Quality of Care for Long-term Care Residents Living with Heart Failure in Ontario and Predictors of Hospitalization

by

Mudathira Kadu

A thesis
presented to the University of Waterloo
in fulfilment of the
thesis requirement for the degree of
Master of Science
in
Health Studies and Gerontology

Waterloo, Ontario, Canada, 2014

Declaration: I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Acknowledgements

I would like to express my deepest appreciation to my supervisor, Dr. Christopher Perlman for his continual and relentless support during the writing of this thesis. Without his guidance, innovative ideas and passion for quality improvement research, this thesis would not have been possible. I have the utmost gratitude for his diligence to providing a collaborative and positive learning environment during my masters.

I would like to thank committee member Dr. George Heckman, whose work and clinical expertise of older adults with heart failure provided a strong foundation for my master's research. Additionally, I would like to express my gratitude to Dr. Paul Stolee for encouraging me to adopt a 'health systems thinking' and critical understanding of the complexity with delivering chronic care for older adults.

I also thank Jonathan Chen of the University of Waterloo InterRAI research group for introducing me to the MDS assessment tool and for being generous with his time, particularly with assistance on technical data queries. Lastly, I would like to thank my friends and siblings for their overwhelming emotional supportive while writing my thesis. Their unconditional encouragement, patience, positive spirits and constant comic relief during the different phases of my work will always be appreciated and certainly made all the difference.

Abstract

Background

Heart failure (HF) is a disease that is on the rise, particularly in the aging population. It is common amongst residents of long-term care homes (LTCHs). Complicating the diagnosis and treatment of HF is the interaction of geriatric symptoms and comorbidities. Literature also suggests that in addition to being under-detected, HF management is suboptimal in the long-term care setting. The combination of the complex nature of the disease in older adults, as well as poor management practices can lead to adverse outcomes such as hospitalization, depression, cognitive decline, loss in activities of daily living (ADL) and mortality. This study addressed the following research questions:

1. Upon admission, what are the clinical and demographic characteristics of residents living with HF, compared to those living without HF?
2. In residents with HF, what admission clinical and demographic characteristics are associated with hospitalization?
3. What is the quality of care for residents with HF in Ontario LTCHs?
4. Are there regional variations in quality of care for residents with HF in Ontario?

Methods

The data in this study were based on the InterRAI Minimum Data Set Instrument (MDS) 2.0 assessments of residents aged 65 years and older, who were admitted to LTCHs in Ontario between January 1st, 2011 and December 31st, 2013. Residents with HF that had an end-stage disease, an expected survival of less than six months, receiving hospice care or in palliative units at admission, were excluded.

Demographic and clinical information of residents with HF, and no HF at admission were summarized using means and standard deviations (SD) for continuous measures, and frequencies and percentages for categorical measures. Chi-square test was be used to evaluate whether the differences were significant in categorical measures, while continuous measures were analyzed using t-tests.

To examine predictors of hospitalization, bivariate associations of demographic and clinical characteristics with spending at least one day in a hospital, were analyzed at the significance level of alpha= 0.05. In addition to p-values and odds ratios, 95% confidence intervals (CI) were used to determine whether the clinical variables were significantly associated with hospitalization. For the multivariable analysis, variables found to be significant at a bivariate level were included. Logistic regression modeling using generalized estimating equations (GEE) was used. Variables identified from the bivariate analysis were individually added to the model using step-wise selection. The C-statistic estimated the model sensitivity to predicting hospitalization

The MDS Third Generation QI scores across all local health integration network (LHIN) were used to demonstrate variability between them by quality domain. Two steps were carried out to understand the overall variability in QI scores among LHINs over time: 1) the adjusted QI scores for each LHIN were calculated within each quarter; 2) the aggregated median, interquartile range, and range in QI scores for each LHIN were calculated and plotted in a Box and Whisker Plot. The median scores were calculated in each QI per LHIN to compare quality performance amongst LTCHs located in the same region.

Results

A total of 48,601 residents were included in the study with 12.3% diagnosed with HF. Compared to other residents, those with HF were slightly older, more frequently admitted from a hospital setting (43.0% vs. 34.4%), had a significantly higher number of comorbidities (6.5±2.4 vs. 4.7±2.1) and were prescribed an average of two additional medications (11.9± 4.6 vs. 9.6± 4.9) at admission. The rate of hospitalization in the sample residents with HF was 36.2%.

In residents with HF, the final regression model found admission to a LTCH from a hospital setting was the strongest predictor of hospitalization (OR: 8.09, CI: 7.05-9.29), followed by a CHESS score of greater than 3, which indicates high levels of health instability (O.R 4.24, CI: 3.07-5.85). Other variables that increased the likelihood of hospitalization included monitoring for acute medical illness (O.R: 1.45, CI: 1.26-1.67). Physician visits of over three days increased odds of hospitalization by 1.6 times (CI: 1.21-2.19, P= 0.0013) and prescription with an anti-depressant (O.R: 1.16, CI: 1.0-1.33, p=0.03).

Quality of care was not consistently high or low among residents in each LHIN, differing in performance across domains of quality. Of the quality indicators, decline in ADL self-performance was highest (Median: 39.6%). Approximately a third of residents had decline in mood from symptoms of depression (26.7%) and were on prescriptions of anti-psychotics without symptoms of psychosis (29.3%), while a quarter had respiratory infections (24.7%). Some QIs scores showed very little variation over time within regions (as shown by interquartile range). On the other hand, some regions demonstrated greater variations over quarters, such as ADL decline in the Central West region, which ranged from 23.6% to 35.7% (25^{th} and 75^{th} percentile, respectively). When comparing QI scores among LHINs, in certain aspects of quality,

some regions had lower median rates, while others had higher scores. For example, mood decline in Toronto Central was at 17.1% in contrast to 30.3% in the Waterloo-Wellington region.

Discussion

This study described the clinical characteristics of residents living with HF in Ontario LTCHs. Findings from this study are consistent with those of previous studies describing the complex clinical profile of residents with HF in LTCH. However, some divergent findings also exist. The prevalence of HF in was 12.3%, which is lower than what has been found by other studies (Hancock et al., 2013; Foebel et al., 2013; Daamen et al., 2010). The difference in prevalence may be related to poor implementation of HF screening guidelines, lack of knowledge of HF symptoms in nursing staff in nursing homes and the complexity of HF in older adults (Marcella et al., 2012).

Another important finding was that residents with HF were significantly more likely to be admitted from hospitals to LTCHs than those without HF. Admission from a hospital into LTC was found to be the strongest predictor of subsequent hospitalization in our study. Older adults that are hospitalized for HF and that are more likely to be discharged into nursing homes, have poorer health in comparison to those discharged to the community (Allen et al., 2011).

Evidence from our results of QI performance among LHINs suggests that there continues to be room for improvement in providing care for residents with HF, particularly in terms of functional decline, symptoms of depression and prescription of anti-psychotics. What this suggests is that some nursing homes within regions face particular challenges in addressing these aspects of quality uniformly across conditions. However, special considerations need to be given to the complex care needs for residents living with HF.

Another important finding was the variability of quality of care among LHINs, with some regions demonstrating low QI scores on certain aspects of quality in comparison to others. It should be noted that this pattern was not consistently found across other QIs, suggesting that performance is not uniform across quality domains or regions. However, these disparities in care quality can be attributed to the care setting, rather than the physical location of the nursing home (Phillips et al., 2004). The differences in regional LTC performance highlight the importance of understanding the complex context of nursing homes and its influence on care. care system

Conclusion

This work shows that residents with HF living in Ontario comprise a subset of the LTC population with complex clinical characteristics. Study findings on admission characteristics that predict hospitalization can inform future research developing a risk adjusted QI measuring hospitalization in this population. The implications of this include early identification of residents facing higher likelihood of hospitalization, as well, detection of LTC practices that result in avoidable admissions. Outcomes and processes of care in nursing homes for residents with HF show that there is a need for improvement in domains of functional ability, anti-psychotic use, anti-depressants and depressive symptoms, highlighting the need to explore the aspects of LTC settings that contribute to these findings.

List of Figures

List of Tables

List of Abbreviations

HF= Heart failure

LTCHs= Long term care homes

COPD= Chronic obstructive pulmonary disease

CCS= Cardiovascular Society Consensus Conference

ACE= angiotensin-converting enzyme

PCPs= primary care physicians

MOHLTC= Ministry of Health and Long-Term Care

QIs = Quality indicators

HQO= Health Quality Ontario (HQO)

CIHI= Canadian Institute for Health Information

ED= Emergency departments

LHIN= Local Health Integration Network

MDS= Minimum Data Set Instrument

RUG-III= Resource Utilization Group-version III

CHESS= Changes in Health, End-stage disease and Symptoms and Signs

DRS= Depression Rating Scale

CPS= Cognitive Performance Scale

CAPs= Clinical Assessment Protocols

CI= Confidence intervals

GEE= Generalized Estimating Equations

AIC= Akaike Information Criterion

OR= Odds ratio

CCRS= Continuing Care Reporting System

I. Introduction

Heart failure (HF) is a chronic disease with a prevalence that has risen with the progressively aging population (Stewart et al., 2003). In Canada, new cases of HF have been concentrated among older adults, with up to 11,999 individuals ages 75-84 years diagnosed with HF between 1997/1998 to 1999/2000 (Lee et al., 2004). The prevalence of HF is higher among adults aged 85 years and older at 17.4%, compared to 0.9% in people aged 64 years and younger (Bleumink et al. 2004). Contributing factors include the rise of age-related cardiovascular diseases and the advancement of therapies for their treatment (Rich, 1997). For example, the improved treatment and management of myocardial infarctions has led to increased survival rates which elevates the future risk for HF. As a result, HF has become a significant issue facing the older population. (Stenestrand & Wallentin, 2001; Velagaleti et al., 2008).

Hospital admission and mortality caused by HF are also higher in older adults. In Ontario, individuals aged 75 years and older constitute 67% of all first-time hospital admissions for HF. Hospital mortality in this age group (12.2 deaths per 100 patients) is also greater than the annual national average (9.5 deaths per 100 patients) (Lee et al., 2004). Due to high rates of hospitalization, older adults with HF have become major drivers of healthcare expenditure. While Canadian figures are unavailable, the annual cost of care for patients aged 74-85 in Sweden in 2010 was approximately $4398 per person, with hospitalizations comprising 69% of health care expenses related to HF (Mejhert et al., 2012).

A. HF: a Cardiogeriatric Syndrome

HF is a syndrome characterized by an abnormally functioning heart, which leads to low cardiac output, accompanied by systemic cardiac and pulmonary congestion (Arnold et al., 2006; Sonnenblick, 1985). The tenth revision of the International Classification of Disease defines HF as "the inability of the heart to pump blood at an adequate volume to meet tissue metabolic requirement, or the ability to do so at an elevation in the filling pressure" (World Health Organization, 2014). Other definitions, such as that of the American Heart Association (2014), describe HF as a condition in which the heart inadequately pumps sufficient blood to meet the body's requirements. There are different types of HF. In diastolic failure, the left lower chamber of the heart, responsible for receiving and pumping oxygenated blood to the body, loses its ability to relax normally causing the heart to insufficiently fill with blood. On the other hand, in systolic heart failure, the lower left chamber loses its ability to contract normally, which affects the heart's ability to pump blood to the rest of the body with sufficient pressure. In congestive HF, as blood flows out of the veins, blood returning to the heart backs up in the veins resulting in congestion in body tissues. This congestion can result in swollen legs and ankles (also known as edema), collection of fluid in the lungs, and it can also affect the kidney's ability to dispose of retained sodium and water (American Heart Association, 2014).

Despite similarities of HF aetiology with younger individuals, older adults show atypical symptoms which may lead to delayed diagnosis. These symptoms may include a confused state, drowsiness, agitated mood, syncope (sudden and temporary loss of consciousness), decline in levels of activity, loss of appetite, day time oliguria (decreased urine output) and nocturia (waking up at night to pass urine) (Tresch, 2000; Rich, 2001). These atypical symptoms can

make it challenging to diagnose HF in older adults in different care setting, particularly in long-term care homes (LTCHs) (Hancock et al., 2013).

Heart Failure in older adults rarely occurs in isolation; hence, the term "cardiogeriatric syndrome" has been used to describe HF, and its associated conditions (Rich, 2001; Heckman et al., 2008; Gary & Davis, 2008). Contributing to the complexity of HF in this population is the presence of multiple comorbidities (Rich & Kitzman, 2000). A cross sectional study of U.S. Medicare beneficiaries with HF showed that almost 40% of the sample had five or more comorbidities, with risk of hospitalization increasing with the number of comorbidities (Braunstein et al., 2003). Some of the frequently co-occurring diseases include hypertension, arthritis, osteoporosis, depression, type 2 diabetes, pulmonary, renal and cerebrovascular disease (Heckman et al., 2004; Foebel et al., 2011; Foebel et al., 2013; Ramos et al., *in press*). These comorbid conditions can have implications for the diagnosis and treatment of HF in older adults (Murad & Kitzman, 2012). For instance, shortness of breath attributed to chronic obstructive pulmonary disease (COPD), may lead to a reduced suspicion of HF. In addition, individuals with COPD may not benefit from HF therapies such as beta-blockers because of perceived contraindications with the disease (Le Jemtel et al., 2007).

