6

Table 3: Analysis of select outcomes for dedicated subgroups by DADLH by total, percentage and 95% confidence interval.

		CHF			COPD			CAD			Dementia			Delirium			Injurious Falls		
	DADLH	#	%	95% CI	#	%	95% CI	#	%	95% CI	#	%	95% CI	#	%	95% CI	#	%	95% CI
ED re-pr 180d	0	3470	55.5	54.3-56.8	3048	53.3	52.0-54.6	4761	46.6	45.7-47.6	108	50.9	44.2-57.7	493	49.0	45.9-52.1	659	38.5	36.2-40.8
	1	632	64.8	61.8-67.8	400	59.5	55.8-63.2	563	57.9	54.8-61.0	55	44.7	35.8-53.6	183	47.9	42.9-52.9	215	39.2	35.1-43.3
	2	1042	61.8	59.4-64.1	799	61.7	59.1-64.4	854	58.6	56.0-61.1	86	48.3	40.9-55.7	369	57.0	53.2-60.9	494	39.2	36.5-41.9
	3	265	66.9	62.3-71.6	181	64.9	59.2-70.5	194	63.8	58.4-69.2	55	61.1	50.8-71.4	129	55.1	48.7-61.5	117	50.2	43.7-56.7
	4	316	64.0	59.7-68.2	221	61.6	56.5-66.6	214	58.8	53.7-63.9	55	49.1	39.7-58.5	173	60.9	55.2-66.6	220	44.8	40.4-49.2
	5	292	55.0	50.7-59.2	184	52.7	47.5-58.0	235	52.9	48.3-57.6	75	47.8	39.9-55.7	237	59.4	54.6-64.2	231	39.8	35.8-43.8
re-admit 180d	0	2315	37.1	35.9-38.3	1862	32.6	31.4-33.8	2617	25.6	24.8-26.5	63	29.7	23.5-35.9	274	27.2	24.5-30.0	312	18.2	16.4-20.1
	1	452	46.3	43.2-49.4	282	42.0	38.2-45.7	350	36.0	33.0-39.0	43	35.0	26.4-43.5	127	33.2	28.5-38.0	125	22.8	19.3-26.3
	2	781	46.3	43.9-48.7	580	44.8	42.1-47.5	583	40.0	37.5-42.5	55	30.9	24.0-37.8	238	36.8	33.1-40.5	274	21.7	19.5-24.0
	3	189	47.7	42.8-52.7	128	45.9	40.0-51.8	140	46.1	40.4-51.7	29	32.2	22.4-42.1	86	36.8	30.5-43.0	61	26.2	20.5-31.9
	4	260	52.6	48.2-57	176	49.0	43.8-54.2	165	45.3	40.2-50.5	43	38.4	29.2-47.5	119	41.9	36.1-47.7	124	25.3	21.4-29.1
	5	239	45.0	40.8-49.3	149	42.7	37.5-47.9	168	37.8	33.3-42.4	58	36.9	29.3-44.6	174	43.6	38.7-48.5	159	27.4	23.7-31.0
Death 180d	0	842	13.5	12.6-14.3	617	10.8	10.0-11.6	660	6.5	6.0-6.9	13	6.1	2.9-9.4	76	7.6	5.9-9.2	67	3.9	3.0-4.8
	1	196	20.1	17.6-22.6	125	18.6	15.7-21.6	116	11.9	9.9-14.0	12	9.8	4.4-15.1	40	10.5	7.4-13.6	26	4.7	3.0-6.5
	2	401	23.8	21.7-25.8	308	23.8	21.5-26.1	239	16.4	14.5-18.3	15	8.4	4.3-12.5	79	12.2	9.7-14.7	71	5.6	4.4-6.9
	3	121	30.6	26.0-35.1	79	28.3	23.0-33.6	63	20.7	16.1-25.3	11	12.2	5.3-19.1	38	16.2	11.5-21.0	20	8.6	5.0-12.2
	4	180	36.4	32.2-40.7	124	34.5	29.6-39.5	105	28.8	24.2-33.5	21	18.8	11.4-26.1	53	18.7	14.1-23.2	42	8.6	6.1-11.0
	5	193	36.3	32.2-40.5	127	36.4	31.3-41.5	113	25.5	21.4-29.5	50	31.8	24.5-39.2	92	23.1	18.9-27.2	96	16.5	13.5-19.6
LTCF 180d	0	219	3.5	3.0-4.0	186	3.3	2.8-3.7	163	1.6	1.4-1.8	45	21.2	15.7-26.8	107	10.6	8.7-12.5	88	5.1	4.1-6.2
	1	103	10.6	8.6-12.5	61	9.1	6.9-11.3	64	6.6	5.0-8.1	38	30.9	22.6-39.2	68	17.8	13.9-21.7	54	9.9	7.4-12.4
	2	181	10.7	9.3-12.2	125	9.7	8.0-11.3	123	8.4	7.0-9.9	54	30.3	23.5-37.2	122	18.9	15.8-21.9	152	12.1	10.3-13.9
	3	85	21.5	17.4-25.5	48	17.2	12.7-21.7	52	17.1	12.8-21.4	38	42.2	31.8-52.6	53	22.6	17.2-28.1	52	22.3	16.9-27.7
	4	103	20.9	17.3-24.4	62	17.3	13.3-21.2	80	22.0	17.7-26.3	43	38.4	29.2-47.5	95	33.5	27.9-39	111	22.6	18.9-26.3
	5	91	17.1	13.9-20.4	52	14.9	11.1-18.7	61	13.7	10.5-17.0	43	27.4	20.3-34.4	116	29.1	24.6-33.5	130	22.4	19.0-25.8
Any 180d	0	3766	60.3	59.1-61.5	3258	57.0	55.7-58.3	5127	50.2	49.3-51.2	129	60.8	54.2-67.5	549	54.6	51.5-57.7	726	42.4	40.1-44.8
	1	679	69.6	66.7-72.5	439	65.3	61.7-68.9	611	62.9	59.8-65.9	73	59.3	50.5-68.2	228	59.7	54.7-64.6	244	44.5	40.4-48.7
	2	1162	68.9	66.7-71.1	882	68.2	65.6-70.7	941	64.5	62.1-67.0	111	62.4	55.2-69.5	428	66.2	62.5-69.8	589	46.7	44.0-49.5
	3	309	78.0	73.9-82.1	212	76.0	70.9-81.0	227	74.7	69.8-79.6	69	76.7	67.8-85.6	157	67.1	61.0-73.2	146	62.7	56.4-68.9
	4	394	79.8	76.2-83.3	273	76.0	71.6-80.5	279	76.6	72.3-81.0	86	76.8	68.8-84.7	215	75.7	70.7-80.7	284	57.8	53.5-62.2
	5	409	77.0	73.4-80.6	261	74.8	70.2-79.4	319	71.8	67.6-76.0	117	74.5	67.6-81.4	316	79.2	75.2-83.2	358	61.6	57.7-65.6

Appendix E: *A priori* and parsimonious logistic regression model selection and sensitivity analysis

Table 1: the seven a priori logistic regression models to LTCF admission at 180 days and their receiver-operator curves, as well as the tolerance and variance inflation factor (VIF) of the linearized coefficients for the purposes of determining multicollinearity. Note that the linearized models used to assess multicollinearity did not treat categorical variables as class variables as the logistic regression model.