Concurrent geriatric syndromes that result in the impairments of multiple organ systems can complicate HF in older adults (Inouye et al., 2007; Heckman et al., 2008). Common geriatric syndromes that co-occur with HF include: cognitive impairment, frailty, falls, and incontinence (Dodson & Chaudhry, 2012). Their complex interaction with comorbidities can also pose special challenges in HF management, and contribute to poor outcomes (Murad & Kitzman, 2012). For example, frailty is a geriatric syndrome that is prevalent in older adults with HF with multiple comorbidities (Cacciatore et al., 2005). In frailty, the accumulation of deficits (such as poor

health, disability, burden on caregivers or the dependence on others for activities of daily activities) threatens an individual's ability to live independently in the community (Rockwood et al., 1994).

As shown in **Figure 1,** the causal relationship between frailty and HF is one that is complicated, with one condition worsening the outcome of the other (Murad and Kitzman, 2012). The figure by Murad and Kitzman (2012) attempts to provide a simple explanatory framework of possible trajectories of frail older adults living with HF (this by no means captures the complexity of their lived experiences). The arrows in the figure show the causal pathways and interactions of different factors that contribute to various outcomes in older adults with HF. For instance, in the figure, frailty can influence severity of HF symptoms, while HF symptoms can increase functional loss and result in further frailty. When a frail older adult experiences acute stressors such as a fall or a stroke, they are likely to be hospitalized. After hospitalization there is an increased risk of functional dependency, ADL loss and disability. Consequently, after experiencing these events, they are often likely to be institutionalized into a nursing home and/or die (Murad & Kitzman, 2012). Indeed, frail older adults with HF have an increased likelihood of adverse outcomes such as death. A prospective cohort study by McNallan and colleagues (2013) found that frail subjects with HF had twice the likelihood of death as their non-frail counter-parts. Similarly, in another cohort study of 120 elderly individuals with HF, frailty was an independent predictor of death (Cacciatore et al., 2005).

Given the complex interaction of geriatric conditions, HF and comorbidities, the Cardiovascular Society Consensus Conference (CCS) has recommended the assessment of older adults for frailty, cognitive impairment and depression as part of HF treatment. Nursing homes

providing care to older adults with HF should screen these conditions in order to ensure their appropriate management with the disease (Arnold et al., 2006).

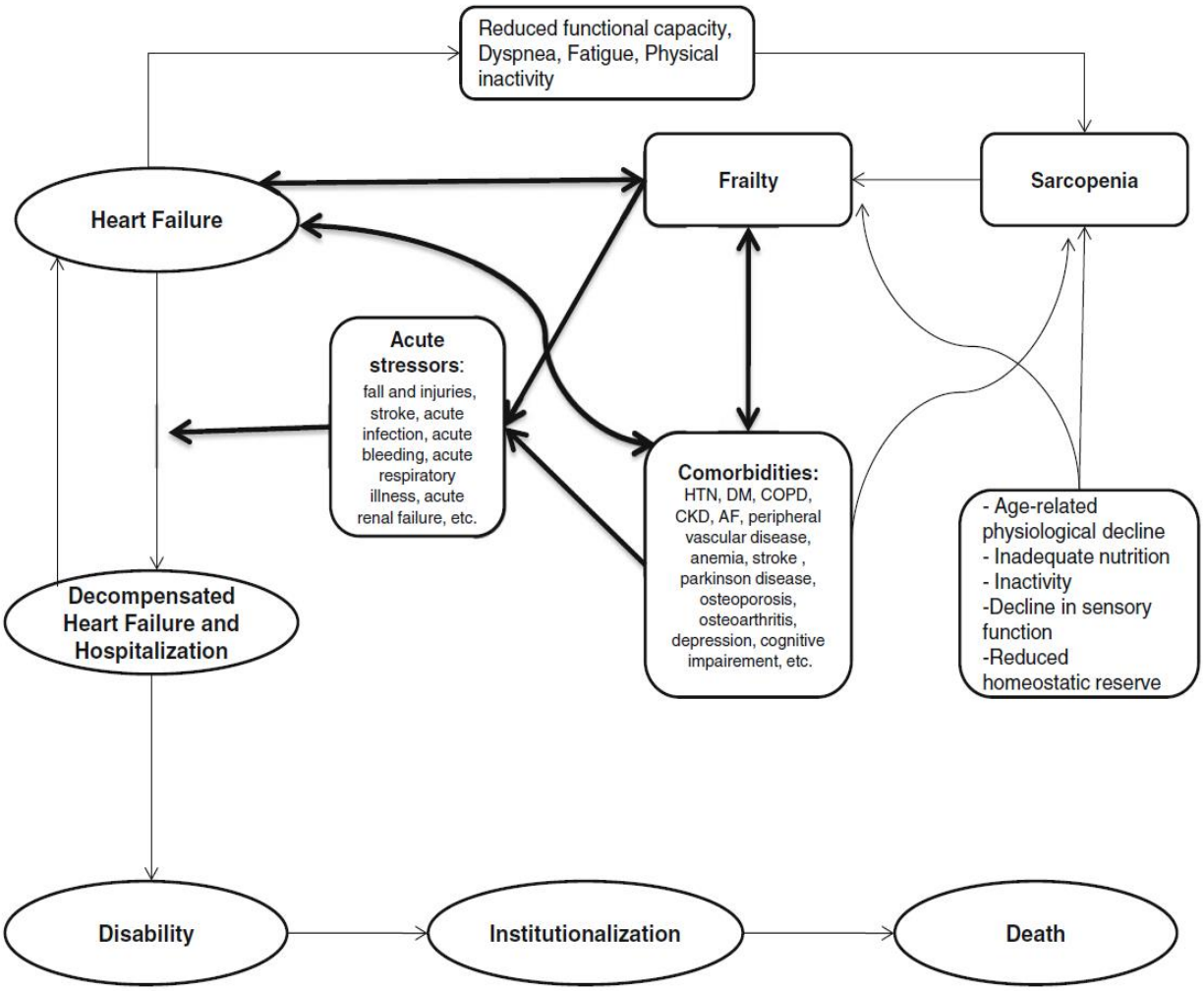

Figure 1 The complex relationship of frailty and HF (from Murad & Kitzman, 2012)

B. Guidelines for HF management

Pharmacological management

The 2006 CCS Consensus Conference recommends that HF therapies used on younger patients, are appropriate for reducing symptoms in older adults (Arnold et al., 2006). Treatments, such as angiotensin-converting enzyme (ACE) inhibitors have been shown to benefit older adults, particularly in reducing risk of hospitalization (Gambassi et al., 2000). In an Italian epidemiological study, after receiving ACE inhibitors, post-hospitalization, improvements in cognitive functioning were shown in 30% of the sample patients living with HF (n= 446) (Zuccala et al., 2004). ACE inhibitor use has also been shown to reduce adverse events after hospitalization: it reduced mortality by 40% in a retrospective cohort, aged 65 years and older discharged from acute care hospitals in Italy (HR [hazard ratio]: 0.60; 95% CI [confidence intervals]: 0.42–0.88] (Pedone et al., 2004).

Polypharmacy

Polypharmacy is very common in older adults with HF due to the increased prevalence of comorbidities. Therapies for HF in this population are often taken in combination with multiple medications for other comorbid conditions, leading to polypharmacy (Rich, 2005). Medication review can prevent adverse drug events due to drug-to-drug interaction. The 2006 CCS Consensus Conference provides a list of medications that should be used carefully to prevent polypharmacy (Arnold et al., 2006).

Nonpharmacological management

Arnold and colleagues (2006) recommend regular physical activity for individuals with stable HF. To prevent muscle deconditioning, daily physical and recreational activities that do not

result in HF symptoms are encouraged. In deconditioned patients, physical exercise can be individualised to lower intensities and duration, to suit their physical abilities (Arnold et al., 2006).

Older adults with HF should limit the amount of salt in their diet to between 2g and 3g per day. Individuals with advanced HF require further salt restriction (1g to 2g per day). HF patients with renal dysfunction, fluid retention or congestion that is not easily managed with diuretics, should restrict fluid intake to 1.5L to 2L daily. Weight monitoring in the morning is also encouraged for these patients (Arnold et al., 2006).

Treatment of individuals with HF by primary care physicians (PCPs) is recommended because of their familiarity with patient medical history and expectations (Arnold et al., 2008). Delivery of care from PCPs should also include patient and caregiver education, comprehensive follow-up and optimization of medical treatment. The CCS Consensus Conference suggests shared care of HF patients between PCPs and specialist to ensure continuity of care, and clear and timely communication (Arnold et al., 2008). Multidisciplinary-collaborative care and disease management programs are recommended for patients with HF. Patients can be managed in a multidisciplinary team of physicians, nurses, pharmacists and other health care providers specializing in different spectrums of HF care (Arnold et al., 2006; Arnold et al., 2008).

C. HF Care in the Community

Community care for older adults with HF is often fragmented and uncoordinated (Aldred et al., 2005). Specialist services are rarely available in the community, contributing to inadequate disease management upon hospital discharge (Murray et al., 2002). Care coordination and information sharing between PCPs and specialist are challenging, with poor communication between PCPs and specialists identified as a common problem (Aldred et al., 2005). In focus group interviews with patients and their caregivers in the United Kingdom, inadequate communication between primary and secondary care was identified as resulting in patient confusion on where to seek clinical care when experiencing health issues. Patients stressed that limited time with their physicians contributed to poor understanding of their specific HF condition, as did inadequate patient education and information about particular HF symptoms and their management (Aldred et al., 2005).

Heart failure in older adults is characterized by gradual and acute episodes of health decline. The disease trajectory can be exacerbated by poor monitoring due to lack of patient knowledge of symptoms or inappropriate adherence to treatment (Murray et al., 2002). Patients can struggle with treatment of multiple comorbidities; often feeling that due to the care demands of other diseases, HF is not a predominant issue that needs to be addressed (Boyd et al., 2004). After discharge from a hospital, uncertainties can emerge when balancing treatment and managing the condition in the community. Many patients and their care-givers report feelings of isolation with barriers to accessing healthcare or social services for support (Murray et al., 2002)

A qualitative study by Boyd and colleagues (2004) exploring the hospital-to-community transition of elderly HF patients found high levels of patient uncertainty in managing the disease after hospitalization. Many patients faced challenges around medication management and

adherence. Complexity of treatment and monitoring was common, with frustrations associated with treatment side-effects. Patients cited that they did not feel like engaged participants in their clinical care. Many felt that providers did not approach them as partners during clinical decision-making, leading to poor communication about treatment. Other patients noted that hospitalization could have been avoided had they found their PCPs more patient-centered or had their health concerns been addressed in a timely manner (Boyd et al., 2004). While the CCS Consensus Conference recommends community based HF care, evidence presented by Boyd and colleagues (2004) suggests that older adults with HF are inadequately managed in this setting,

During discharge planning from hospitals, special consideration should be given to the social environment of older adults with HF, as well as the potential for cognitive and physical decline (Lough, 1996). Timely out-patient follow ups, particularly within 7 days after discharge have been found to reduce 30-day admission rates in patients with HF (Hernandez et al., 2010). An intervention by Naylor and colleagues (2004) aimed at addressing transition issues between hospital and community-based care, recruited advanced practice nurses (APNs). The APNs worked collaboratively with the patients' physicians to manage and monitor HF after discharge. The APNs also conducted frequent timely assessments and engaged patients and their caregivers in establishing goals that ensured optimal disease management. Older adults that received the intervention had longer time between hospital readmissions and demonstrated improvements in quality of life and satisfaction in care (Naylor et al., 2004).

Older adults with HF that receive homecare after hospital-discharge have been shown to have a reduction in risk of readmission. Older HF patients receiving homecare have been found to have better self-rated health, medication adherence and reduced risk of readmission (Proctor et al.,

2000). These studies suggest that both homecare and discharge planning can be used as interventions to improve quality of care and reduce risk of hospitalizations in older adults living with HF in the community.

Institutionalization of Individuals with HF

After an acute medical illness such as HF, many factors can influence the institutionalization of an older adult. For instance, being divorced or widowed are independent predictors of admission to nursing homes after hospital discharge (Luk et al., 2009). Other studies show that being single, female, without adequate care-giving support increases the likelihood of hospital discharge to nursing homes (Smith & Stevens, 2009). Given the complex care needs of older adults with HF, presence of a caregiver is important for disease management (Pattenden et al., 2007). This is particularly the case for older adults with activities of daily living (ADL) dependencies living alone in the community, who are less likely to show improvements in functional abilities, and therefore more likely to receive care in nursing homes (Mahoney et al., 2000). Other factors associated with nursing home admission include: advanced age, dementia, functional decline, poor self-rated health, poor understanding of illness, recent hospitalization, admission due to falls, or having urinary incontinence at discharge (Glazebrook et al., 1994; Luk et al., 2009).

Hospitalization of older adults with HF significantly increases their likelihood of institutionalization. The older the HF patient, and the longer their hospital stay, the more likely they were to be admitted to a nursing home after discharge (Ahmed et al., 2003). Indeed, nursing homes have been cited as common care providers for older adults with HF after hospitalization. In a cross sectional study of 1492 nursing homes in the United States (US), 66% of nursing home residents with HF were admitted from hospitals (Gambassi et al., 2000). Given that a significant

proportion of residents with HF are admitted from this care-setting, it is important to explore whether they are clinically different than those discharged to the community in order to better address their care needs.

The characteristics of patients with HF admitted to nursing homes after hospitalization differ from those sent home: they are older and have a greater number of comorbidities (Allen et al., 2011). Compared to older adults with HF who are discharged to the community, those in nursing homes are more likely to experience poor outcomes such as high mortality and rehospitalization rates (Allen et al., 2011). An observational study of discharge outcomes of 15,459 Medicare beneficiaries hospitalized for HF found that at one year follow up, 53.5% of patients discharged to skilled nursing facilities homes died, compared 29.1% of those discharged to their homes. The proportion of rehospitalization was also greater in those admitted to nursing homes (76.1% versus 72.2%). Even after controlling for in-hospital patient characteristics, increased risk of death and hospitalization continued to be significant for this group, suggesting that admission to a nursing home can play a contributing role to these adverse outcomes (Allen et al., 2011).

A Profile of nursing home residents with HF

A significant proportion of nursing home residents in Canada live with HF. A retrospective study of 25 long-term care homes in Edmonton, Alberta, reported HF at a prevalence of 15% (Shibata et al., 2005). However, the inadequate charting of HF symptoms and the complexity of diagnosing the disease in older adults suggests that many cases go undetected in nursing homes (Arling, 1997; Rich, 2001). To address this issue, Hancock and colleagues (2013) conducted a study evaluating the prevalence of HF in LTCHs in the UK following the European Society of Cardiology guidelines to diagnose HF. Signs and symptoms of 399 residents were assessed through conducting echocardiographies and reviewing health records. The point prevalence of HF was 22.8%, with a great proportion of previously unidentified new cases (90%). After screening 1223 medical charts in LTC facilities in Ontario, based on the Boston criteria, Heckman and colleagues (2004) found an approximately similar proportion (20%).

A profile of Ontario LTC residents with HF showed that compared to residents without the disease: they were older (85.8 years ± 6.1 vs. 83.8 years ± 6.7), a greater proportion were admitted from hospitals (59.8% vs. 44.2%). They also had higher rates of comorbidities such as renal failure (41.9% vs. 12.8%) and pulmonary disease (47.4 % vs. 35.3%), and they used a greater number of medications (9.5 ± 3.5 vs. 7.5 ± 3.4) (Foebel et al., 2013). Heckman and colleagues (2004) found that over half of residents living with HF were cognitively impaired (59%), and had difficulty performing physical self-maintenance; indicating functional limitations.

The interaction of geriatric conditions with HF can negatively influence the disease prognosis in LTCHs. Older adults with HF show reduced functional capacity, fatigue and shortness of breath. This can accelerate muscle loss, leading to frailty (Fried et al., 2001). The

co-existence of frailty and HF with multiple comorbidities and polypharmacy can increase their risk for adverse drug interactions. Delayed treatment in nursing homes may result from the complexity of screening and treatment of HF in frail older adults (Uchmaniwicz, 2014). Clinical providers may under-treat frail residents with ACE inhibitors due to concerns with perceived complications such as renal impairment. On the other hand, treatment of frail residents with diuretics can lead to urinary incontinence (Fuat et al., 2003; Murad & Kitzman, 2012). Impaired systolic function in residents experiencing acute HF may lead to cognitive impairment, cerebral perfusion and delirium. While optimal treatment with ACE-inhibitors has been shown to improve cognitive functioning, they are under-prescribed in residents living with HF (Gambassi et al., 2000). Alternatively, to manage cognitive impairment and dementia-like-symptoms such as delirium and delusions, residents are more likely to be restrained and treated with anti-psychotics. These LTC practices have implications on the quality of care and outcomes of residents with HF (Banerjee, 2009).

D. Quality of Care for residents with HF in LTC homes

Measuring LTC performance on HF-specific processes of care is important to identify practices that can influence resident outcomes. Management of HF, despite guideline recommendations on best care practices, is often inadequate in LTC. Brocco and colleagues (2010) found the under-prescription of evidence-based therapies such as ACE inhibitors, to be a significant issue facing community living elderly (62% in >84years). However, after institutionalization, they are even more under-prescribed with guideline recommended HF therapies, suggesting a greater gap between guidelines and clinical practice in this care setting. Gambassi and colleagues (2000) evaluated the pharmacological treatment of LTC residents with HF in five American states and found that only a quarter of all residents received ACE inhibitors (Gambassi et al., 2000). HF guideline adherence continues to be a challenge in Ontario LTCH; with lower than expected prescription rates of ACE inhibitors, diuretics and beta-blockers at 55%, 69% and 25%, respectively (Heckman et al., 2004). Comparatively, residents of other provinces such as Alberta have even lower utilization rates of ACE inhibitors (51%) and beta-blockers (16%) (Shibata et al., 2005). This pattern of under-prescription could be a reflection of the challenges with applying guideline recommendations to a clinically complex population that is frail, advanced in age, comorbid, and on multiple medications (Rich, 2001; 2004; Brocco et al., 2010; Gambassi et al., 2000).

Adoption of clinical practice guidelines in LTCHs is challenged by individual, organizational and environmental factors (Berta et al., 2005). At the individual level, barriers could include lack of provider familiarity, experience, self-efficacy and skills in implementing evidence-based practice. Organizational factors can also influence implementation of guidelines, such as staff turnover and shift rotation, which can impact knowledge transfer among staff. Other

factors include whether the facility has strong policies that require implementation of standardized assessments and documentation of care practices, and whether there is a culture of multi-disciplinary collaboration and communication (Berta et al., 2005)

Structural factors can also influence effective management of HF in LTCH. Marcella and colleagues (2012) assessed the environmental context of LTCH prior to the adaption of CCS Consensus Conference HF guidelines. Focus groups revealed that nursing homes presented a complex environment for the management of HF. Many residents had multiple health issues, which complicated care processes such as assessment of signs and symptoms. Front line staff, particularly personal support workers, played a key role in identifying changes in patients; yet lacked sufficient knowledge on the clinical manifestation of HF. Staff knowledge has been shown to be a significant barrier to guideline adherence in nursing homes (Specht, 2013). In addition, the nursing homes assessed by Marcella and colleagues (2012) had not implemented care protocols for management of HF. As a result, care practices lacked consistency across homes. As discussed earlier, hospitalization is a significant issue facing residents with HF; however, homes had different protocols on when it was deemed appropriate to hospitalize residents. Variability has been identified in the adoption of HF management protocol in skilled nursing homes (Dolansky et al., 2013). In the homes that participated in the Marcella et al. (2012) study, medication boxes containing narcotics for the purpose of HF related emergencies were only available in two out of the three homes. Other reported barriers to effective HF management included nursing home regulations. Staff noted that general care provision policies in nursing homes, which were at times not applicable to residents with HF, influenced care practices. For instance, residents were served meals that contained high sodium contents: this practice did not reflect guideline recommendations on ensuring low-sodium intake in individuals

with HF (Arnold et al., 2006). Inter-professional communication was highlighted as key in HF assessment and management, yet, sharing clear and consistent information amongst staff, in different shifts, proved a significant challenge (Marcella et al., 2012). This is consistent with findings by Newhouse and colleagues (2012) on the nature of interprofessional practice in LTCHs. Delphi surveys and focus groups revealed that the greatest barrier to effective HF management in LTC as poor communication between residents and clinical providers, between providers: particularly across specialties, and between LTCHs and hospitals.

Cardiac-rehabilitation following acute hospitalization is lacking in skilled nursing homes: Dolansky and colleagues (2012) dubbed it a 'missed opportunity' (p115). In an effort to better understand cardiac rehabilitation practices in nursing homes, the authors conducted a retrospective medical record review of 80 residents following hospitalization for cardiac events and surveyed 21 healthcare professionals. Results showed that interventions such as monitored endurance exercise therapy were not routinely integrated into nursing care. Nurses cited lack of time beyond occupational therapy sessions and scheduling conflicts as barriers. Additionally, monitoring of patient response and cardiac activity during exercise therapy, an important aspect of safe rehabilitation, were not standard practices in nursing staff. Moreover, since almost a third of residents living in skilled nursing homes are discharged to the community, education on symptom monitoring and disease management is an important aspect of discharge planning. However, Dolansky and colleagues (2012) found that during discharge, only 27% of nurses provided education on chest pain, 64% on symptoms of HF, while only 32% patients received information and resources on community exercise programs (Dolansky et al., 2012). While this study was in the context of skilled nursing facilities which tend to offer more convalescent rather than palliative care, findings suggests that there continues to be room for improvement in terms

of integration of cardiac rehabilitation in nursing homes after hospitalization and prior to discharge into the community.

Background on nursing homes

"Long-term care homes (LTCHs) (including those formerly known as Nursing Homes, Municipal Homes for the Aged, and Charitable Homes), provide accommodation and access to 24 hour nursing services to individuals who require assistance with activities of daily living in a secure environment" (Ministry of Health and Long-Term Care (MOHLTC), 2014a). In Ontario, LTCHs are funded by the MOHLTC and governed under the Long-Term Care Homes Act that was passed in 2007. Under the act, they are required to meet outlined quality standards in order to maintain licensing; by ensuring that residents receive high quality care (MOHLT, 2014b).

LTCHs or nursing homes are major providers of care to older adults. In 2006, 6.3% of the Canadian population over the age of 65 years lived in nursing homes (Hirdes et al., 2011). In Ontario, approximately 600 nursing homes provide care to over 75,000 residents. Some of the factors that contributed to this trend include an increase in life expectancy and a shift of chronic disease care from the acute hospital setting to nursing homes (Sharkey, 2008). The increased utilization of nursing homes is reflected by the rise of their national expenditure from $49 billion in 1975, to $602 billion in 2010; with 2013 projections expecting a $30 billion dollar increase (Caplan & Meller, 2013).

Measuring quality of care in LTC

Quality indicators (QIs) are used to measure and compare aspects of service delivery and outcomes. They are important tools in monitoring healthcare performance and identifying areas for improvement (Health Council of Canada, 2011). QIs can be used to measure structures, processes or outcomes of LTC. Structural indicators describe the amount and type of resources available in a healthcare setting. For instance, the number of registered nurses assigned to specific units in a nursing home is a structural measure of care (Mainz, 2003). Process QIs measure tasks performed by a healthcare provider and patient activities in receiving care, such as the proportion of HF residents who receive treatment according to clinical guidelines. Events that follow care and the effects of healthcare on resident health are defined as outcome measure (Donabedian, 1966; Mainz, 2003). While outcome measures are more commonly used, process indicators are direct measures of care and are more sensitive to changes to quality of care; making them easier to interpret. For example, prescription of ACE-inhibitors in residents with HF is a direct aspect of quality, while in-hospital mortality due to HF is an indirect measure. However, outcome measures may be more advantageous as they can reflect all aspects of processes or structures of care, including those that are measurable and immeasurable (such as provider knowledge and skills) (Mant, 2001).

According to Donabedian's quality assessment model, presence of good structures promotes better processes of care, increasing the likelihood of positive outcomes (Donabedian, 1997). Others have suggested the complex intermediary role of structural measures (such as staffing levels) and operational processes (such as restraint use) in determining between-facility variance in resident outcomes (Chesteen et al., 2005). While numerous frameworks attempt to

explain the different relationships of health system components, the Canadian Institute for Health Information (CIHI) framework is currently used to support Canadian jurisdictional performance measurement and quality improvement efforts (CIHI, 2012). The framework is comprised of four interlinked performance dimensions: health system outcomes, social determinants of health, health system outputs and health system inputs and characteristics. These four dimensions are embedded in a demographic, political, economic and cultural environment, which influence the way the dimensions' interact with each other. While most performance frameworks are static, and view performance measurement in terms of process, outcome and structure, this framework recognizes the complexity of the healthcare system and views it as a more dynamic system. The arrows in **Figure 2** show the causal relationship between each component, with the key goal as improving outcomes through a better performing health system (CIHI, 2012)