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Tolerance & VIF	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	Tol	VIF
ICU admission			0.66	0.59-0.74							0.72	0.60-0.86	0.73	0.61-0.87	0.86	1.16
UPI			1.06	0.92-1.22							1.23	1.01-1.49	1.24	1.02-1.50	0.97	1.03
Admit Length	1.02	1.02-1.02	1.02	1.02-1.02	1.02	1.01-1.02	1.02	1.02-1.02	1.02	1.01-1.02	1.02	1.02-1.02	1.02	1.02-1.02	0.89	1.12
AF							0.88	0.72-1.09	0.93	0.75-1.15			1.01	0.76-1.35	0.95	1.06
Age 70-74*	1.36	1.15-1.61	1.36	1.15-1.62	1.34	1.14-1.59	1.35	1.14-1.60	1.34	1.13-1.59	1.35	1.06-1.70	1.34	1.06-1.70	0.88	1.13
Age 75-79*	2.56	2.20-2.97	2.55	2.19-2.97	2.51	2.16-2.91	2.55	2.19-2.96	2.50	2.15-2.91	2.42	1.95-2.99	2.41	1.95-2.99		
Age 80-84*	3.62	3.14-4.18	3.62	3.13-4.19	3.54	3.06-4.09	3.59	3.11-4.15	3.52	3.05-4.07	3.32	2.70-4.08	3.31	2.70-4.07		
Age 85-89*	5.12	4.44-5.91	5.07	4.38-5.87	5.02	4.35-5.80	5.10	4.42-5.89	5.00	4.33-5.78	4.62	3.76-5.68	4.64	3.77-5.70		
Age 90+*	7.32	6.31-8.48	7.06	6.07-8.22	7.24	6.24-8.41	7.33	6.32-8.51	7.21	6.21-8.37	6.96	5.63-8.62	6.98	5.64-8.64		
Supervision AADLH **											1.84	1.53-2.23	1.85	1.53-2.23	0.74	1.34
Limited AADLH **											2.09	1.82-2.41	2.09	1.82-2.41		
Extensive AADLH **											2.96	2.48-3.53	2.97	2.49-3.54		
Maximal AADLH **											2.48	2.12-2.91	2.49	2.13-2.93		
Dependent AADLH **											1.92	1.66-2.22	1.91	1.65-2.22		
History of Angina					0.8	0.67-0.96			1.01	0.82-1.25	0.75	0.58-0.97	0.92	0.67-1.26	0.33	3.04
DDx Asthma							0.3	0.11-0.83	0.34	0.12-0.93			0.19	0.03-1.37	1.00	1.00
History of CAD					0.78	0.69-0.89			0.81	0.71-0.93	0.9	0.75-1.08	0.93	0.78-1.12	0.43	2.31
CCI	1.02	1.00-1.04	1.02	1-1.04	1.02	1.00-1.05	1.03	1.01-1.05	1.02	1.00-1.05	1.01	0.98-1.04	1.01	0.98-1.04	0.65	1.54
DDx Heart Failure							0.98	0.86-1.11	1.11	0.94-1.3			1.03	0.82-1.30	0.51	1.96
History Heart Failure					1.01	0.92-1.10			0.96	0.86-1.08	1.04	0.91-1.18	1.02	0.87-1.20	0.54	1.85
History of COPD							1.00	0.87-1.14	1.01	0.84-1.22			1.15	0.88-1.50	0.42	2.38
DDx COPD					1.05	0.95-1.16			1.03	0.90-1.19	1.06	0.92-1.22	0.97	0.79-1.19	0.43	2.35
History of Delirium					1.84	1.65-2.04			1.83	1.64-2.03	2.26	1.94-2.63	2.26	1.94-2.63	0.95	1.05
History of Dementia					3.04	2.59-3.58			3.04	2.59-3.58	3.23	2.58-4.05	3.25	2.59-4.07	0.98	1.02
Supervision DADLH **	2.75	2.48-3.05	2.82	2.53-3.14	2.56	2.30-2.85	2.68	2.41-2.97	2.55	2.30-2.84	2.08	1.78-2.42	2.07	1.78-2.42	0.70	1.43
Limited DADLH **	3.22	2.96-3.50	3.10	2.85-3.38	2.98	2.73-3.24	3.11	2.86-3.38	2.96	2.72-3.23	2.47	2.19-2.80	2.47	2.18-2.79		
Extensive DADLH **	5.58	4.96-6.29	5.28	4.68-5.97	4.92	4.36-5.55	5.35	4.74-6.03	4.90	4.34-5.53	3.82	3.20-4.54	3.82	3.21-4.55		
Maximal DADLH **	5.87	5.28-6.53	5.83	5.22-6.50	5.15	4.62-5.73	5.52	4.96-6.15	5.10	4.58-5.69	3.67	3.13-4.32	3.66	3.11-4.30		
Dependent DADLH **	5.14	4.64-5.69	5.07	4.56-5.64	4.41	3.97-4.90	4.8	4.33-5.33	4.39	3.95-4.88	3.28	2.78-3.87	3.27	2.77-3.86		
DDx Diabetes							1.13	0.86-1.47	1.10	0.83-1.45			1.12	0.76-1.65	0.95	1.05
History of Diabetes					1.08	1.00-1.17			1.08	0.99-1.17	1.12	1.00-1.26	1.12	0.99-1.26	0.73	1.36

DDx Injurious Fall							1.15	1.02-1.28	0.88	0.71-1.09			1.17	0.85-1.59	0.24	4.11
Hx Injurious Fall					1.24	1.12-1.38			1.36	1.12-1.65	1.12	0.97-1.29	0.98	0.75-1.30	0.24	4.13
FP Visits			0.88	0.85-0.91							0.88	0.84-0.93	0.88	0.84-0.93	0.95	1.05
DDx HTN							1.10	0.69-1.76	1.27	0.79-2.04			0.93	0.46-1.89	0.98	1.02
History of HTN					0.86	0.81-0.93			0.86	0.81-0.93	0.91	0.82-1.01	0.92	0.83-1.02	0.90	1.11
DDx CAD							0.51	0.43-0.60	0.64	0.51-0.81			0.67	0.48-0.95	0.33	3.07
Income Quintile 2 §			0.85	0.77-0.92							0.86	0.76-0.97	0.86	0.76-0.97	0.98	1.02
Income Quintile 3 §			0.82	0.75-0.90							0.79	0.70-0.91	0.79	0.70-0.90		
Income Quintile 4 §			0.74	0.67-0.82							0.76	0.66-0.87	0.76	0.66-0.87		
Income Quintile 5 §			0.78	0.71-0.86							0.79	0.70-0.91	0.79	0.69-0.91		
South East LHIN §§			1.76	1.48-2.09							1.82	1.40-2.36	1.83	1.41-2.38	0.97	1.03
Champlain LHIN §§			2.34	1.74-3.14							2.25	1.56-3.24	2.27	1.57-3.28		
NSM LHIN §§			2.34	2.02-2.71							2.6	2.06-3.30	2.61	2.06-3.31		
North East LHIN §§			1.57	1.23-2.01							1.84	1.24-2.74	1.87	1.26-2.78		
North West LHIN §§			1.15	0.15-8.75							<0.01	-	<0.01	-		
Eerie St Clair LHIN §§			1.15	0.84-1.59							1.15	0.70-1.89	1.15	0.7-1.88		
South West LHIN §§			1.85	1.55-2.21							2.00	1.54-2.59	2.01	1.55-2.61		
WW LHIN §§			1.65	1.41-1.94							1.77	1.38-2.27	1.78	1.39-2.28		
HNHB LHIN §§			1.43	1.22-1.68							1.70	1.29-2.23	1.70	1.29-2.23		
Central West LHIN §§			1.45	1.17-1.79							1.85	1.35-2.53	1.85	1.35-2.54		
Toronto Central §§			1.17	0.99-1.38							1.07	0.83-1.38	1.07	0.83-1.39		
Central LHIN §§			1.44	1.20-1.72							1.49	1.14-1.97	1.50	1.14-1.98		
Central East LHIN §§			1.71	1.48-1.98							1.72	1.36-2.18	1.73	1.36-2.19		
DDx Pneumonia							0.83	0.71-0.98	0.84	0.71-0.99			0.80	0.64-1.00	0.97	1.03
Rural			0.94	0.86-1.04							0.97	0.86-1.1	0.97	0.86-1.10	0.95	1.05
DDx Seizure							0.94	0.48-1.82	0.59	0.25-1.39			1.04	0.30-3.58	0.49	2.03
Sex F vs M	1.18	1.11-1.26	1.17	1.10-1.25	1.17	1.10-1.25	1.17	1.10-1.24	1.17	1.10-1.25	1.13	1.03-1.23	1.13	1.03-1.23	0.96	1.04
History of Stroke					1.36	1.15-1.61			1.36	0.98-1.88	1.43	1.12-1.83	1.66	1.02-2.72	0.20	4.99
DDx Stroke							1.20	0.99-1.46	0.98	0.68-1.43			0.81	0.47-1.42	0.30	4.96
History of Seizure					1.24	0.81-1.88			1.55	0.90-2.67	1.02	0.54-1.90	0.99	0.42-2.36	0.49	2.03
DDx UTI							1.15	0.98-1.34	1.10	0.94-1.29			1.00	0.80-1.25	0.97	1.03
AUROC	0.81	0.80-0.81	0.82	0.81-0.82	0.82	0.81-0.82	0.81	0.80-0.81	0.82	0.81-0.82	0.84	0.83-0.85	0.84	0.83-0.85		

* compared to Age 65-59; ** compared to an independent ADL hierarchy; § compared to the 1st (lowest) income quintile; §§ compared to the Peel LHIN; AF = atrial fibrillation, DDx = discharge diagnosis, NSM = North Simcoe Muskoka, WW = Waterloo Wellington, HNHB = Hamilton Niagara Haldimand Brandt, UTI = urinary tract infection.

Table 2: Variables selected using best subset selection in predicting admission/wait list to LTCF with associated χ2 values.