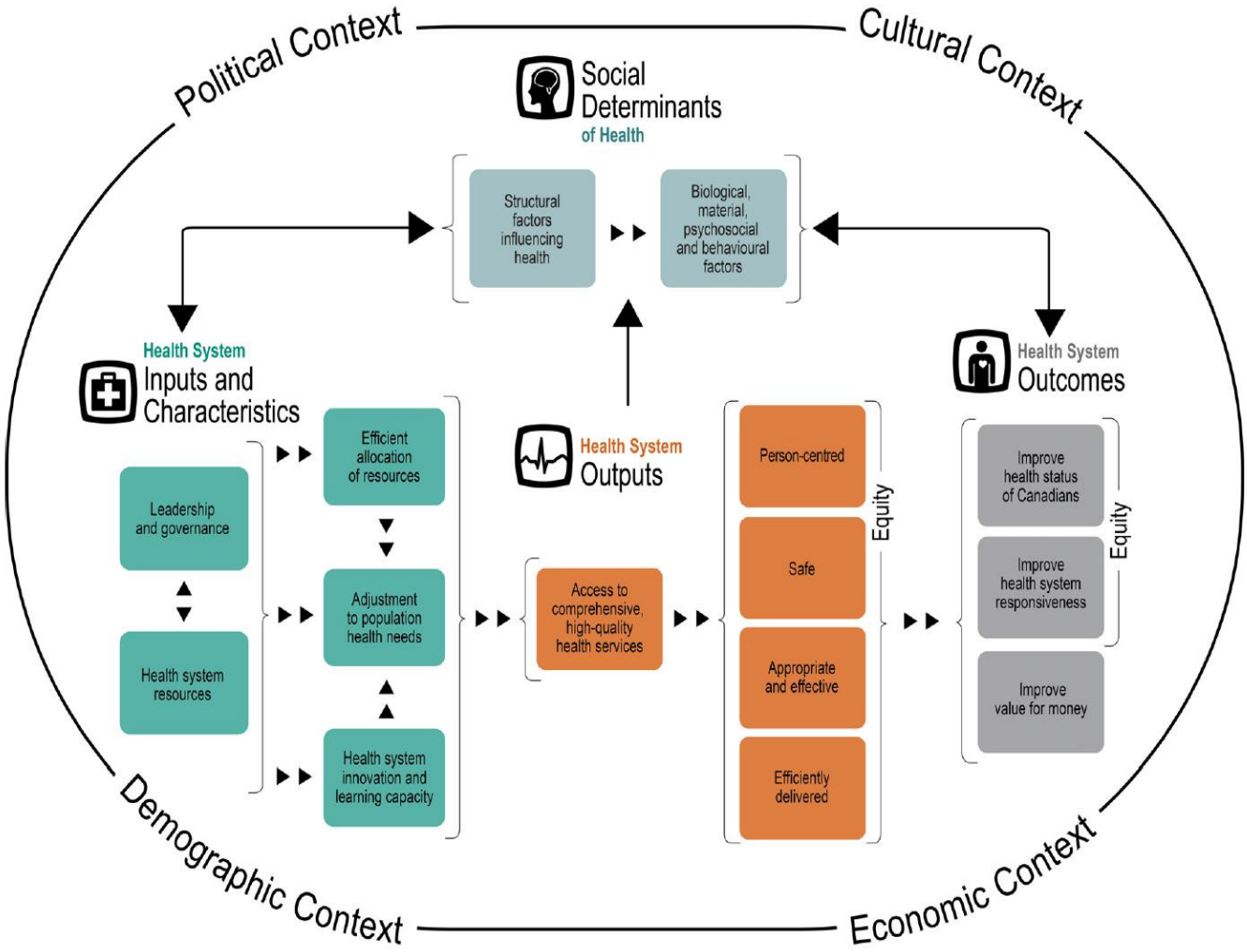

Figure 2 A performance Measurement Frame for the Canadian Health System (Source: CIHI, 2012)

To ensure public accountability and transparency, Health Quality Ontario (HQO) was mandated under The Excellent Care for All Act in 2010, to measure and publicly report quality of care in LTCHs (HQO, 2014). HQO measures LTC performance using a combination of outcome, process and structure QIs in 5 domains: accessibility, effectiveness, safety, appropriateness of resources and population health focus. The QIs measured and reported by

HQO (**Table 1**) are based on data collected from the Resident Assessment Instrument Minimum Data Set 2.0 (RAI-MDS 2.0), an assessment tool used in all Ontario LTCHs (HQO, 2014).

In the domain of effectiveness, HQO reported that between April 2012 and April 2013, 19.3% of residents were incontinent, 34.4% had difficulties with activities of daily living (ADL), 10% showed decline in cognitive function, 11.3% experienced worsened pain and 5.6 per 100 residents visited the emergency department. In terms of safety: 13.6% of residents experienced a fall every 30 days, 2.6 % developed a more severe pressure ulcer, 11.0% were physically restrained and 44 per 100,000 residents were prescribed drugs inappropriately. At first glance, these rates may seem low, however, the report also indicates that less than 15% of all LTCHs in Ontario met QI benchmarks in 2012/213. Benchmarks are markers of high standards of care that can be used to drive quality improvement. The inability to reach these benchmarks suggests that a great proportion of Ontario nursing homes have suboptimal performance, with considerable room for improvement in providing care that can effectively reduce negative resident outcomes and ensure their safety (HQO, 2014).

Table 1 Performance measures reported by LTCHs in Ontario (Source: HQO, 2013)

Domain	**Health topic**	**Indicator**
Accessible	Wait times	Median number of days to LTCH placement
Effective	Incontinence	Percentage of residents with worsening bladder control
Effective	Activities of Daily Living	Percentage of residents with increasing difficulty carrying out normal everyday tasks
Effective	Pain	Percentage of residents with pain that got worse recently
Effective	Effective Cognitive Function	Percentage of residents whose language, memory and thinking abilities have recently decreased
Effective	Emergency Department Visits	Number of emergency department visits for ambulatory care sensitive conditions
Safe	Falls	Percentage of residents who had a fall in the last 30 days
Safe	Pressure Ulcers	Percentage of residents who had a pressure ulcers that recently got worse
Safe	Restraints	Percent of residents who were physically restrained
Safe	Medication Safety	Number of residents prescribed a drug that should never be used among the elderly per 100 000 residents aged 65 years or older per year
Appropriately Resourced	Human Health Resources	Number of injuries per 100 long-term care workers per year
Focused on Population Health	Infections	Percent of residents with one or more infections

Outcomes and Processes of Care

Processes of care in LTCHs are important to measure as they can have positive or negative effects on resident outcomes. For example, general LTC care processes which are not specific to HF-management, such as the use of major tranquilizers and anti-depressants have been associated with increased risk of death and hospitalization in this population (Foebel et al., 2013). On the other hand, outcome indicators can be used to evaluate changes in LTCHs structures and processes of care, and to compare quality of care between different facilities. Measuring outcomes of residents with HF is particularly important because they face a greater risk of adverse events in nursing homes (Hutt et al., 2003; Tjam et al., 2012).

i. Restraint Use

In Canada, restraint use in LTCHs is particularly high (31%) (Feng et al., 2009). Restraints are physical devices used by nursing homes to manage resident behaviors such as aggression or wondering; particularly in those with cognitive impairments (Hamers et al., 2004; HQO, 2013). Residents who are restrained show decline in physical function, cognitive impairment, severe depression, behavioural issues, and low social engagement (Castle, 2006; Engberg et al., 2008). The negative effects can be evident up to 3 months after restraint use, with residents more likely to show further cognitive impairment (OR:1.23, $P < .01$, CI: 95%), depressive symptoms (OR 1.08; $P < .01$) and lower social engagement (OR 1.24; $P < P.001$) (Castle, 2004). This care process should be particularly monitored in residents with HF because case studies show that restraint use due to agitation can provoke psychological stress, activating the sympathetic system and resulting in sudden cardiac death (Uemura et al., 2008).

ii. Anti-psychotic medication

Due to safety concerns with physical restraint, nursing homes have been alternatively using antipsychotic medication as a form of chemical restraint on residents with dementia-related agitation (Passmore et al., 2008). In a cross sectional study by Stevenson and colleagues (2010), anti-psychotics were prescribed to over a quarter of residents (26%), a great proportion of whom were inappropriately prescribed (40%). Residents who were diagnosed with depression, dementia, and had behavioral issues, were at a particular risk for anti-psychotic use without indicated need for such use. This practice has been associated with negative outcomes such as increased risk of mortality and femur fractures (Huybrechts et al., 2011). In residents with HF, anti-psychotic drugs can lead to cardiovascular events such as sudden death from arrhythmias, common in individuals living with HF (Buckley & Sanders, 2000). This highlights the need to monitor its use in an effort to improve care quality.

iii. Activities of Daily Living

Functional decline threatens many residents in Ontario LTCH, with up to 16% incapable of performing the lowest level of activities of daily living (Hirdes et al., 2011). Changes in ADLs (mobility, bathing, dressing, feeding, grooming and toileting) can serve as indicators of decline in functional status (Scharpf & Madigan, 2010). Alternatively, functional limitations associated with HF can affect ability to perform ADLs (Pattenden et al., 2007). In an observational study in the Netherlands, frail nursing home residents with HF scored higher on ADL dependency measures than those without HF. Diagnosis with HF increased the odds of needing ADL help by approximately 4.68 times (CI= 1.35-16.17) (Barents et al, 2011). Additionally, impairment in functional ability, as measured by ADL, is a risk factor for shorter survival time after admission to a nursing home (Lee et al., 2009). Frail HF residents who show changes in ADL have a two-

fold risk of death, six month after admission to a LTCH (OR= 2.61, 95% CI= 0.78 to 8.75) (Tjam et al., 2012). In order to engage in early care planning, and to prevent such adverse outcomes, changes ADL should be measured in residents with HF.

iv. Delirium

Delirium is a common clinical feature of HF in the frail older adults. Heart Failure guidelines recommend delirium screening of older individuals with HF based on the Confusion Assessment Method, yet, delirium continues to be under-detected in nursing homes (Arnold et al., 2006; Kelly et al., 2002). After hospitalization for an acute medical illness, delirium rates in nursing home residents can be particularly high (22%, 1 month post discharge) (Kelly et al., 2002). Delirium should be particularly monitored in residents with HF since it is as a risk factor for cognitive decline, and has been previously associated with mortality (Boockvar et al., 2013; Kelly et al., 2002).

v. Cognitive decline

Cognitive decline can manifest through delirium or dementia in individuals living with HF, making it particularly challenging to screen (Heckman et al., 2007). Appropriate management of HF through therapies such as ACE-inhibitors can reduce cognitive decline (Zuccala et al., 2004). However, treatment of HF in LTC is suboptimal, further contributing to the negative consequences of cognitive impairment (Gambassi et al., 2000; Heckman et al., 2007). Similar to ADL dependency and delirium, poor cognitive performance has been linked to early mortality in nursing homes (Lee et al., 2009). In residents with HF, changes in cognitive function can increase risk of death by 2.41 times (95% C.I= 1.09 to 5.35), within 6 months after admission (Tjam et al., 2012). It is therefore important to appropriately screen and measure changes in cognition in residents with HF.

vi. Falls

Falls are common in LTCHs, with up to 6.6% of Ontario residents considered high risk for falls (Hirdes et al., 2011). Comparatively, the prevalence of falls in residents 85 years and older with HF is high: at 33.5% (Gambassi et al., 2000). Both syncope (a symptom of HF) and frailty are associated with falls in older adults (Cronin & Kenny, 2010; Ensrud, et al., 2007). Fractures, which are negative consequences of falls, are more frequent in individuals living with HF than those without HF, accounting for 25% of all nursing home transfers to emergency departments (Gerber et al., 2011; Kirsebom et al., 2014). Measuring the prevalence and risk of falls in residents with HF can help inform strategies that aim to prevent these adverse events in this population.

vii. Depression

Depression is a HF comorbidity that is common in Ontario LTCHs (32.9%) (Hirdes et al., 2011), affecting a third of residents with HF (Foebel et al., 2013). It is an important predictor of poor quality of life, and mortality (Hallas et al., 2011; Tjam et al., 2012). Tjam and colleagues (2012) found that depressive mood in residents with HF increased likelihood of death by 2.6 times (95% C.I= 0.78 to 8.75). This is problematic given that not only is depression under-diagnosed in individuals living with HF, but only a fraction of LTC residents receive adequate treatment for it (Okonkwo et al., 2007; Brown et al., 2002). Taking in to account the prognostic effects of depression on residents with HF, comprehensive screening and monitoring is necessary.

viii. Hospitalization and mortality

Hospitalization and death are outcomes that have been well documented in LTC residents with HF (Hutt et al., 2003; Hutt et al., 2011; Tjam et al., 2012; Foebel et al., 2013). In a prospective

cohort study of 546 new nursing home admissions in Ontario, Foebel and colleagues found that residents with HF had a mortality rate of 42%, compared to 19% in residents without HF. Hospitalization rates of residents with HF (31%) were also higher than those without HF (26%).. Hutt and colleagues (2003) reviewed the medical records of 58 skilled nursing homes in the US, and found an association between HF processes and outcomes of care. Residents who were not prescribed ACE-inhibitors were three times more likely to die than those who were prescribed. Within 90 days of admission to nursing homes, 56.6% of residents were hospitalized, while 21.1% died. Comparatively, mortality rates were even higher one year post-admission at over 45%, with more than half of the residents likely to be hospitalized (Hutt et al., 2003).

There are many challenges associated with transfer of an older adult from nursing homes to emergency departments (ED) (Kessler et al., 2013). Older adults tend to have multiple comorbidities, they have multiple care providers, as well as cognitive and functional impairments limiting the participation in their own care. Further, often residents are admitted to EDs with missing information on medication list, reason for transfer and vital status due to poor communication and documentation from nursing homes. This may result in poor transitions, which are characterized by: inadequate communication, adverse drug events from lack of medication reconciliation, and lack of coordination and follow-up between nursing homes and the hospitals. The consequences from poor transitions can include hospitalization, morbidity and mortality (Kessler et al., 2013). In a retrospective cohort study-investigating site of death of nursing home residents, Levy and colleagues (2004) found that of those who died in the hospital (n=51,187), 24.2% died within 24 hours of admission. Those admitted to hospitals from nursing homes had severe functional dependence (52%) and were also frail. The authors of the study did not adjust for resident characteristics; therefore it is difficult to ascertain whether admission to

the hospital setting increased likelihood of death or whether this was attributed to the clinical characteristics of the person. Creditor (1993) offers a potential explanation, noting that hospitalization of the elderly can be problematic given that it results in functional decline and other complications despite treatment of the admission condition. For instance, prolonged bed rest can accelerate muscle and bone mineral loss, and reduce aerobic capacity, therefore diminishing the patients' physiological reserve and functional capacity. This may also increase risk of falls in situations such as when a resident tries to climb over high bed railings. Further, prolonged immobilization from bed rest may increase likelihood of pressure ulcers due to pressure on the aging skin: this is further exacerbated by surface wetness from urinary incontinence. Sensory deprivation or overload in a hospital can also increase likelihood of a confused state or delirium in residents. Creditor (1993) suggests that these factors can interact with each other and lead to further functional dependency of the older adult upon hospitalization.

Avoidable hospitalizations may be reduced by initiatives that combine standardized assessment tools, advanced care planning, review of hospital transfers, improving clinical skills in a team work environment and frequent communication and sharing of lessons learnt (Tena-Nelson et al., 2012). Reducing unnecessary hospitalization through improving treatment in nursing homes has also implications on health care expenditure given that the average daily cost of stay for Medicare nursing home residents who died in the hospital in comparison to those who died in a nursing home in 2004 was $969 vs. $300 (Levy et al., 2004).

E. Influence of Region on LTC Quality of Care: LHINs

Created in April 1, 2007, the Local Health Integration Networks (LHINs) are fourteen based community based health authorities responsible for the administration of health services (MOHLTC, 2014c). In Ontario, the LHINs are funded by the MOHLTC to plan and coordinate the delivery of LTC services. In 2011, the LHINs were allocated approximately 22 billion dollars in healthcare expenditures, working collaboratively with the MOHLTC to align local regional with provincial priorities, in order to improve and sustain Ontario's health system (MOHL, 2014c). In alignment with the Provincial Action Plan, each LHIN developed its own Integrated Health Service Plans to meet its specific local population needs. For instance, the Central LHIN is divided into 7 planning areas, with majority of the population living in large urban centers (88.7%). In addition, approximately half of the Central region comprises of immigrants, with English being their second language. Each LHIN receives own budget, which it allocates towards health services: with considerations given to identified strategic priorities and plans, as well as the varying demographic structures of the population, and its economic, social and health conditions (Central LHIN, 2012).

Upon their inception, the LHINs signed performance agreements with the ministry to ensure that they meet provincial and local standard of care across sectors; these are revised and signed annually (MOHLTC, 2014c). LHIN goals include proving the right care at the right place and at the right time. One of the priorities is to increase funding for services that help individuals stay in their homes longer and healthier, such as the Aging at Home Strategy. Delivered through individual LHINs, the government invested approximately $1.1 billion in the delivery of a continuum of community and home-care support services in order to reduce loss of independence through premature institutionalization into LTCHs and hospitals (MOHLTC, 2014c).

Location and Quality of Care

Regional variations in quality of health services can reflect differences in clinical practices, socio-demographic characteristics, and clinical status of the population. Differences in quality of care can also be influenced by the urban-rural distribution of the population. In the US utilization of Medicare funded Home Health Care Services has been shown to vary by region, with higher rates found in Southern states (Welch et al., 1996). Even after controlling for baseline health characteristics, older adults living in regions with higher Medicare end-of-life spending received 60% more care (Fisher & Wennberg, 2003). Site of death of nursing home residents has also been found to vary by geographic location of the facility, with rural and hospital based facilities having the lowest in-hospital death rates (Levy et al., 2004). Mortality and hospitalization of residents with HF in nursing homes has also been shown to vary by region in the US, with lower risk of death associated with smaller and rural facilities in the South, (Hutt et al., 2011). Similarly, Phillips and colleagues (1996) reported that restraint use, a nursing home practice of care associated with ADL and cognitive decline, varied by geographic location.

Some of these observed differences could be rooted in facility-based characteristics such as staffing level. Studies show that high nursing hours in LTCHs improve resident functional ability, reduce pressure sores and urinary tract infections, increase probability of discharge from nursing homes, and reduce the likelihood of death (Bliesmer et al., 1998; Konetzka et al., 2008). The prescription of antipsychotic drugs to residents with dementia in the Netherlands is more prevalent in larger urban homes, than in smaller rural homes. These homes are also more likely to under-performed on structural measures such as: staffing levels, personal care and recreational activities (Kleijer et al., 2011).

II. STUDY RATIONALE

LTCH residents with HF are a complex population that face particular vulnerabilities from institutionalization. Compared to other residents, they are at a greater risk for adverse events such as poor ADLs, cognitive decline, hospitalization and death. Studying characteristics of individuals with in this context is necessary as little is known about their care needs in LTC. Long-term care QIs have been routinely measured in nursing homes in Ontario, however, they have yet to be investigated in residents with HF. Assessing the care quality outcomes of this population is an important aspect of LTC improvement.

Ample research has previously evaluated HF-specific care management (particularly pharmacological treatment) in nursing homes, yet there is a dearth of research measuring other aspects of LTC performance among residents with HF. Measuring care quality in LTC can ensure that high standards of care are met for residents with HF across all homes in Ontario.

Hospitalization in LTC residents with HF has been previously measured, however, it has not been under consideration as a QI. Given the negative impact of hospitalization on nursing home residents, there is a need to understand how clinical characteristics of residents with HF at admission predict hospitalization. This can also serve as beneficial in the identification and care planning of residents who are likely to be hospitalized.

Quality of care in nursing homes has also been found to vary by region; however, this has not been adequately assessed in residents with HF. Given this gap in literature, there is a need for comparison of QIs scores across LHINs, with an examination of the regions that excel and underperform on quality of care measures.

III. OBJECTIVES

This study will evaluate the care quality for residents with HF in Ontario LTCHs, using a mix of process and outcome QIs.

This study will answer the following questions:

5. Upon admission, what are the clinical and demographic characteristics of residents living with HF, compared to those living without HF?
6. In residents with HF, what admission clinical and demographic characteristics are associated with hospitalization?
7. What is the quality of care for residents with HF in Ontario LTCHs?
8. Are there regional variations in quality of care for residents with HF in Ontario?

IV. METHODS

Assessment Instrument

The data in this study are based on the InterRAI Minimum Data Set Instrument (MDS) 2.0. The MDS was developed by a network of researchers to assess and improve care of medically complex individuals in nursing homes. The assessment system includes applications for decision support and care planning, evaluation, and resource utilization (Hirdes et al., 2000; Hirdes et al., 2011). In order to integrate health information in Ontario, LTCHs began implementing the MDS 2.0 in 2006, with all homes completing the process by September 2010 (Hirdes, 2006; Hirdes et al., 2011). The MDS includes clinical assessment of over 400 items consisting of: demographic information, disease diagnoses and treatment, health conditions, medication use, social, physical, and cognitive functioning (Jones et al., 2010). In Ontario, a full assessment of the MDS is completed by trained clinical providers on eligible residents, within 14 days upon admission. The assessor is usually a front-line clinician who can be a nurse, physiotherapist, occupational therapist or other specialized provider.

The reliability and validity of interRAI Assessments have been well established by empirical studies. In the context of evaluating quality of care, reliability is important in describing whether the instrument provides a consistent assessment of an individual's clinical characteristics (Donabedian, 1966). Items in the MDS such as functional status, cognition, activities of daily living (ADL), continence and diagnoses showed high reliability (intraclass correlation $\geq .7$) when tested in 13 American nursing homes (Hawes et al., 1995). Validity addresses the degree to which the assessment truly reflects what is intended to be measured (Donabedian, 1966). Brizioli and colleagues (2003) evaluated the validity of the Resource

Utilization Group-version III (RUG-III), an algorithm that uses MDS items to classify LTCH residents by the type and level of healthcare utilization. The study administered the MDS in 11 LTCJs and intermediate homes in Italy, and found that the RUG-III explained variance in 61% and 44% of rehabilitative and of nursing wage-adjusted care time, respectively. The evidence suggested that this algorithm is a valid indicator of resource utilization in nursing homes.

The MDS 2.0 has been used to assess care of the frail elderly with complex conditions, many who live in nursing homes (Fries et al., 2001). The assessment tool has been previously used to compare mortality and hospitalization rates of residents with HF by nursing home characteristics in the U.S (Hutt et al., 2011); therefore, secondary data from this instrument are appropriate for this study.

Data

This study used data from MDS 2.0 assessments of all LTCH residents in Ontario between January 1st 2011 and December 31st, 2013. The data were electronically submitted to the Canadian Institute for Health Information (CIHI) within 45 days of assessment, as part of the Continuing Care Reporting System (CCRS) (Hirdes et al., 2011, CCRS specification manual). When a resident is admitted, a full admission assessment is conducted within fourteen days of admission. For the length of the resident's stay in the nursing home, quarterly assessments are completed between full assessments, within a 92 day window period from the last reference assessment. Full annual assessments are conducted within 366 days since the last full assessment. When a resident dies or is discharged to another facility, a Discharge Track Form is completed and submitted along with the entire Full Assessment Form. The Discharge Tracking Form provides information about resident deaths or facility discharges.

Assessments are reviewed for accuracy and completion prior to submission. If any errors are detected after submission to CCRS, then a Significant Correction of Prior Full Assessment form is completed. In order to ensure confidentiality and resident privacy, each resident is assigned a unique registration identifier upon admission to the LTCH (CIHI, 2010). Through a data-sharing agreement between CIHI the Canadian Collaborating Centre for interRAI, CIHI sends an anonymized copy of the data to the University of Waterloo. An ethics application to conduct the study was completed through the University of Waterloo Research Ethics Committee, and clearance was granted on June 10, 2014 (ORE #19945).

CHAPTER ONE: Description of Clinical Characteristics of Residents with HF

1.1 Research question

Upon admission, what are the clinical and demographic characteristics of residents living with HF, compared to those living without HF?

1.2 Sample

The sample included residents aged 65 years and older, who were admitted to LTCHs in Ontario between January 1st, 2011 and December 31st, 2013. Residents had to have stayed in the nursing home long enough to receive a full MDS admission assessment (14-days), followed by their first quarterly assessment. Any assessments that were missing or flagged for data quality issues were not included. The time between the two assessments could not have been greater than 93 days. A resident could have had multiple admissions to the same LTCH after being discharged; however, only the most recent stay, also known as an episode, was selected for this study. Residents with HF that also had an end-stage disease, an expected survival of less than six months, receiving hospice care or in palliative units at admission assessment were excluded from the study (n=4).

Previous studies examining the diagnostic quality of the tool reported high sensitivity (80%) to HF diagnosis, compared to hospital administrative databases (Wodchis et al., 2009). Variables in the MDS were also found to be superior to the *New York Heart Association Functional Classification* in predicting the death of nursing home residents with HF at six month post-admission (Tjam et al., 2012). Residents with HF were identified using ICD10 codes beginning with ‘150', which is the diagnostic code for HF, or if indicated in the disease

diagnoses section of the Admission Full Assessment. These included left ventricular, diastolic and systolic heart failure. As such, heart failure was defined as 'the inability of the heart to pump blood at an adequate volume to meet tissue metabolic requirements, or, the ability to do so only at an elevation in the filling pressure' (World Health Organization, 2014).

1. 3 Variables

Demographic and Clinical Characteristics

Demographic and clinical characteristics of residents with and without HF at admission were described using admission data from the MDS. Variables included sex, age, marital status, previous care setting prior to admission, common comorbidities, cardiovascular history, number of medications and physician visits. **Table 2** shows all the variables include

Table 2 Clinical and demographic variables of residents with HF and no HF

Domain	Variable	Description	Code	Coding	Captured on
Demographic characteristics	Heart failure	Residents whose diagnosis in assessment form or ICD10 code indicates presence of heart failure	Derived from i1f and ICD10	0 = No 1 = Yes	Assessment
	Sex	Sex of the resident- Male, Female or Other	AA2	M= Male F = Female O = Other	Admission record
	Marital status	Indicates the resident's marital status at admission.	A5	1 - Never married 2 - Married 3 - Widowed 4 - Separated 5 - Divorced 9 - Unknown	Assessment
	Language group	Indicates the grouping of the primary language spoken by the resident at home on a regular basis	Ab8	ENG - English FRA - French OTH- other language	Admission Record
	Age	Age at assessment	Age assessment	0-999	CCRS generated
	Lived alone	Whether a resident lived alone prior to entry into facility	AB3	0 = No 1 = Yes	Admission Record

Domain	Variable	Description	Code	Coding	Captured on
				9 = Unknown	
	Service entry type	Service type of facility in which resident was admitted from	AB2A	0 = Ambulatory Health Service 1 = Inpatient Acute Care Service 2 = Inpatient Rehabilitation Service (General) 3 = Inpatient Continuing Care Service 4 = Residential Care Service (24-hour nursing care) 5 = Inpatient Psychiatry Service 6 = Other/Unclassified Service 7 = Inpatient Rehabilitation Service (Specialized) 8 = Home Care Service 9 = Residential Care Service (board and care) 10 = Private Home	Admission Record