# of variables	χ^2	Variables included in model
1	2311.77	DADLH
2	3171.65	Age, DADLH
3	3645.35	Age, DADLH, Admission Length
4	3877.55	Age, DADLH, Admission Length, Dementia
5	4056.74	Age, DADLH, Admission Length, Delirium, Dementia
6	4115.64	Age, DADLH, Admission Length, ICU ADMISSION, Delirium, Dementia
7	4156.83	Age, AADLH, DADLH, Admission Length, ICU ADMISSION, Delirium, Dementia
8	4188.67	Age, FP visits, AADLH, DADLH, Admission Length, ICU ADMISSION, Delirium, Dementia
9	4210.31	Age, Income Quintile, FP visits, AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia
10	4229.24	Age, Rural, Income Quintile, FP visits, AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia
11	4244.65	Age, Rural, Income Quintile, FP visits, UPI AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia
12	4260.27	Age, LHIN, Rural, Income Quintile, FP visits, UPI AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia
13	4269.22	Age, Sex, LHIN, Rural, Income Quintile, FP visits, UPI AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia
14	4276.85	Age, Sex, LHIN, Rural, Income Quintile, FP visits, UPI AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia, Hypertension
15	4280.96	Age, Sex, LHIN, Rural, Income Quintile, FP visits, UPI AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia, Hypertension, Stroke
16	4283.66	Age, Sex, LHIN, Rural, Income Quintile, FP visits, UPI AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia, Hypertension, Angina, Stroke
17	4285.04	Age, Sex, LHIN, Rural, Income Quintile, FP visits, UPI AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia, Diabetes, Hypertension, Angina, Stroke
18	4285.43	Age, Sex, LHIN, Rural, Income Quintile, FP visits, UPI AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia, Diabetes, Hypertension, Angina, Injurious fall, Stroke
19	4285.6	Age, Sex, LHIN, Rural, Income Quintile, FP visits, UPI AADLH, DADLH, Admission Length, ICU admission, Delirium, Dementia, Diabetes, Hypertension, Angina, Injurious fall, CAD, Stroke
20	4285.65	Age, Sex, LHIN, Rural, Income Quintile, FP visits, UPI AADLH, DADLH, Admission Length, ICU ADMISSION, Delirium, Dementia, Diabetes, Hypertension, Angina, COPD, Injurious fall, CAD, Stroke,

Table 3: Parsimonious logistic regression models to predict admission / wait listing to LTCF. Model 11 was selected as the optimal parsimonious model as the addition of LHINs as a class variable in model 12 rendered rurality non-significant.

	Model 7		Model 8		Model 9		Model 10		Model 11		Model 12	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
ICU admission	0.63	0.53-0.75	0.65	0.54-0.77	0.65	0.54-0.77	0.65	0.55-0.78	0.66	0.55-0.78	0.67	0.56-0.8
UPI									1.33	1.10-1.61	1.26	1.04-1.53
Admit Length	1.02	1.02-1.02	1.02	1.02-1.02	1.02	1.02-1.02	1.02	1.02-1.02	1.02	1.02-1.02	1.02	1.02-1.02
Age 70-74*	1.36	1.07-1.72	1.37	1.08-1.73	1.38	1.09-1.75	1.35	1.07-1.71	1.35	1.07-1.71	1.35	1.06-1.71
Age 75-79*	2.41	1.95-2.98	2.44	1.97-3.01	2.45	1.98-3.03	2.43	1.96-3.00	2.42	1.95-2.99	2.42	1.95-2.99
Age 80-84*	3.26	2.66-4.00	3.29	2.69-4.03	3.34	2.72-4.09	3.28	2.67-4.03	3.25	2.65-3.99	3.29	2.68-4.04
Age 85-89*	4.56	3.73-5.59	4.60	3.76-5.64	4.66	3.80-5.71	4.62	3.77-5.67	4.55	3.7.00-5.58	4.58	3.73-5.62
Age 90+*	6.86	5.58-8.44	6.91	5.61-8.50	7.03	5.71-8.66	6.91	5.60-8.52	6.73	5.45-8.31	6.84	5.54-8.44
Supervision AADLH **	1.79	1.49-2.15	1.78	1.48-2.14	1.78	1.48-2.14	1.76	1.46-2.12	1.77	1.47-2.13	1.88	1.56-2.27
Limited AADLH **	2.14	1.86-2.46	2.12	1.85-2.44	2.11	1.83-2.42	2.12	1.85-2.44	2.13	1.86-2.46	2.15	1.87-2.47
Extensive AADLH **	3.07	2.58-3.65	3.02	2.54-3.59	2.99	2.52-3.56	2.98	2.50-3.55	2.99	2.51-3.56	3.02	2.53-3.60
Maximal AADLH **	2.59	2.22-3.03	2.54	2.17-2.97	2.54	2.17-2.97	2.50	2.13-2.92	2.51	2.14-2.94	2.56	2.19-3.01
Dependent AADLH **	1.74	1.51-2.00	1.72	1.50-1.98	1.71	1.49-1.97	1.74	1.51-2.00	1.75	1.52-2.02	1.98	1.71-2.29
History of Delirium	2.03	1.75-2.35	2.05	1.77-2.38	2.06	1.78-2.39	2.10	1.81-2.44	2.11	1.82-2.45	2.25	1.93-2.62
History of Dementia	2.96	2.38-3.69	2.97	2.38-3.69	3.03	2.43-3.78	3.01	2.41-3.76	3.00	2.40-3.75	3.18	2.54-3.98
Supervision DADLH **	2.05	1.76-2.38	2.02	1.74-2.35	2.01	1.73-2.34	2.03	1.75-2.37	2.03	1.74-2.37	2.11	1.81-2.46
Limited DADLH **	2.63	2.33-2.97	2.57	2.28-2.90	2.56	2.27-2.89	2.57	2.28-2.90	2.58	2.28-2.91	2.53	2.24-2.86
Extensive DADLH **	4.21	3.55-4.99	4.06	3.42-4.81	4.02	3.39-4.78	3.95	3.32-4.70	3.96	3.32-4.71	3.89	3.27-4.63
Maximal DADLH **	3.91	3.34-4.57	3.72	3.17-4.35	3.77	3.21-4.42	3.78	3.22-4.43	3.77	3.22-4.43	3.81	3.25-4.48
Dependent DADLH **	3.64	3.10-4.27	3.42	2.91-4.01	3.38	2.88-3.98	3.42	2.91-4.03	3.41	2.9-4.02	3.39	2.88-4.00
FP Visit			0.86	0.82-0.90	0.86	0.82-0.91	0.87	0.83-0.91	0.87	0.83-0.91	0.88	0.84-0.92
Income Quintile 2 §					0.85	0.75-0.96	0.85	0.75-0.96	0.85	0.75-0.96	0.86	0.76-0.97
Income Quintile 3 §					0.77	0.68-0.88	0.78	0.68-0.88	0.78	0.68-0.88	0.79	0.69-0.9
Income Quintile 4 §					0.72	0.63-0.83	0.73	0.64-0.83	0.73	0.64-0.83	0.75	0.65-0.86
Income Quintile 5 §					0.74	0.65-0.84	0.74	0.65-0.84	0.74	0.65-0.84	0.78	0.69-0.9
South East LHIN §§											1.85	1.43-2.4
Champlain LHIN §§											2.21	1.53-3.18
NSM LHIN §§											2.62	2.07-3.31
North East LHIN §§											1.79	1.21-2.66
North West LHIN §§											<0.01	∞
Eerie St Clair LHIN §§											1.12	0.68-1.83
South West LHIN §§											1.99	1.54-2.58
WW LHIN §§											1.74	1.36-2.23
HNHB LHIN §§											1.68	1.28-2.21
Central West LHIN §§											1.84	1.34-2.52
Toronto Central §§											1.06	0.82-1.37
Central LHIN §§											1.47	1.12-1.93
Central East LHIN §§											1.71	1.35-2.16
Income Quintile 2 §							1.2	1.08-1.32	1.18	1.07-1.30	0.98	0.87-1.11
AUROC	0.83	0.82-0.84	0.83	0.83-0.84	0.83	0.83-0.84	0.83	0.83-0.84	0.83	0.83-0.84	0.84	0.83-0.85

* compared to Age 65-59; ** compared to an independent ADL hierarchy; § compared to the 1st (lowest) income quintile; §§ compared to the Peel LHIN; AF = atrial fibrillation, DDx = discharge diagnosis, NSM = North Simcoe Muskoka, WW = Waterloo Wellington, HNHB = Hamilton Niagara Haldimand Brandt, UTI = urinary tract infection.

Appendix F: Subgroup logistic analysis of outcomes

Table 1: Multivariable logistic regression for ED-representation at 180 days by subgroup