Domain	Variable	Description	Code	Coding	Captured on
				(no home care)	
	No contact with family	Absence of personal contact with family/friends	F2E	0 = No 1 = Yes 8 = Comatose	Assessment form
Clinical: cardiovascular history	Hypertension	Hypertension	I1H	0 = No 1 = Yes	Assessment form
	Diabetes mellitus	Diabetes mellitus	I1A	0 = No 1 = Yes	Assessment form
	Arterio heart disease	Arterio heart disease	I1D	0 = No 1 = Yes	Assessment form
	Cardiodysrythmias	Cardiodysrythmias	I1E	0 = No 1 = Yes	Assessment form
	Peripheral vascular disease	Peripheral vascular disease	I1J	0 = No 1 = Yes	Assessment form
	Other cardiovascular disease	Other cardiovascular disease	I1K	0 = No 1 = Yes	Assessment form
Clinical: common comorbidities	Arthritis	Arthritis	I1L	0 = No 1 = Yes	Assessment form
	Osteoporosis	Osteoporosis	I1O	0 = No	Assessment form

Domain	Variable	Description	Code	Coding	Captured on
				1 = Yes	
	Alzheimer	Alzheimer	I1R	0 = No 1 = Yes	Assessment form
	Dementia	Dementia	I1V	0 = No 1 = Yes	Assessment form
	Depression	Depression	I1GG	0 = No 1 = Yes	Assessment form
	Cancer	Cancer	I1RR	0 = No 1 = Yes	Assessment form
	Renal failure	Renal failure	I1UU	0 = No 1 = Yes	Assessment form
	Number of comorbidities	Total number of comorbidities at admission	Total_comorb	Sum of all listed assessment comorbidities	Assessment form
Clinical: Symptoms	Dizziness	Dizziness	J1F	0 = No 1 = Yes	Assessment form
	Edema	Edema	J1G	0 = No 1 = Yes	Assessment form
	Shortness of breath	Shortness of breath	J1L	0 = No 1 = Yes	Assessment form

Domain	Variable	Description	Code	Coding	Captured on
	Syncope	Syncope	J1M	0 = No 1 = Yes	Assessment form
	Unsteady gait	Unsteady gait	J1N	0 = No 1 = Yes	Assessment form
	Chest pain	Chest pain	J3C	0 = No 1 = Yes	Assessment form
Clinical: medication	Number of medications	The number of different medications used in the last seven days	O1	0-99	Assessment form
	Anti-psychotics	Whether resident is on anti-psychotic	O4A	0 = No 1 = Yes	Assessment form
	Anti-anxiety	Whether resident is on anti-anxiety	O4B	0 = No 1 = Yes	Assessment form
	Anti-antidepressants	Whether resident is on anti-depressants	O4C	0 = No 1 = Yes	Assessment form
Service utilization	Physician visit	Whether resident had a physician visit since admission or last 14 days	Derived from P7	0 = No 1 = Yes	Assessment form
	Hospital admission	Whether resident had at least one hospital stay in the last 90 days for	Derived from P5	0 = No 1 = Yes	Assessment form

Clinical Scales

The MDS contains clinical scales that can be used to assess a resident's clinical status. At admission, these scales can provide a comprehensive measure of the clinical profile of residents with HF that can predict further adverse outcomes. The MDS Changes in Health, End-stage disease and Symptoms and Signs (CHESS), a measure of frailty status, has been found to be predictive of mortality in Ontario chronic hospital patients and frail nursing home residents with HF (Hirdes et al., 2003, Tjam et al., 2012). The scales are not meant to be used for diagnostic purposes, however, scores on the Depression Rating Scale (DRS), for instance, have been previously related to depression symptoms. The validity of the DRS in detecting symptoms of depression in 82 nursing home residents was found to be high, with a sensitivity of 91% and specificity 69% (Burrows et al., 2000). Other validated scales include the Cognitive Performance Scale (CPS) (Hartmaier et al., 1995), the ADL Hierarchy Scale (Morris et al., 1999), the Pain Scale (Fries et al., 2001), the CHESS (Armstrong et al., 2010), and the Aggressive behaviour Scale (ABS) (Perlman & Hirdes, 2008). Scales included in the study are the Cognitive Performance Scale (CPS), Depression Rating Scale (DRS), Activities of Daily Living (ADL) Hierarchy Scale, CHESS scale, Social engagement Scale, Pain Scale and Pressure Ulcer Scale. **Table 3** below shows a description of the scales included in the study.

Table 3 Clinical Scales Used to Describe Characteristics of LTCH Residents

	Variable	**Description**	**MDS code**	**Scale score**	**Derived from**
Clinical: Scales	Cognitive Performance Scale (CPS)	The Cognitive Performance Scale is used to measure memory, level of consciousness and executive functioning. A score of 0 represents intact cognition and 6 indicates severe cognitive impairment	CPS_nh2	0-6	CCRS generated
	Depression Rating Scale	This is a measure of depressive symptoms with scores of 3 or more used as a conventional cut-off for potential depression	DRS_nh2	0-14	CCRS generated
	Index for Social Engagement	The Index of Social Engagement is a measure of involvement in the social life of the facility with higher scores indicating greater levels of engagement.	Soceng_nh2	0-6	CCRS generated
	Activities of Daily Living Hierarchy	ADL Hierarchy score indicates level of functional impairment and disability. It ranges from 0 to 6 with higher scores indicating more severe impairment in late loss ADLs	ADL_hier_nh2	0-6	CCRS generated
	CHESS	The Changes in Health, End-Stage Disease, Signs, and Symptoms Scale (CHESS) is can be used to identify residents with medical complexity and health instability. The scale has a range of 0 indicated absence of instability to 5 indicating high instability.	Chess_nh2	0-5	CCRS generated
	Pain Scale	Score for Pain Scale indicates 0 for no evidence or complaint of pain and 3 showing severe pain	Pain_nh2	0-3	CCRS generated
	Aggressive Behaviour Scale	The Aggressive Behaviour Scale is a summary scale that includes four types of aggression with scores ranging from 0 to 12. Scores of 5 or more are used as a conventional cut-off for severe	Abs_nh2	0-12	CCRS generated

		aggressive behaviour disturbance.			
	Pressure Ulcer Risk Scale	Score for Pressure Ulcer Scale range from 0-8, with 0 indicating no risk for pressure ulcer development and 8 indicating the highest level of risk	Pur_nh2	0-8	CCRS generated

Table 4 Clinical Assessment Protocols Used to Describe Characteristics of LTCH Residents

	Variable	**Description**	**MDS code**	**Scale score**	**Derived from**
Clinical Assessment Protocols (CAPs):	ADL CAP	Help clinician focus on key issues in ADL functioning identified during the assessment process	ADL_CAP	0 = Not Triggered 1 = Triggered to prevent decline 2 = Triggered to facilitate improvement	CCRS generated
	Physical restraint CAP	Help clinician focus on key issues in physical restraint identified during the assessment process	cREST	0 = Not Triggered 1 = Triggered to remove restraints for persons with little or no ability to perform middle or early loss ADLs 2 = Triggered to remove restraints for persons with the ability to perform middle or early loss ADLs	CCRS generated

	Cognitive loss CAP	Helps clinician focus on cognitive impairment identified during the assessment process	cCOGNIT	0 = Not Triggered 1 = Triggered to monitor for risk of cognitive decline 2 = Triggered to prevent decline	CCRS generated
	Delirium CAP	Helps clinician focus on delirium issue identified during assessment process	cDELIR	0 = Not Triggered 1 = Triggered	CCRS generated
	Communication CAP	Helps clinician focus on communication decline or improvement identified during assessment	cCOMMUN	0 = Not Triggered 1 = Triggered with potential for improvement 2 = Triggered to prevent decline	CCRS generated
	Mood CAP	Helps clinician focus on level of risk for mood decline identified during assessment	cMOOD	0 = Not Triggered 1 = Triggered - medium risk 2 = Triggered - high risk	CCRS generated

	Behaviour CAP	Helps clinicians focus on behavioural issues identified during assessment	cBEHAV	0 = Not Triggered 1 = Triggered to prevent behaviours from occurring daily 2 = Triggered to reduce the occurrence of daily behaviours	CCRS generated
	Activities CAP	Helps clinicians focus on issues related to resident activities identified during assessment	cACTIV	0 = Not Triggered 1 = Triggered	CCRS generated
	Social relationship CAP	Helps clinicians focus on issues related to social relationships identified during assessment	cSOCFUNC	0 = Not Triggered 1 = Triggered	CCRS generated
	Falls CAP	Helps clinicians focus on issues related to level of risk of falling identified during assessment	cFALLS	0 = Not Triggered 1 = Triggered into the medium risk of future falls group 2 = Triggered into the high risk of future falls group	CCRS generated

	Pain CAP	Helps clinicians focus on issues related to level of pain identified during assessment	cPAIN	0 = Not Triggered 1 = Medium - priority trigger 2 = High - priority trigger	CCRS generated
	Pressure ulcer CAP	Helps clinicians focus on issues related to level of risk of falling identified during assessment	cPULCER	0 = Not Triggered 1 = Triggered - has a stage 2 or higher level pressure ulcer and the goal is healing 2 = Triggered - has a stage 1 pressure ulcer 3 = Triggered - does not have a pressure ulcer but has risk factors	CCRS generated
	Cardio-respiratory CAP	Helps clinicians focus on cardio-respiratory issues identified during assessment	cCARDIO	0 = Not Triggered 1 = Triggered	CCRS generated

	Under nutrition CAP	Helps clinicians identified and focus on risk for under nutrition during assessment	cNUTRI	0 = Not Triggered 1 = Triggered - medium risk 2 = Triggered - high risk	CCRS generated
	Dehydration CAP	Helps clinician identify and focus on level of dehydration risk in resident during assessment	cDEHYD	0 = Not Triggered 1 = Triggered - low level 2 = Triggered - high level	CCRS generated

	Feeding tube CAP	Helps clinicians identify and focus on resident need for feeding tube depending on level of cognitive impairment	cFEEDTB	0 = Not Triggered 1 = Triggered - absence of cognitive abilities 2 = Triggered - has some residual cognitive abilities	CCRS generated
	Appropriate medication CAP	Helps clinician identify whether there are issues with appropriate prescription to medication	cDRUGS	0 = Not Triggered 1 = Triggered for high priority	CCRS generated

	Urinary incontinence CAP	Helps clinician identify and focus on whether resident urinary incontinence is showing improvement or decline	cURIN	0 = Not Triggered 1 = Not Triggered - continent at baseline 2 = Triggered to prevent decline 3 = Triggered to facilitate improvement	CCRS generated
	Bowel condition CAP	Helps clinicians identify and focus on decline or improvement of bowel condition	cBOWEL	0 = Not Triggered 1 = Triggered to prevent decline 2 = Triggered with potential for improvement	CCRS generated

Clinical Assessment Protocols (CAPs)

The CAPs were designed to assist clinicians with identification of issues following assessment. Developed in 2007, the second generation CAPS can be used in decision making with the resident on how to and whether to intervene (the LTCF CAP manual can be found on www.inteRrai.org). Information from the CAPS at admission can also be used to identify residents at risk for adverse outcomes or with potential for improvement. The MDS CAPs have different levels; some are binary (yes or no), while others have different trigger levels. They can be used to initiate care planning to address resident needs in different domains, some of which include cardio-respiratory, delirium, depression, ADLs, falls, and restraints. To address study objectives 1 and 2, CAPS generated from the Full Admission Assessment Form were used. **Table 4** provides a description of CAPs included in the study and how they were coded.

1.4 Analysis

Demographic and clinical information of residents with HF, and no HF at admission were summarized using means and standard deviations (SD) for continuous measures, and frequencies and percentages for categorical measures. When comparing the two populations on categorical measures such as levels of cognitive impairment (as scored on CPS), then the Chi-square test was be used to evaluate whether the differences were significant. Continuous measures such as differences in number of medications were analyzed using t-tests. An a priori α level of 0.05 and CI of 95% was used to evaluate the significance of all statistical tests.

1.5 Results

A total of 48,601 residents were included in the study with 12.3% (n=**5977**) diagnosed with HF. The majority of the residents were female, widowed rather than married, 85 years or older, spoke English, and were admitted from a community sitting. Compared to other residents, those with HF were slightly older (over 85 years: 65.4% vs. 50.9%), more frequently admitted from a hospital setting (43.0% vs. 34.4%), had a significantly higher number of comorbidities (6.5±2.4 vs. 4.7±2.1) and were prescribed an average of two additional medications (11.9± 4.6 vs. 9.6± 4.9) at admission. Cardiovascular related diseases such as hypertension, cardiac dysrythmias and arteriosclerotic heart disease were also more prevalent, as were other comorbidities such as renal failure and Type 2 diabetes. Heart failure related symptoms such as shortness of breath and edema were more commonly exhibited in residents with HF in comparison to their counter-parts, and a greater proportion was monitored for acute medical illness (37.2 vs. 27.0).

Table 5. Demographic and clinical characteristics of LTCH residents living with heart failure in Ontario (n=48601)

Variable	**HF (n=5977)**	**No HF (n=42,624)**	**P value**
	%	**%**	
Female	67.9	68	0.3954
Age			<.0001
65-74 years	6.07	10.9	
75-84 years	30.6	38.2	
85+ years	63.4	50.9	
Married	25.1	29.8	<.0001
Admitted from Hospital	43	34.4	<.0001
Community	56.3	65	<.0001
Spoke English	81.9	82.4	0.4145
Cardiovascular history			
Hypertension	65.8	59.5	<.0001
Deep vein thrombosis	1.6	1.0	0.0001
Arteriosclerotic heart disease	21.8	10.84	<.0001
Cardiac dysrythmias	16.2	6	<.0001
Other cardiovascular diseases	23.5	13.7	<.0001
Common diseases			
Diabetes mellitus	31.09	22.41	<.0001
Arthritis	45.9	38.5	<.0001

Alzheimer's disease	10.8	20.5	<.0001
Dementia	41.8	48.2	<.0001
Depression	22.4	23.3	0.0985
Cancer	11	9.7	0.0014
Renal failure	17.8	7.1	<.0001
Symptoms			
Edema	21.9	11.7	<.0001
Shortness of breath	17.4	5.5	<.0001
Syncope	0.22	0.48	0.0043
Unsteady gait	45.7	42.8	<.0001
Chest pain	1.74	0.64	<.0001
Psychotropic Medications			
Anti-psychotics	23.3	30.5	<.0001
Anti-depressants	41.8	43	0.0711
Anti-anxiety	14.4	14.4	0.9804
Service utilization			
Monitoring of acute medical condition	37.2	27	<.0001
Physician visits days			0.0034
0	17.8	17.5	
1	52.7	54.7	
2	22.6	21.8	
3+	6.9	5.8	

Scores on clinical scales indicated that residents with HF had lower cognitive impairment, with a greater proportion scoring less than 2 on the CPS. Similarly, they also had lower rates of aggressive behavior as shown by their ABS scores. They did not differ from those without HF in terms of severity of depression. Results show that for both resident groups, approximately a quarter had DRS scores greater than 3 (DRS 3≥ 24.7% vs. 25.8); a conventional cut off for symptoms of depression. Residents with HF had greater functional limitations with higher scores on the ADL Hierarchy Scale and showed evidence of greater health instability upon admission to LTCHs (as indicated by their CHESS scores). Additionally, they had greater risk for pressure ulcers and lived with more pain than those without HF.

Table 6 Resident scores on clinical scales according to their heart failure status (n= 48,601)

Scale	HF (n=5977)	No HF (42,624)	P value
CPS			<.0001
0	19.42	12.92	
1-2	41.58	34.75	
3-4	30.95	39.53	
5-6	8.05	12.80	
ADL Hierarchy Scale			<.0001
0	6.29	6.64	
1-2	24.19	28.61	
3-4	42.71	41.89	
5-6	26.80	22.86	
DRS			0.1791
0	42.55	41.72	
1-2	32.71	32.46	
3+	24.73	25.83	
CHESS			<.0001
0	42.43	54.88	
1-2	50.93	41.00	
3+	6.64	4.11	
ABS			<.0001
0	67.12	61.01	
1-4	27.64	30.75	
5+	5.24	8.24	

Social Engagement Scale			<.0001
0-1	19.59	23.17	
2-4	55.25	52.78	
5-6	25.16	24.05	
Pain Scale			<.0001
0	52.67	60.16	
1-2	44.50	37.93	
3	2.83	1.91	
Pressure Ulcer Scale			<.0001
0	25.88	36.59	
1-2	41.89	37.47	
3-4	27.79	23.35	
5-6	4.43	2.59	

CPS= Cognitive Performance Scale
ADL Hierarchy Scale= Activities of Daily Living Hierarchy Scale
DRS= Depression Rating Scale
CHESS= The Changes in Health, End-Stage Disease, Signs, and Symptoms Scale
ABS= Aggressive Behaviour Scale

**With the exception of the Social Engagement Scale, higher scores on clinical scales indicate greater severity of the condition.

Table 7 provides results of selected clinical assessment protocols (CAPS) that may be used to initiate care planning or to identify needs of residents living with HF. The ADL CAP has two trigger levels. Comparing trigger rates showed that residents with HF had slightly lower triggers to prevent decline (44.6% in HF vs. 48.8% in non-HF) and slightly higher rates to facilitate improvements (48.8% in HF vs. 40.9% in non-HF). The communication CAP, which is similar, shows that residents with HF, had slightly lower trigger rates to prevent decline (18.3 vs. 22.8%) and facilitate improvement (13.8% vs. 14.1%). Despite scoring lower on the CPS, approximately half those with HF triggered monitoring for risk of cognitive decline compared to a third of those without HF.

The Falls CAP categorizes residents by level of risk; medium (single fall) compared to high (multiple falls). Results show that similar proportions in both groups for this CAP, with a greater proportion at medium risk for falls. Delirium trigger rates also showed very little variability between the two populations (7.7% vs. 8.8%). On the other hand, the Appropriate Medication CAP, which identifies residents with inappropriate prescription issues, indicates that those with HF have comparatively, twice the trigger rates. Following a similar trend is the Cardio-respiratory CAP, which is triggered when residents exhibit respiratory or cardiovascular symptoms. Trigger rates ranged from 20.7% in those with HF compared to 8.7% in those without HF.

Table 7 Percent of residents triggering clinical assessment protocols (CAPS) by HF status at admission (n= 48601)

CAP	HF	No HF	P value
ADL			<.0001
Prevent decline	44.64	48.78	
Facilitate improvement	46.66	40.85	
Cognitive loss			<.0001
Monitor risk for decline	49.87	36.87	
Prevent decline	11.13	10.8	
Communication			<.0001
Facilitate improvement	13.77	14.06	
Prevent decline	18.3	22.75	
Falls			0.6992
Medium risk	12.1	12.03	
High risk	6.32	6.06	
Urinary incontinence			<.0001
Continent at baseline	28.58	29.78	
Prevent decline	48.69	46.45	
Facilitate improvement	14.69	10.97	
Pressure Ulcer			<.0001
Stage 2 or higher	6.98	4.69	
Stage 1 ulcer	3.81	2.59	
No ulcer, but risk	2.91	2	
Social relationship			<.0001

Triggered	61.5	55.9	
Physical restraints			0.0406
Unable to perform middle/early loss ADL	5.94	6.81	
Able to perform middle/early loss ADLs	0.9	0.88	
Pain			<.0001
Medium	17.72	13.83	
High	3.3	2.32	
Appropriate medication**			<.0001
Triggered	15.7	6.3	
Delirium			0.0046
Triggered	7.73	8.83	
Cardio-respiratory***			<.0001
Triggered	20.69	8.72	
Bowel			0.0001
Prevent decline	15.28	17.41	
Facilitate improvement	6.58	6.05	

CHAPTER TWO: Predictors of Hospitalization

2.1 Research question

In residents with HF, what admission clinical and demographic characteristics are associated with hospitalization?

2.2 Variables

Hospitalization

Hospitalization of residents with HF was an outcome of interest in this study, particularly the association between hospitalization and demographic and admission clinical characteristics, including scores on scales and CAPs. The hospitalization variable was a dichotomous '0 or '1' event that was based on whether a resident had spent at least one day in the care setting. Hospitalizations that occurred after admission to LTCHs but prior to the first 90-day quarterly assessment period were included. Information on hospital stay was ascertained from the Quarterly Assessment Form that is completed as part of the MDS starting at 90 days following admission. It was defined as an all-purpose hospital stay regardless of reason for hospitalization, since the MDS Quarterly Assessment Form did not collect data on reason for the hospitalization.

2.3 Analysis

Bivariate associations of demographic and clinical characteristics with spending at least one day in a hospital, including clinical scales and CAPs, were first analyzed.

Continuous variables such as clinical scale were converted in to categorical variables for the analysis for ease of interpretation. As well, collapsing scores was helpful in categorizing residents by severity of conditions through different levels and cut points. For instance, scoring above certain cut points (>3) on the DRS is associated with symptoms of depression (Burrows et

al., 2000). The clinical score categories were modelled after a similar analysis by a recent study that described the clinical characteristics of all Ontario residents using these scales (Hirdes et al., 2011). Bivariate logistic regression analyses were used to predict probability of hospitalization at the significance level of alpha= 0.05. In addition to p-values and odds ratios, 95% confidence intervals (CI) were used to determine whether the clinical variables were significantly associated with hospitalization. Odds ratios (ORs) were used to compare the probability of hospitalization given the expression of baseline clinical characteristics. An OR of greater than 1 is associated with higher probability of hospitalization, while OR of less than one is associated with lower odds, and 1 indicates that the risk factor does not influence the outcome. The 95% CI is an indicator of precision of the OR, however, unlike the p-value, it is not a measure of significance. While wide CIs indicate lower precision, narrower CI values indicate higher precision of ORs (Szumilas, 2010).

For the multivariable analysis, variables found to be significant at a bivariate level were included. Logistic regression modeling using generalized estimating equations (GEE) was used due to the correlated nature of the data. GEE is recommended when observations are clustered (Ghisletta & Spini, 2004). In our sample, two residents living with HF in one facility may receive similar type of care, which may result in similarities in some variables. The GEE model allowed for the control of clustering within a facility in the analysis by using the CIHI assigned facility codes as the clustering variable. GEE also addressed the fact that some of the clinical variables were correlated with each other, such as prescription with antidepressants and scores on the DRS. Our analysis specified an exchangeable working covariance structure, which assumed constant time dependency of the predictor variables (Carruthers et al., 2008). Using step-wise selection, variables identified from the bivariate analysis were individually added to the model,

with p<.05 being the criterion for variable inclusion to the model. In the step-wise regression, variables were added to the model and retained depending on the significance of their p values, ORs and CIs. The goodness of fit of the model was evaluated using Akaike Information Criterion (AIC). With the addition of each variable, AIC scores were compared between models, and the model with the lowest value was selected. In the final model, a separate logistic regression model was run to obtain the C-statistic. The C-statistic estimated the model sensitivity to predicting hospitalization, where the value 0.5 represented the model randomly predicting the outcome and 1 indicated the model perfectly discriminating the outcome.

2.4 Results

Table 8 summarizes the predictors of hospitalization in residents with HF from the bivariate analysis. A total of 5300 observations were read, while 677 were deleted due to missing values for the response or explanatory variables. The rate of hospitalization in the sample residents with HF was 36.2%. In bivariate analyses, previous admission to LTCH from a hospital setting was the strongest predictor and increased the likelihood of subsequent hospitalization by 8.5 times (95% CI= 7.49-9.54). The second strongest predictor was the health instability of the resident, as measured by the CHESS, with scores higher than three increasing odds of hospitalization by almost 7 times (CI= 5.43-8.69). Number of medications was also significantly associated with hospitalization. Among the clinical scales, scores on the ADL Hierarchy, DRS, Pain and the Pressure Ulcer Score (PUS) were predictive of hospitalization, with higher scores increasing the event likelihood. In the case of the PUS, with every increase in score category, odds of hospitalization saw a one unit increase. However, cognitive impairment, as measured by the CPS was not found to be significant. Triggering the CAPs for restraint use, inappropriate medication, falls and bowel were significantly associated with hospitalization. Other positively related

variables included living alone prior to admission to LTC, presence of edema, unsteady gait, prescription on an anti-depressant, physician visits and monitoring of medical condition. On the other hand, a high level of social engagement (O.R=0.64, CI: 0.51-0.79) and admission to the LTCH from the community (O.R= 0.12, CI: 0.11-0.14) were both found to significantly reduce likelihood of hospitalization.

Table 8 Results of Bivariate Analysis of Admission Characteristics that Predict Hospitalization in LTCH Residents Living with HF in Ontario (n=5300)

Clinical characteristic	**Odds ratio (SE)**	**95% Confidence Interval**	**P-value**
Age, 85+ years	0.78 (0.11)	0.63-0.97	0.03
Female	1.49 (0.67)	0.40-5.57	0.55
Married	1.11 (0.061)	0.99-1.26	0.08
English	0.92 (0.14)	0.69-1.21	0.53
Admitted from hospital	8.45 (0.06)	7.49-9.54	<.0001
Admitted from community	0.12 (0.06)	0.11-0.14	<.0001
Lived alone	1.35 (0.07)	1.17-1.56	<.0001
Cardiovascular history	0.56 (0.58)	0.18-1.75	0.32
Chest pain	1.31 (0.21)	0.86-1.99	0.20
Dizziness	1.29 (0.14)	0.99-1.69	0.061
Edema	1.39 (0.06)	1.22-1.57	<.0001
Syncope	0.79 (0.60)	0.24-2.6	0.69
Unsteady gait	1.264 (0.05)	1.14-1.41	<.0001

Medications			<.05
1-3	5.43 (0.76)	1.26-23.41	0.02
4-6	3.89 (0.75)	0.89-16.98	0.07
7+	4.42 (0.75)	1.02-19.13	0.05
Comorbidities, 7+	0.62 (1.41)	0.04-9.93	0.74
Anti-depressant	1.26 (0.05)	1.13-1.40	<.0001
Anti-anxiety	1.17 (0.076)	1.01-1.35	0.04
Anti-psychotic	1.19 (0.06)	1.05-1.34	0.0068
Physician visit, 2	1.58 (0.09)	1.33-1.87	<.0001
Physician visits, 3+	1.99 (0.12)	1.58-2.52	<.0001
Monitoring of medical condition	2.06 (0.06)	1.85-2.30	<.0001
CPS			
1-2	1.07 (0.07)	0.92-1.24	0.38
3-4	1.19 (0.08)	1.02-1.38	0.03
5-6	1.06 (011)	0.85-1.32	0.63
ADL scale			
1-2	1.25 (0.14)	0.96-1.63	0.09
3-4	1.89 (0.13)	1.47-2.43	<.0001
5-6	2.76 (0.13)	2.13-3.57	<.0001
DRS			
1-2	1.40 (0.06)	1.24-1.59	<.0001
3+	1.52 (0.07)	1.33-1.73	<.0001
CHESS scale			
1-2	1.76 (0.058)	1.57-1.97	<.0001