	CAD		Heart Failure		COPD		Injurious Falls		Dementia		Delirium	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Demographics												
Age 70-74*	1.12	(0.97-1.29)	0.99	(0.81-1.21)	1.04	(0.86-1.25)	0.80	(0.59-1.08)	0.75	(0.24-2.29)	0.64	(0.40-1.02)
Age 75-79*	1.24	(1.07-1.43)	1.05	(0.87-1.28)	1.14	(0.94-1.37)	1.06	(0.79-1.42)	1.06	(0.37-3.04)	1.12	(0.73-1.74)
Age 80-84*	1.42	(1.22-1.64)	1.18	(0.98-1.42)	1.28	(1.06-1.55)	1.16	(0.87-1.53)	1.82	(0.65-5.13)	0.90	(0.59-1.37)
Age 85-89*	1.62	(1.37-1.93)	1.23	(1.01-1.50)	1.51	(1.21-1.87)	1.27	(0.95-1.69)	1.56	(0.54-4.48)	0.98	(0.63-1.52)
Age 90+*	1.74	(1.39-2.17)	1.22	(0.97-1.53)	1.39	(1.05-1.85)	1.67	(1.21-2.30)	1.92	(0.63-5.80)	1.53	(0.95-2.46)
Sex (F v M)	1.13	(1.03-1.25)	1.01	(0.91-1.13)	0.96	(0.85-1.08)	0.79	(0.67-0.94)	0.67	(0.44-1.01)	1.04	(0.83-1.30)
Income Quintile 2 **	0.94	(0.82-1.08)	0.97	(0.82-1.13)	0.96	(0.81-1.13)	0.88	(0.69-1.12)	0.96	(0.51-1.81)	0.91	(0.66-1.26)
Income Quintile 3 **	1.04	(0.90-1.20)	0.90	(0.76-1.06)	0.83	(0.70-1.00)	0.96	(0.75-1.23)	0.71	(0.37-1.34)	0.72	(0.51-1.00)
Income Quintile 4 **	0.85	(0.74-0.98)	0.93	(0.78-1.09)	0.89	(0.74-1.07)	0.81	(0.63-1.05)	0.93	(0.45-1.91)	0.83	(0.59-1.16)
Income Quintile 5 **	0.82	(0.71-0.95)	0.98	(0.82-1.16)	0.80	(0.67-0.96)	0.84	(0.65-1.09)	0.77	(0.42-1.42)	0.79	(0.57-1.09)
South East LHIN §	1.15	(0.91-1.45)	1.26	(0.96-1.64)	1.21	(0.88-1.65)	1.23	(0.75-2.02)	1.07	(0.39-2.90)	1.18	(0.68-2.04)
Champlain LHIN §	1.74	(1.16-2.63)	2.21	(1.45-3.36)	1.90	(1.20-3.00)	1.09	(0.53-2.25)	2.87	(0.41-19.99)	1.63	(0.59-4.46)
NSM LHIN §	1.18	(0.97-1.44)	1.45	(1.15-1.84)	1.28	(0.94-1.73)	1.05	(0.67-1.66)	0.75	(0.27-2.07)	1.19	(0.71-2.00)
North East LHIN §	1.72	(1.28-2.32)	1.88	(1.21-2.93)	1.75	(1.11-2.78)	1.13	(0.59-2.20)	2.11	(0.41-10.73)	6.86	(1.83-25.79)
North West LHIN §	1.86	(0.36-9.49)	-	-	-	-	-	-	-	-	-	-
Eerie St Clair LHIN §	1.59	(1.17-2.17)	1.52	(1.01-2.29)	1.60	(0.99-2.61)	0.49	(0.19-1.26)	0.28	(0.04-2.09)	0.52	(0.10-2.78)
South West LHIN §	1.87	(1.50-2.33)	1.88	(1.45-2.44)	1.82	(1.31-2.54)	1.60	(0.97-2.66)	1.43	(0.54-3.82)	1.74	(0.95-3.18)
WW LHIN §	1.20	(1.01-1.43)	1.22	(0.97-1.52)	1.02	(0.76-1.37)	0.81	(0.5-1.33)	1.00	(0.43-2.33)	1.64	(1.06-2.54)
HNHB LHIN §	1.09	(0.87-1.36)	1.27	(0.98-1.65)	1.16	(0.82-1.63)	0.74	(0.44-1.24)	0.50	(0.13-1.99)	0.89	(0.47-1.69)
Central West LHIN §	0.93	(0.71-1.21)	1.19	(0.87-1.64)	1.02	(0.68-1.53)	0.98	(0.51-1.89)	0.83	(0.20-3.39)	1.65	(0.83-3.27)
Toronto Central LHIN §	1.15	(0.93-1.42)	1.61	(1.26-2.06)	0.87	(0.62-1.23)	0.93	(0.58-1.48)	1.10	(0.47-2.61)	1.58	(1.02-2.44)
Central LHIN §	1.09	(0.86-1.38)	1.49	(1.11-1.99)	0.91	(0.62-1.33)	1.02	(0.62-1.70)	0.90	(0.32-2.49)	1.91	(1.12-3.26)
Central East LHIN §	1.05	(0.87-1.27)	1.53	(1.22-1.92)	1.09	(0.81-1.46)	0.90	(0.57-1.41)	1.18	(0.50-2.79)	1.36	(0.89-2.08)
Rural	1.16	(1.01-1.33)	1.09	(0.93-1.28)	1.03	(0.88-1.20)	1.01	(0.80-1.28)	1.29	(0.67-2.48)	1.16	(0.79-1.71)
Functional Status												
Supervision AADLH §§	1.16	(0.95-1.42)	1.17	(0.95-1.43)	0.99	(0.79-1.24)	1.69	(1.11-2.57)	2.76	(1.13-6.74)	1.20	(0.74-1.94)
Limited AADLH §§	1.09	(0.93-1.27)	1.01	(0.86-1.18)	1.12	(0.94-1.32)	1.48	(1.12-1.94)	0.97	(0.49-1.92)	1.38	(0.95-2.00)
Extensive AADLH §§	0.91	(0.71-1.17)	1.10	(0.85-1.42)	1.40	(1.07-1.84)	1.78	(1.18-2.70)	1.67	(0.70-3.98)	0.94	(0.59-1.50)
Maximal AADLH §§	1.23	(0.96-1.58)	1.16	(0.92-1.45)	1.15	(0.90-1.46)	1.46	(1.08-1.96)	1.31	(0.63-2.74)	1.07	(0.71-1.61)
Dependent AADLH §§	1.08	(0.92-1.25)	1.06	(0.88-1.27)	1.21	(0.99-1.50)	1.32	(1.04-1.67)	1.38	(0.69-2.74)	1.12	(0.79-1.57)
Supervision DADLH §§	1.34	(1.11-1.62)	1.30	(1.07-1.58)	1.14	(0.91-1.43)	0.88	(0.66-1.18)	1.12	(0.58-2.14)	0.79	(0.56-1.13)

Limited DADLH §§	1.28	(1.08-1.51)	1.12	(0.95-1.31)	1.13	(0.94-1.35)	0.95	(0.77-1.18)	0.80	(0.43-1.48)	1.06	(0.77-1.45)
Extensive DADLH §§	1.12	(0.79-1.58)	1.14	(0.84-1.56)	1.03	(0.72-1.47)	1.06	(0.70-1.60)	1.56	(0.68-3.57)	0.82	(0.53-1.26)
Maximal DADLH §§	1.00	(0.72-1.40)	1.26	(0.95-1.68)	1.19	(0.85-1.66)	1.03	(0.76-1.39)	0.57	(0.28-1.18)	1.46	(0.94-2.26)
Dependent DADLH §§	1.00	(0.74-1.34)	0.83	(0.63-1.10)	0.79	(0.55-1.12)	0.90	(0.67-1.22)	0.61	(0.29-1.29)	1.04	(0.70-1.54)
Admission Characteristics & Health Service Use												
ICU admission	0.86	(0.77-0.97)	0.81	(0.70-0.95)	1.00	(0.82-1.22)	1.22	(0.85-1.77)	1.60	(0.54-4.73)	0.93	(0.66-1.32)
Admission Length of Stay	1.01	(1.00-1.01)	1.00	(1.00-1.01)	1.00	(0.99-1.01)	1.01	(1.00-1.01)	1.00	(0.99-1.01)	1.01	(1.00-1.01)
Usual Provider Index	0.48	(0.38-0.60)	0.50	(0.38-0.65)	0.38	(0.28-0.50)	0.50	(0.34-0.72)	0.24	(0.09-0.65)	0.38	(0.23-0.64)
Family Physician visits	1.14	(1.09-1.19)	1.04	(0.98-1.09)	1.09	(1.03-1.16)	1.20	(1.1-1.31)	1.02	(0.82-1.28)	1.02	(0.92-1.13)
Comorbidities												
CCI	1.10	(1.05-1.15)	1.12	(1.06-1.17)	1.06	(1.01-1.12)	1.18	(1.07-1.30)	0.89	(0.71-1.11)	1.11	(1.01-1.22)
Angina	1.02	(0.92-1.13)	1.00	(0.81-1.23)	0.98	(0.71-1.34)	1.10	(0.52-2.32)	1.44	(0.40-5.15)	1.55	(0.91-2.65)
CAD	-	-	1.03	(0.88-1.20)	1.19	(0.96-1.46)	0.94	(0.61-1.46)	0.79	(0.31-2.00)	0.77	(0.51-1.15)
Heart Failure	1.14	(1.01-1.30)	-	-	1.04	(0.88-1.21)	0.86	(0.54-1.37)	1.44	(0.64-3.24)	0.93	(0.66-1.31)
COPD	1.26	(1.07-1.49)	0.95	(0.82-1.10)	-	-	1.14	(0.76-1.70)	1.89	(0.83-4.27)	1.03	(0.72-1.47)
Delirium	0.99	(0.76-1.29)	0.92	(0.68-1.24)	0.98	(0.70-1.35)	1.23	(0.84-1.82)	1.45	(0.81-2.60)	-	-
Dementia	0.84	(0.46-1.52)	0.92	(0.48-1.76)	1.29	(0.63-2.62)	0.88	(0.46-1.70)	-	-	1.07	(0.63-1.79)
Diabetes	1.04	(0.91-1.18)	1.00	(0.86-1.15)	0.95	(0.81-1.12)	0.83	(0.64-1.08)	2.26	(1.20-4.27)	1.04	(0.79-1.36)
Injurious Falls	0.72	(0.51-1.03)	0.66	(0.43-1.01)	0.80	(0.55-1.17)	-	-	0.93	(0.45-1.91)	0.84	(0.57-1.25)
Hypertension	0.90	(0.82-0.98)	0.89	(0.79-1.00)	0.90	(0.78-1.03)	0.93	(0.76-1.14)	1.21	(0.77-1.92)	0.91	(0.72-1.15)
Seizure	0.73	(0.47-1.15)	0.67	(0.36-1.24)	0.66	(0.31-1.39)	1.93	(0.72-5.21)	3.69	(0.59-23.14)	1.39	(0.65-2.98)
Stroke	2.01	(0.59-6.87)	0.34	(0.06-1.97)	2.50	(0.65-9.68)	1.63	(0.55-4.84)	7.20	(0.77-67.09)	0.52	(0.15-1.88)
AUROC	0.63	(0.62-0.65)	0.60	(0.58-0.61)	0.61	(0.59-0.62)	0.64	(0.62-0.66)	0.70	(0.65-0.75)	0.64	(0.61-0.67)

* compared to Age 65-59; ** compared to the 1st (lowest) income quintile; § compared to the Peel LHIN; §§ compared to an independent ADL hierarchy; NSM = North Simcoe Muskoka, WW = Waterloo Wellington, HNHB = Hamilton Niagara Haldimand Brandt.

Table 2: Multivariable logistic regression for ED-representation at 180 days by subgroup

	Hospital Re-admission at 180 Days											
	CAD		Heart Failure		COPD		Injurious Falls		Dementia		Delirium	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Demographics												
Age 70-74*	1.08	(0.91-1.28)	1.04	(0.84-1.28)	0.93	(0.76-1.15)	1.25	(0.85-1.86)	2.37	(0.55-10.26)	0.81	(0.48-1.36)
Age 75-79*	1.31	(1.10-1.55)	1.12	(0.91-1.37)	0.94	(0.76-1.15)	1.74	(1.19-2.53)	3.25	(0.80-13.18)	1.12	(0.69-1.81)
Age 80-84*	1.36	(1.14-1.62)	1.29	(1.06-1.58)	1.21	(0.99-1.49)	1.37	(0.94-2.00)	3.72	(0.93-14.81)	0.98	(0.61-1.55)
Age 85-89*	1.58	(1.30-1.92)	1.38	(1.12-1.70)	1.17	(0.93-1.47)	1.87	(1.29-2.71)	3.85	(0.95-15.65)	0.99	(0.61-1.62)
Age 90+*	1.76	(1.37-2.25)	1.37	(1.08-1.74)	1.02	(0.75-1.38)	1.91	(1.27-2.87)	4.42	(1.05-18.55)	1.70	(1.03-2.83)
Sex (F v M)	0.97	(0.87-1.08)	0.90	(0.80-1.00)	0.82	(0.73-0.94)	0.79	(0.64-0.97)	0.71	(0.45-1.10)	0.92	(0.72-1.17)

Income Quintile 2 **	1.04	(0.88-1.22)	0.94	(0.8-1.11)	0.92	(0.77-1.10)	0.93	(0.69-1.24)	1.31	(0.67-2.54)	1.02	(0.71-1.45)
Income Quintile 3 **	1.09	(0.92-1.28)	0.97	(0.81-1.15)	0.87	(0.72-1.05)	0.90	(0.66-1.22)	0.90	(0.45-1.81)	1.04	(0.72-1.49)
Income Quintile 4 **	0.94	(0.79-1.11)	0.90	(0.75-1.07)	0.80	(0.65-0.97)	0.96	(0.70-1.31)	1.00	(0.45-2.21)	0.90	(0.62-1.30)
Income Quintile 5 **	0.93	(0.78-1.10)	1.00	(0.84-1.19)	0.80	(0.66-0.97)	1.09	(0.81-1.48)	1.29	(0.66-2.50)	0.97	(0.68-1.40)
South East LHIN §	0.86	(0.65-1.15)	1.01	(0.76-1.34)	0.88	(0.63-1.23)	0.78	(0.44-1.38)	1.72	(0.56-5.24)	0.61	(0.32-1.16)
Champlain LHIN §	1.39	(0.89-2.17)	1.17	(0.77-1.80)	1.18	(0.73-1.91)	0.66	(0.28-1.58)	0.63	(0.06-6.86)	1.66	(0.58-4.71)
NSM LHIN §	1.22	(0.96-1.54)	1.29	(1.01-1.66)	1.13	(0.82-1.57)	0.71	(0.42-1.2)	2.32	(0.78-6.89)	1.09	(0.62-1.92)
North East LHIN §	1.86	(1.34-2.58)	1.36	(0.87-2.13)	1.39	(0.86-2.24)	0.64	(0.28-1.48)	4.26	(0.82-22.24)	3.24	(1.13-9.27)
North West LHIN §	2.48	(0.44-13.97)	-	-	-	-	-	-	-	-	-	-
Eerie St Clair LHIN §	1.05	(0.73-1.52)	0.91	(0.58-1.41)	0.89	(0.52-1.51)	0.33	(0.09-1.19)	0.97	(0.14-6.55)	1.06	(0.19-5.80)
South West LHIN §	1.45	(1.13-1.87)	1.20	(0.91-1.58)	1.12	(0.78-1.60)	0.94	(0.52-1.68)	1.48	(0.51-4.36)	1.48	(0.77-2.85)
WW LHIN §	0.84	(0.68-1.05)	0.86	(0.67-1.09)	0.88	(0.64-1.22)	0.50	(0.28-0.91)	1.54	(0.60-3.96)	1.21	(0.75-1.95)
HNHB LHIN §	1.13	(0.87-1.47)	1.24	(0.94-1.62)	1.16	(0.81-1.68)	0.70	(0.39-1.27)	1.55	(0.35-6.83)	0.74	(0.36-1.54)
Central West LHIN §	1.12	(0.82-1.52)	1.50	(1.08-2.08)	1.47	(0.96-2.25)	0.69	(0.31-1.52)	2.55	(0.59-11.13)	0.91	(0.41-2.02)
Toronto Central LHIN §	1.09	(0.85-1.39)	1.35	(1.05-1.74)	0.89	(0.62-1.29)	0.85	(0.50-1.45)	1.05	(0.39-2.78)	1.19	(0.74-1.91)
Central LHIN §	1.19	(0.90-1.56)	1.41	(1.04-1.90)	1.00	(0.66-1.52)	0.68	(0.38-1.24)	1.44	(0.47-4.37)	1.42	(0.81-2.49)
Central East LHIN §	0.95	(0.76-1.19)	1.08	(0.85-1.38)	0.91	(0.66-1.26)	0.76	(0.45-1.27)	1.68	(0.65-4.33)	0.83	(0.52-1.33)
Rural	0.81	(0.69-0.96)	0.81	(0.68-0.96)	0.80	(0.67-0.95)	0.92	(0.69-1.23)	1.20	(0.60-2.41)	0.82	(0.53-1.27)
Functional Status												
Supervision AADLH §§	1.29	(1.04-1.60)	1.18	(0.96-1.45)	1.05	(0.82-1.35)	1.64	(0.99-2.70)	2.21	(0.90-5.42)	1.16	(0.67-1.99)
Limited AADLH §§	1.28	(1.08-1.52)	0.93	(0.79-1.10)	1.18	(0.98-1.41)	1.42	(1.01-1.99)	1.20	(0.57-2.55)	1.42	(0.94-2.14)
Extensive AADLH §§	1.19	(0.90-1.57)	1.22	(0.94-1.59)	1.49	(1.13-1.96)	1.44	(0.88-2.36)	1.47	(0.58-3.72)	1.29	(0.77-2.15)
Maximal AADLH §§	1.18	(0.91-1.54)	0.99	(0.79-1.25)	1.30	(1.01-1.68)	1.43	(0.99-2.04)	1.50	(0.67-3.35)	1.18	(0.75-1.86)
Dependent AADLH §§	1.15	(0.96-1.37)	0.98	(0.81-1.19)	1.24	(0.99-1.54)	1.20	(0.89-1.62)	1.77	(0.83-3.77)	1.35	(0.92-1.98)
Supervision DADLH §§	1.41	(1.15-1.73)	1.28	(1.05-1.56)	1.25	(0.98-1.58)	1.20	(0.85-1.70)	1.49	(0.74-2.99)	1.24	(0.85-1.83)
Limited DADLH §§	1.46	(1.22-1.74)	1.27	(1.07-1.49)	1.26	(1.04-1.52)	1.06	(0.81-1.39)	0.96	(0.48-1.92)	1.16	(0.82-1.64)
Extensive DADLH §§	1.41	(0.99-2.03)	1.05	(0.77-1.45)	0.98	(0.67-1.43)	0.93	(0.56-1.55)	1.22	(0.51-2.92)	0.76	(0.46-1.25)
Maximal DADLH §§	1.35	(0.95-1.90)	1.69	(1.28-2.25)	1.47	(1.05-2.05)	1.12	(0.78-1.60)	1.34	(0.62-2.89)	1.65	(1.05-2.60)
Dependent DADLH §§	1.20	(0.87-1.66)	1.15	(0.86-1.53)	1.03	(0.71-1.49)	1.43	(1.01-2.02)	1.14	(0.51-2.54)	1.29	(0.84-1.97)
Admission Characteristics & Health Service Use												
ICU admission	0.82	(0.72-0.94)	0.84	(0.72-1.00)	1.05	(0.85-1.30)	1.58	(1.05-2.38)	1.58	(0.51-4.91)	0.95	(0.65-1.39)
Admission Length of Stay	1.01	(1.00-1.01)	1.01	(1.01-1.02)	1.00	(1.00-1.01)	1.01	(1.00-1.02)	1.00	(0.99-1.01)	1.01	(1.00-1.01)
Usual Provider Index	0.60	(0.46-0.79)	0.47	(0.35-0.62)	0.46	(0.34-0.63)	0.53	(0.33-0.84)	1.05	(0.37-2.94)	0.57	(0.32-1.00)
Family Physician visits	1.04	(0.99-1.09)	0.95	(0.90-1.00)	0.96	(0.90-1.03)	1.00	(0.90-1.11)	0.95	(0.74-1.21)	0.90	(0.80-1.02)
Comorbidities												
CCI	0.88	(0.79-0.99)	0.91	(0.74-1.13)	0.74	(0.53-1.03)	0.88	(0.38-2.06)	0.55	(0.13-2.26)	1.25	(0.69-2.28)
Angina	-	-	1.16	(0.99-1.35)	1.11	(0.89-1.38)	1.06	(0.64-1.75)	0.97	(0.36-2.58)	0.68	(0.43-1.08)

CAD	1.19	(1.13-1.24)	1.11	(1.06-1.17)	1.13	(1.07-1.20)	1.16	(1.05-1.29)	0.96	(0.76-1.22)	1.09	(0.99-1.20)
Heart Failure	1.50	(1.31-1.71)	-	-	1.13	(0.96-1.33)	0.85	(0.51-1.44)	1.74	(0.73-4.13)	1.19	(0.83-1.70)
COPD	1.18	(0.99-1.42)	1.03	(0.88-1.20)	-	-	1.57	(1.02-2.42)	2.54	(1.14-5.67)	1.18	(0.80-1.72)
Delirium	0.78	(0.57-1.05)	0.80	(0.59-1.10)	0.88	(0.62-1.25)	0.97	(0.62-1.52)	0.98	(0.52-1.85)	-	-
Dementia	0.75	(0.39-1.43)	1.03	(0.53-2.02)	1.81	(0.90-3.63)	0.97	(0.46-2.04)	-	-	0.88	(0.50-1.54)
Diabetes	0.97	(0.84-1.12)	1.14	(0.98-1.32)	0.92	(0.78-1.10)	0.75	(0.55-1.02)	2.12	(1.11-4.03)	1.20	(0.89-1.61)
Injurious Falls	0.75	(0.50-1.12)	0.54	(0.33-0.86)	0.91	(0.61-1.35)	-	-	0.77	(0.35-1.71)	0.67	(0.43-1.05)
Hypertension	0.93	(0.83-1.04)	0.91	(0.81-1.03)	1.00	(0.86-1.15)	0.98	(0.77-1.25)	1.28	(0.79-2.08)	0.92	(0.71-1.19)
Seizure	0.72	(0.43-1.22)	0.89	(0.47-1.69)	0.63	(0.27-1.46)	0.75	(0.23-2.47)	6.45	(1.00-41.46)	1.06	(0.49-2.28)
Stroke	2.46	(0.79-7.65)	1.09	(0.19-6.08)	1.54	(0.45-5.32)	0.26	(0.03-2.14)	1.49	(0.28-7.86)	0.53	(0.11-2.58)
AUROC	0.67	(0.65-0.68)	0.62	(0.61-0.64)	0.63	(0.61-0.64)	0.64	(0.62-67)	0.70	(0.65-0.74)	0.65	(0.62-0.68)

Table 3: Multivariable logistic regression for LTCF readiness at 180 days by subgroup

	CAD		**Heart Failure**		**COPD**		**Injurious Falls**		**Dementia**		**Delirium**	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
						Demographics						
Age 70-74*	2.00	(0.82-4.91)	1.18	(0.60-2.32)	0.74	(0.40-1.38)	1.11	(0.51-2.41)	0.65	(0.17-2.41)	0.76	(0.33-1.78)
Age 75-79*	3.94	(1.73-9.00)	2.26	(1.24-4.11)	1.58	(0.93-2.71)	2.03	(1.02-4.06)	1.06	(0.31-3.58)	1.38	(0.65-2.94)
Age 80-84*	4.65	(2.08-10.41)	2.60	(1.45-4.64)	2.44	(1.47-4.07)	2.46	(1.27-4.74)	1.10	(0.34-3.63)	2.72	(1.34-5.55)
Age 85-89*	8.45	(3.78-18.85)	3.54	(1.98-6.33)	2.75	(1.61-4.69)	4.51	(2.38-8.56)	0.83	(0.24-2.84)	2.12	(1.02-4.40)
Age 90+*	12.32	(5.39-28.18)	5.49	(3.04-9.92)	5.62	(3.20-9.88)	4.59	(2.37-8.90)	1.22	(0.35-4.29)	3.53	(1.69-7.38)
Sex (F v M)	1.15	(0.88-1.52)	1.01	(0.80-1.26)	1.11	(0.86-1.44)	1.30	(0.96-1.75)	1.58	(0.98-2.54)	1.02	(0.76-1.37)
Income Quintile 2 **	0.71	(0.48-1.05)	1.11	(0.81-1.52)	0.94	(0.65-1.36)	0.85	(0.58-1.24)	0.66	(0.33-1.34)	0.83	(0.55-1.26)
Income Quintile 3 **	0.91	(0.62-1.34)	1.08	(0.77-1.51)	0.92	(0.62-1.36)	0.79	(0.54-1.17)	0.69	(0.34-1.42)	0.61	(0.39-0.95)
Income Quintile 4 **	0.68	(0.44-1.03)	0.82	(0.57-1.18)	1.10	(0.74-1.64)	0.77	(0.50-1.18)	0.57	(0.25-1.31)	0.51	(0.32-0.81)
Income Quintile 5 **	0.52	(0.33-0.83)	1.01	(0.71-1.45)	0.89	(0.60-1.34)	0.58	(0.37-0.91)	1.34	(0.69-2.60)	0.78	(0.51-1.21)
South East LHIN §	1.36	(0.62-2.98)	2.43	(1.32-4.49)	1.24	(0.59-2.61)	1.65	(0.67-4.08)	1.74	(0.55-5.50)	0.94	(0.46-1.90)
Champlain LHIN §	2.98	(1.13-7.87)	2.67	(1.18-6.06)	1.25	(0.47-3.31)	1.64	(0.47-5.67)	5.86	(0.81-42.66)	0.89	(0.26-3.13)
NSM LHIN §	2.84	(1.49-5.40)	3.09	(1.77-5.39)	1.79	(0.85-3.76)	1.85	(0.79-4.36)	2.98	(0.92-9.59)	1.45	(0.75-2.78)
North East LHIN §	1.00	(0.31-3.27)	2.09	(0.73-6.05)	1.72	(0.60-4.98)	1.90	(0.59-6.07)	2.73	(0.46-16.34)	0.23	(0.03-2.05)
North West LHIN §	-	-	-	-	-	-	-	-	-	-	-	-
Eerie St Clair LHIN §	0.41	(0.09-1.91)	1.05	(0.30-3.73)	0.55	(0.11-2.77)	0.25	(0.03-2.25)	-	-	4.35	(0.93-20.34)
South West LHIN §	1.51	(0.71-3.22)	1.57	(0.83-2.98)	1.05	(0.47-2.36)	1.45	(0.57-3.66)	1.85	(0.58-5.88)	1.39	(0.64-3.02)
WW LHIN §	1.83	(0.99-3.38)	2.04	(1.16-3.58)	1.37	(0.66-2.83)	0.68	(0.25-1.83)	3.39	(1.26-9.13)	0.99	(0.55-1.76)
HNHB LHIN §	1.12	(0.53-2.36)	2.24	(1.21-4.14)	1.00	(0.42-2.36)	1.05	(0.41-2.72)	1.65	(0.36-7.59)	1.04	(0.45-2.38)
Central West LHIN §	1.80	(0.76-4.27)	2.29	(1.13-4.63)	0.72	(0.23-2.26)	1.59	(0.49-5.14)	3.16	(0.65-15.33)	0.71	(0.25-2.00)
Toronto Central LHIN §	0.59	(0.28-1.28)	0.48	(0.23-1.00)	0.85	(0.37-1.93)	0.76	(0.31-1.85)	0.96	(0.34-2.73)	0.45	(0.25-0.83)
Central LHIN §	1.09	(0.49-2.43)	2.16	(1.13-4.13)	1.28	(0.51-3.17)	1.23	(0.48-3.15)	1.36	(0.42-4.44)	0.79	(0.39-1.59)

Central East LHIN §	1.40	(0.75-2.64)	2.11	(1.21-3.68)	1.20	(0.59-2.47)	1.19	(0.50-2.80)	1.81	(0.65-5.06)	0.96	(0.55-1.67)
Rural	0.84	(0.55-1.29)	0.84	(0.61-1.16)	1.18	(0.84-1.65)	0.96	(0.66-1.39)	1.19	(0.58-2.45)	1.19	(0.73-1.94)
Functional Status												
Supervision AADLH §§	2.25	(1.34-3.81)	1.49	(0.94-2.34)	2.31	(1.36-3.91)	2.21	(1.06-4.63)	0.99	(0.36-2.75)	1.57	(0.77-3.21)
Limited AADLH §§	1.78	(1.17-2.72)	1.75	(1.25-2.45)	2.05	(1.36-3.08)	1.74	(1.06-2.83)	2.03	(0.91-4.52)	1.57	(0.90-2.73)
Extensive AADLH §§	2.81	(1.64-4.81)	2.45	(1.58-3.81)	4.00	(2.47-6.48)	1.87	(0.96-3.63)	4.14	(1.61-10.61)	2.25	(1.19-4.23)
Maximal AADLH §§	2.56	(1.59-4.14)	1.95	(1.30-2.91)	2.79	(1.75-4.43)	2.04	(1.23-3.37)	1.63	(0.71-3.75)	2.17	(1.24-3.82)
Dependent AADLH §§	1.89	(1.20-2.95)	1.80	(1.23-2.63)	2.67	(1.70-4.21)	1.57	(1.00-2.45)	1.63	(0.73-3.64)	1.88	(1.11-3.18)
Supervision DADLH §§	2.09	(1.32-3.31)	1.83	(1.26-2.67)	1.39	(0.89-2.16)	1.91	(1.11-3.29)	1.60	(0.74-3.48)	1.39	(0.83-2.32)
Limited DADLH §§	2.52	(1.73-3.67)	2.04	(1.50-2.76)	1.48	(1.03-2.12)	1.93	(1.27-2.93)	1.72	(0.84-3.49)	1.90	(1.22-2.95)
Extensive DADLH §§	6.87	(4.09-11.52)	3.93	(2.55-6.06)	3.44	(2.07-5.72)	4.09	(2.30-7.28)	2.82	(1.16-6.88)	1.62	(0.93-2.83)
Maximal DADLH §§	6.10	(3.64-10.23)	2.80	(1.84-4.26)	1.98	(1.19-3.28)	4.05	(2.54-6.46)	2.04	(0.92-4.56)	3.38	(1.99-5.74)
Dependent DADLH §§	3.47	(1.98-6.09)	2.10	(1.31-3.35)	1.65	(0.92-2.95)	3.95	(2.45-6.37)	1.17	(0.49-2.77)	2.30	(1.38-3.84)
Admission Characteristics & Health Service Use												
ICU admission	0.63	(0.42-0.94)	0.73	(0.50-1.05)	1.10	(0.70-1.73)	1.02	(0.53-1.94)	0.75	(0.20-2.81)	0.36	(0.20-0.67)
Admission Length of Stay	1.01	(1.00-1.02)	1.02	(1.01-1.03)	1.02	(1.01-1.03)	1.02	(1.01-1.03)	1.00	(0.99-1.01)	1.00	(1.00-1.01)
Usual Provider Index	1.32	(0.71-2.48)	0.84	(0.49-1.44)	0.95	(0.52-1.74)	1.25	(0.69-2.26)	0.70	(0.23-2.12)	1.59	(0.83-3.03)
Family Physician visits	0.90	(0.78-1.05)	0.93	(0.82-1.04)	0.81	(0.69-0.95)	1.00	(0.87-1.15)	1.03	(0.81-1.32)	0.87	(0.75-1.02)
Comorbidities												
CCI	1.05	(0.94-1.17)	1.04	(0.95-1.15)	0.98	(0.87-1.09)	0.96	(0.81-1.13)	1.14	(0.90-1.46)	0.98	(0.87-1.10)
Angina	0.78	(0.59-1.05)	0.86	(0.53-1.39)	0.44	(0.19-1.05)	0.38	(0.11-1.30)	0.55	(0.12-2.58)	0.66	(0.27-1.60)
CAD	-	-	0.80	(0.57-1.12)	1.05	(0.67-1.65)	1.97	(1.07-3.62)	1.03	(0.36-2.98)	1.26	(0.70-2.27)
Heart Failure	0.93	(0.68-1.29)	-	-	0.99	(0.71-1.39)	0.84	(0.42-1.64)	0.31	(0.11-0.92)	0.48	(0.28-0.82)
COPD	1.13	(0.74-1.72)	0.97	(0.71-1.31)	-	-	1.15	(0.60-2.21)	1.69	(0.72-3.97)	0.87	(0.52-1.43)
Delirium	2.59	(1.61-4.16)	0.99	(0.59-1.65)	1.55	(0.93-2.56)	2.02	(1.24-3.31)	2.76	(1.48-5.13)	-	-
Dementia	4.15	(1.90-9.04)	1.78	(0.69-4.57)	5.37	(2.37-12.14)	2.85	(1.34-6.07)	-	-	3.57	(2.02-6.32)
Diabetes	0.92	(0.64-1.31)	1.06	(0.79-1.42)	1.59	(1.13-2.25)	1.06	(0.69-1.65)	1.22	(0.62-2.42)	1.01	(0.70-1.46)
Injurious Falls	1.71	(0.99-2.95)	1.21	(0.66-2.22)	1.25	(0.68-2.30)	-	-	1.05	(0.49-2.29)	0.99	(0.61-1.60)
Hypertension	0.97	(0.73-1.28)	0.87	(0.67-1.11)	0.88	(0.65-1.19)	0.79	(0.56-1.11)	1.15	(0.68-1.95)	0.96	(0.70-1.31)
Seizure	2.06	(0.91-4.65)	2.86	(1.20-6.82)	1.25	(0.35-4.55)	0.16	(0.02-1.56)	2.65	(0.46-15.16)	1.95	(0.82-4.65)
Stroke	0.83	(0.07-9.67)	-	-	0.30	(0.02-5.77)	0.43	(0.03-7.38)	0.80	(0.13-5.04)	3.69	(0.87-15.71)
AUROC	0.88	(0.86-0.90)	0.80	(0.78-0.82)	0.80	(0.78-0.83)	0.80	(0.78-0.83)	0.77	(0.69-0.79)	0.77	(0.74-0.80)

* compared to Age 65-59; ** compared to the 1st (lowest) income quintile; § compared to the Peel LHIN; §§ compared to an independent ADL hierarchy; NSM = North Simcoe Muskoka, WW = Waterloo Wellington, HNHB = Hamilton Niagara Haldimand Brandt.

Table 4: Multivariable logistic regression for death at 180 days by subgroup

	CAD	Heart Failure	COPD	Injurious Falls	Dementia	Delirium

	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Demographics												
Age 70-74*	1.08	(0.75-1.55)	1.35	(0.99-1.84)	0.99	(0.73-1.34)	0.84	(0.40-1.74)	0.84	(0.04-19.68)	0.41	(0.16-1.06)
Age 75-79*	1.71	(1.22-2.39)	1.17	(0.87-1.59)	0.94	(0.69-1.28)	0.93	(0.46-1.89)	3.04	(0.25-37.82)	0.88	(0.41-1.88)
Age 80-84*	2.09	(1.51-2.90)	1.65	(1.24-2.19)	1.40	(1.04-1.87)	1.19	(0.62-2.29)	12.42	(1.06-145.24)	0.99	(0.49-2.00)
Age 85-89*	3.19	(2.28-4.46)	1.98	(1.48-2.66)	1.32	(0.95-1.82)	1.82	(0.96-3.46)	8.03	(0.67-96.49)	1.54	(0.76-3.14)
Age 90+*	4.49	(3.06-6.57)	2.29	(1.66-3.14)	0.98	(0.65-1.50)	2.84	(1.47-5.47)	10.30	(0.83-127.45)	1.87	(0.89-3.92)
Sex (F v M)	0.69	(0.57-0.83)	0.74	(0.64-0.87)	0.72	(0.60-0.86)	0.49	(0.34-0.69)	0.64	(0.32-1.26)	0.92	(0.65-1.32)
Income Quintile 2 **	0.92	(0.71-1.20)	0.96	(0.78-1.19)	1.07	(0.84-1.37)	0.97	(0.60-1.58)	0.52	(0.18-1.53)	1.14	(0.66-1.96)
Income Quintile 3 **	0.81	(0.62-1.07)	0.91	(0.72-1.15)	0.88	(0.67-1.15)	1.11	(0.68-1.82)	0.72	(0.26-1.97)	1.69	(1.00-2.84)
Income Quintile 4 **	0.92	(0.70-1.20)	0.97	(0.77-1.21)	0.84	(0.64-1.11)	0.78	(0.46-1.33)	1.73	(0.57-5.20)	0.99	(0.56-1.74)
Income Quintile 5 **	0.93	(0.71-1.23)	0.99	(0.79-1.25)	0.72	(0.54-0.95)	0.48	(0.26-0.89)	0.27	(0.08-0.90)	1.30	(0.76-2.21)
South East LHIN §	1.25	(0.78-1.99)	1.19	(0.80-1.75)	1.42	(0.84-2.40)	0.52	(0.19-1.45)	0.89	(0.15-5.34)	0.58	(0.21-1.62)
Champlain LHIN §	1.30	(0.66-2.59)	1.19	(0.68-2.08)	1.39	(0.70-2.77)	0.30	(0.05-1.73)	-	-	0.92	(0.16-5.28)
NSM LHIN §	1.50	(0.99-2.26)	1.35	(0.96-1.91)	1.60	(0.95-2.69)	0.44	(0.17-1.19)	2.43	(0.45-13.07)	1.70	(0.72-4.01)
North East LHIN §	2.15	(1.22-3.79)	2.02	(1.15-3.56)	1.38	(0.65-2.92)	0.12	(0.01-1.13)	9.10	(0.93-88.66)	3.40	(0.84-13.79)
North West LHIN §	-	-	-	-	-	-	-	-	-	-	-	-
Eerie St Clair LHIN §	0.99	(0.52-1.88)	0.87	(0.45-1.68)	1.53	(0.70-3.35)	1.64	(0.38-7.14)	9.25	(1.01-84.63)	-	-
South West LHIN §	1.30	(0.83-2.03)	1.18	(0.81-1.73)	1.17	(0.67-2.04)	0.56	(0.20-1.58)	0.56	(0.10-3.19)	1.98	(0.75-5.17)
WW LHIN §	0.99	(0.68-1.45)	1.08	(0.77-1.52)	1.10	(0.66-1.85)	1.14	(0.44-2.98)	1.19	(0.25-5.67)	1.20	(0.57-2.53)
HNHB LHIN §	1.52	(0.98-2.36)	1.32	(0.90-1.92)	1.72	(0.98-3.02)	1.27	(0.47-3.39)	4.26	(0.56-32.37)	0.68	(0.20-2.31)
Central West LHIN §	1.07	(0.60-1.90)	1.44	(0.91-2.26)	1.28	(0.65-2.50)	0.41	(0.09-1.88)	0.88	(0.08-9.86)	1.56	(0.51-4.80)
Toronto Central LHIN §	1.05	(0.68-1.63)	1.71	(1.21-2.43)	1.81	(1.04-3.13)	0.51	(0.19-1.36)	0.65	(0.14-3.13)	1.57	(0.75-3.28)
Central LHIN §	1.05	(0.63-1.73)	1.40	(0.93-2.12)	1.15	(0.60-2.21)	0.55	(0.18-1.66)	0.57	(0.08-4.26)	1.59	(0.67-3.78)
Central East LHIN §	1.02	(0.68-1.52)	1.20	(0.86-1.68)	1.34	(0.80-2.22)	0.70	(0.28-1.75)	0.73	(0.16-3.29)	1.31	(0.63-2.72)
Rural	1.13	(0.87-1.47)	1.04	(0.84-1.29)	1.12	(0.88-1.41)	1.62	(1.01-2.60)	1.53	(0.52-4.48)	1.07	(0.58-1.98)
Functional Status												
Supervision AADLH §§	1.49	(1.08-2.07)	1.57	(1.20-2.07)	1.40	(0.99-1.97)	0.90	(0.35-2.32)	3.30	(0.69-15.8)	1.05	(0.43-2.59)
Limited AADLH §§	1.34	(1.03-1.75)	1.31	(1.05-1.63)	1.44	(1.12-1.86)	1.18	(0.65-2.15)	2.36	(0.64-8.73)	1.30	(0.68-2.52)
Extensive AADLH §§	1.46	(0.97-2.19)	1.43	(1.02-1.98)	1.14	(0.77-1.70)	0.78	(0.29-2.09)	1.07	(0.20-5.77)	1.19	(0.52-2.73)
Maximal AADLH §§	1.42	(0.99-2.03)	1.67	(1.27-2.20)	1.71	(1.24-2.37)	1.04	(0.55-1.95)	3.68	(0.95-14.26)	1.97	(1.01-3.84)
Dependent AADLH §§	0.99	(0.73-1.33)	1.18	(0.93-1.52)	1.43	(1.06-1.92)	1.14	(0.67-1.96)	2.26	(0.58-8.83)	1.49	(0.81-2.76)
Supervision DADLH §§	1.18	(0.85-1.64)	1.13	(0.87-1.47)	1.39	(1.01-1.92)	0.89	(0.44-1.81)	0.98	(0.27-3.55)	1.36	(0.75-2.47)
Limited DADLH §§	1.60	(1.24-2.08)	1.63	(1.33-2.01)	2.02	(1.58-2.57)	1.34	(0.80-2.23)	1.58	(0.46-5.43)	0.97	(0.56-1.67)
Extensive DADLH §§	1.86	(1.16-2.98)	2.36	(1.66-3.36)	2.24	(1.43-3.51)	1.88	(0.84-4.20)	1.77	(0.40-7.82)	0.96	(0.47-1.97)
Maximal DADLH §§	2.27	(1.48-3.47)	2.52	(1.84-3.45)	3.03	(2.06-4.45)	1.63	(0.86-3.08)	2.82	(0.82-9.64)	1.30	(0.67-2.54)
Dependent DADLH §§	3.75	(2.54-5.53)	3.47	(2.53-4.75)	3.13	(2.07-4.75)	4.84	(2.80-8.36)	7.08	(1.95-25.7)	2.11	(1.15-3.86)
Admission Characteristics & Health Service Use												

ICU admission	0.70	(0.55-0.88)	0.71	(0.57-0.90)	0.82	(0.60-1.11)	1.27	(0.61-2.64)	0.37	(0.03-4.65)	0.76	(0.42-1.38)
Admission Length of Stay	1.00	(0.99-1.01)	1.00	(1.00-1.01)	1.00	(1.00-1.01)	0.99	(0.98-1.01)	1.00	(0.98-1.01)	0.99	(0.98-1.00)
Usual Provider Index	0.68	(0.44-1.06)	0.51	(0.35-0.75)	0.56	(0.36-0.87)	0.46	(0.21-1.02)	2.27	(0.47-10.95)	0.25	(0.10-0.61)
Family Physician visits	0.77	(0.70-0.85)	0.84	(0.78-0.91)	0.72	(0.65-0.80)	0.94	(0.78-1.14)	0.53	(0.32-0.87)	0.84	(0.70-1.02)
Comorbidities												
CCI	0.88	(0.73-1.06)	1.03	(0.78-1.35)	0.99	(0.62-1.60)	1.10	(0.29-4.12)	1.87	(0.26-13.37)	0.92	(0.38-2.23)
Angina	-	-	1.16	(0.94-1.42)	0.78	(0.57-1.06)	0.90	(0.41-1.99)	0.58	(0.13-2.66)	0.96	(0.50-1.83)
CAD	1.56	(1.46-1.66)	1.35	(1.27-1.43)	1.48	(1.39-1.58)	1.60	(1.40-1.82)	1.41	(1.01-1.96)	1.40	(1.24-1.57)
Heart Failure	1.85	(1.53-2.23)	-	-	1.28	(1.04-1.58)	1.45	(0.74-2.84)	1.04	(0.30-3.62)	1.40	(0.87-2.23)
COPD	0.95	(0.73-1.23)	1.11	(0.91-1.34)	-	-	1.47	(0.79-2.74)	0.96	(0.28-3.22)	1.10	(0.65-1.88)
Delirium	0.83	(0.53-1.31)	0.71	(0.48-1.06)	0.65	(0.40-1.05)	0.87	(0.42-1.79)	0.63	(0.21-1.92)	-	-
Dementia	0.86	(0.37-1.98)	0.72	(0.31-1.68)	0.73	(0.29-1.82)	0.87	(0.29-2.61)	-	-	0.41	(0.15-1.09)
Diabetes	0.55	(0.44-0.69)	0.69	(0.58-0.84)	0.43	(0.33-0.55)	0.46	(0.28-0.78)	1.19	(0.45-3.12)	0.59	(0.38-0.91)
Injurious Falls	0.67	(0.36-1.23)	0.68	(0.39-1.18)	0.69	(0.40-1.20)	-	-	0.51	(0.13-1.98)	0.67	(0.35-1.31)
Hypertension	0.95	(0.79-1.14)	0.77	(0.65-0.91)	0.77	(0.62-0.95)	0.68	(0.44-1.06)	0.54	(0.23-1.26)	0.77	(0.52-1.13)
Seizure	0.59	(0.27-1.31)	0.58	(0.24-1.37)	0.48	(0.16-1.43)	2.38	(0.59-9.61)	-	-	1.13	(0.41-3.06)
Stroke	1.01	(0.12-8.48)	-	-	0.51	(0.06-4.18)	1.33	(0.16-11.16)	-	-	1.51	(0.18-12.52)
AUROC	0.82	(0.81-0.84)	0.72	(0.70-0.74)	0.75	(0.74-0.77)	0.79	(0.75-0.83)	0.86	(0.82-0.91)	0.75	(0.71-0.77)

* compared to Age 65-59; ** compared to the 1st (lowest) income quintile; § compared to the Peel LHIN; §§ compared to an independent ADL hierarchy; NSM = North Simcoe Muskoka, WW = Waterloo Wellington, HNHB = Hamilton Niagara Haldimand Brandt.