3+	6.87 (0.12)	5.43-8.69	<.0001
ABS scale			
1-4	1.19 (0.06)	1.06-1.35	0.003
5+	1.07 (0.12)	0.84-1.36	0.57
Social engagement scale			
1-2	0.92 (0.11)	0.74-1.14	0.43
3-4	0.79 (0.11)	0.65-0.98	0.03
5-6	0.64 (0.11)	0.51-0.79	<.0001
Pain scale			
1-2	1.27 (0.05)	1.14-1.41	<.0001
3	1.64 (0.16)	1.19-2.24	0.0019
Pressure ulcer scale			
1-2	1.91 (0.07)	1.65-2.20	<.0001
3-4	2.92 (0.78)	2.51-3.40	<.0001
5+	4.07 (0.14)	3.11-5.33	<.0001
Restraint CAP			
1 = Triggered to remove restraints for persons with little or no ability to perform middle or early loss ADLs	1.59 (0.11)	1.29-1.98	<.0001
2 = Triggered to remove restraints for persons with the ability to perform middle or early loss ADLs	0.70 (0.31)	0.39-1.27	0.24
Appropriate medication CAP	2.36 (0.08)	2.03-2.74	<.0001
Falls CAP			
1=Medium risk for falls	1.39 (0.08)	1.18-1.62	<.0001

2= High risk for falls	1.93 (0.10)	1.56-2.38	<.0001
Delirium CAP	1.09(0.09)	0.89-1.32	0.39
Bowel CAP			
1= Triggered to prevent decline	1.15 (0.07)	0.99-1.33	0.06
2= Triggered to facilitate improvement	1.78 (0.11)	1.45-2.19	<.0001

CPS= Cognitive Performance Scale
ADL Hierarchy Scale= Activities of Daily Living Hierarchy Scale
DRS= Depression Rating Scale
CHESS= The Changes in Health, End-Stage Disease, Signs, and Symptoms Scale
ABS= Aggressive Behaviour Scale

**With the exception of the Social Engagement Scale, higher scores on clinical scales indicate greater severity of the condition.

Table 9 shows a summary of results from the final logistic regression model using GEE. Functional limitation, symptoms of depression, social engagement, presence of edema, or triggered CAP for bowel incontinence were not associated with hospitalization. Admission to a LTCH from a hospital setting remained the strongest predictor of hospitalization (OR: 8.09, CI: 7.05-9.29), followed by a CHESS score of greater than 3, which indicates high levels of health instability (O.R 4.24, CI: 3.07-5.85). Other variables that increased the likelihood of hospitalization included monitoring for acute medical illness (O.R: 1.45, CI: 1.26-1.67). Physician visits of over three days increased odds of hospitalization by 1.6 times (CI: 1.21-2.19, P= 0.0013) and prescription with an anti-depressant (O.R: 1.16, CI: 1.0-1.33, p=0.03). Likelihood for the outcome increased when CAPs were triggered for: inappropriate medication (O.R 1.47, CI: 1.18-1.82) and high risk for falls (O.R 1.92, CI: 1.47-2.49). The model had a c-

statistic of 0.809, suggesting high sensitivity for accurately predicting hospitalization in our independent variables.

Table 9 Multivariate Results of Admission Characteristics that Significantly Predicted Hospitalization in LTCH Residents Living with HF in Ontario (n=5300)

Variable	**Odds ratio**	**95% Wald Confidence Limits**	**Standard Error**	**P value**

CHESS 1-2	1.529	1.305	1.793	0.0811	<.0001
CHESS 3+	4.237	3.072	5.845	0.1641	<.0001
Inappropriate Medications CAP	1.466	1.181	1.82	0.1104	0.0005
Falls CAP-Medium risk	1.224	1.001	1.496	0.1024	0.0487
Falls CAP-High risk	1.915	1.468	2.498	0.1356	<.0001
Bowel CAP-triggered to facilitate improvement	1.297	0.994	1.693	0.1358	0.0552
Monitoring for acute medical illness	1.452	1.261	1.672	0.072	<.0001
Physician visit- 1 day	1.309	1.089	1.575	0.0942	0.0042
Physician visit- 2 days	1.428	1.155	1.765	0.1081	0.001
Physician visit- 3 days	1.631	1.211	2.197	0.1519	0.0013
Antidepressant	1.161	1.011	1.333	0.0705	0.0343
Admitted from hospital	8.089	7.046	9.286	0.0704	<.0001
Lived alone prior to LTC admission	1.29	1.078	1.544	0.0918	0.0055

CHAPTER THREE: Quality of Care for Residents living with HF

3.1 Research questions

What is the quality of care for residents with HF in Ontario LTCHs?

Are there regional variations in quality of care for residents with HF in Ontario?

3.2 Quality Indicators

Quality indicators are key mechanisms of performance measurement in nursing homes. The adoption of the RAI MDS across LTCHs in Ontario has made possible the comparison of healthcare quality across facilities and regions. The MDS QIs have been used to support healthcare decision-making, public reporting and quality improvement efforts in the province (Hospital Report Research Collaborative, 2001; Hutchinson et al., 2009; HQO, 2013). The MDS QIs were developed in response to a need for measures indicative of poor care practices and outcomes in nursing homes. The MDS QIs have gone through several iterations of development. After extensive review by a multidisciplinary panel of researchers and expert clinicians, 175 QIs were drafted and organized into 12 clinical domains. However, further feasibility and validity testing resulted in 30 QIs that reflected incidence and prevalence measures, as well as processes and outcomes of care (Zimmerman 2003). The MDS 2.0 third generation nursing QIs are organized in domains of: ADL, behavior, continence, cognitive function, communication, delirium, falls, infection, mobility, mood, nutrition/weight gain, pain, pressure ulcers, restraints and medication (Zimmerman, 1997; 2003). Indicators are classified as prevalence measures when they show overall status such as *percentage of residents with pain*. When QIs illustrate a resident status in a specific time point, for example, *percentage of residents whose cognitive ability worsened*, they are called incidence measures (Zimmerman, 2003).

A minimum sample size of at least 20 observations of residents with HF was required to calculate the QIs. While no standard exists, other studies have indicated that a sample size of at least 20 observations is needed to produce stable values for each indicator (Dalby et al., 2005). This is due to the fact that some small nursing homes may have proportionately higher numbers of residents with HF, which could provide inaccurate score estimates of the QI condition.

Studies have measured the reliability of multiple MDS QIs. For instance, Mor and colleagues (2003) in a large inter-rater reliability trial of the MDS QIs found good inter-rater reliability of the QIs between regular practice and gold-standard assessment . In clinical practice, 'gold-standard' refers to the best available test built through consensus, which other tests can be compared and measured against (Versi, 1992). Of the MDS Of QIs, 14 were highly recommended, and 17 were reported as appropriate. On the other hand, the QIs 'infections' and 'little or no activity' had low kappa levels (<.4). However, 'low body-mass index' and 'tube feeding' showed high inter-rater reliability (kappa values >.8) (Mor et al., 2003). More specifically, Bates-Jensen and colleagues (2003) found that the pressure ulcer QI accurately differentiated between LTCHs that scored in the upper and lower quartile in a cohort study of 329 residents in California, US. Similarly, in another cohort study of 16 facilities, Cadogan and colleagues (2004) demonstrated that the pain QI could discriminate between different rates of pain across nursing homes, with higher detection correlated to higher prevalence.

Quality indicators of residents with HF will be reported by Ontario's 14 Local Health Integration Network (LHINs) regions. The facility LHIN information is included on the MDS Facility Profile Form.

3.3 Risk adjustment

Certain considerations should be made when calculating QIs from individual level data. One of the issues associated with developing performance measures in nursing homes is the need to

adjust for variations in risk of adverse outcomes in residents. “Risk can be defined as the likelihood that given a resident's health or functional status, they might require certain care processes or experience certain negative outcomes”: (Zimmerman et al., 2003, p. 252). LTCHs have residents with different clinical trajectories and demographic profiles, which may influence their care processes. In assessing quality of nursing homes, it is important to differentiate adverse outcomes that are the result of poor quality of care from those that are related to resident health conditions. Risk adjustment controls the effects of resident risk from those related to quality of care. This allows for a more effective targeting of quality issues and unbiased comparison of care among facilities (Jones et al., 2010; Zimmerman et al., 2003).

The third generation RAI 2.0 QIs use a method of risk adjustment that involves restriction, indirect standardization and stratification with direct standardization (Jones et al., 2010). **Table 10** shows the variables used in the adjustment of the QIs used in this study, including their specific covariates (CIHI, 2010).

Table 10 Parameters used to Calculate MDS QIs

Domain	**Code**	**Quality Indicator**	**Numerator**	**Denominator**	**Individual Covariates**	**Facility level stratification**
ADL	ADL01	Percent of residents who had an unexpected loss of function in some basic daily activities	Residents with worse late-loss ADL self-performance (increased score) on their target compared to prior assessment	Residents whose late-loss ADL score could decline (did not have maximum score on prior assessment), excluding comatose and end-of-life residents	Age younger than 65	ADL Long Form

	ADL05	Percent of residents whose status improved on mid-loss ADL functioning (transfer and locomotion) or remained completely independent in mid-loss ADLs	Residents with improved mid-loss ADL self-performance (decreased score) on their target compared with prior assessment or a score on both prior and target assessment	Residents with valid assessments, excluding comatose and end-of-life residents	Age younger than 65 CPS	ADL Long Form
	ADL06	Percent of residents whose status improved on early-loss ADL functioning (dressing and personal hygiene) or remained completely independent in early loss ADLs	Residents with improved early-loss ADL self-performance (decreased score) on their target compared with prior assessment or a score of 0 on both prior and target assessments	Residents with valid assessments, excluding comatose and end-of-life residents	RUG Late-loss ADL Scale Age younger than 65 	CPS

	ADL1A	Percent of residents who had an improvement of function in some basic daily activities	Residents with improved late-loss ADL self-performance (decreased score) on their target compared with prior assessment	Residents whose late-loss ADL score could improve (did not have maximum score on prior assessment) excluding comatose and end-of-life residents	PSI-Subset 1-Diagnoses	CMI
					CPS	
					RUG Behaviour	
					RUG Cognitive Impairment	
					Age younger than 65	
					Not totally dependent in transferring	
					Locomotion problem	
					PSI-Subset 2- Non diagnoses	
					Age younger than 65	

	ADL6A	Percent of residents whose status declined on early-loss ADL functioning (dressing and personal hygiene) or remained completely dependent in early loss ADLs	Residents with worse early-loss ADL self-performance (increased score) on their target compared with prior assessment or a score of 0 on both prior and target assessments	Residents with valid assessments, excluding comatose and end-of-life residents	Not totally dependent in transferring	CMI
					Locomotion problem	
					PSI-Subset 2-Non-Diagnoses	
					CPS	
					Age younger than 65	
	ADL7D	Percent of residents whose ADL self-performance declined	Residents with worse ADL self-performance (increased ADL Long Form score) on their target compared with prior assessment	Residents with valid assessments, excluding comatose and end-of-life residents	Not totally dependent in transferring	CMI
					Locomotion problem	
					PSI-Subset 2-Non-Diagnoses	
					Age younger than 65	

Behaviour	BEHD4	Percent of residents whose behavioural symptoms declined	Residents with more behavioural symptoms present on their target compared with prior assessment	Residents with valid assessments, excluding comatose residents	CPS	CPS
					Motor agitation	
					Age younger than 65	
	BEHI4	Percent of residents whose behavioural symptoms improved	Residents with fewer behavioural symptoms on their target compared with prior assessment	Resident with valid assessments, excluding comatose residents	Moderate/impaired decision-making problem	CPS
					Motor agitation	
					Age younger than 65	
Continence	CAT02	Percent of residents with indwelling catheters	Residents with an indwelling catheter on their target assessment	Residents with valid assessments excluding end-of-life residents	Pressure ulcer (stage 3 or 4)	CPS
					ALS/MS diagnosis	
					Age younger than 65	

	CAT02	Percent of residents with indwelling catheter	Residents with indwelling catheter on their target assessment	Residents with valid assessments excluding end-of-life residents	Pressure ulcer (stage 3 or 4)	CMI
					ALS/MS diagnosis	
					Age younger than 65	
	CNT02	Percent of residents whose bowel continence worsened	Residents with a greater value for bowel incontinence on their target compared with prior assessment	Residents with valid assessments whose bowel continence could decline (did not have maximum score on prior assessment), excluding comatose and end-of-life residents and those with ostomy present	RUG Nursing CMI	ADL Long Form
					PSI-Subset 1-Diagnoses	
					PSI-Subset 1-Non-Diagnoses	
					Age younger than 65	

	CNT03	Percent of residents whose bladder continence worsened	Residents with a greater value for bladder incontinence on their target compared with prior assessment	Residents with valid assessments whose bladder continence could decline (did not have maximum score on prior assessment), excluding comatose and end-of-life residents	PSI-Subset 1-Diagnoses	ADL Long Form
					PSI-Subset 2-Non-Diagnoses	
					CPS	
					Age younger than 65	
	CN104	Percent of residents with a urinary tract infection	Residents with urinary tract infection on their target assessment	Residents with valid assessments excluding end-of-life residents	Age younger than 65	CMI

	CNT2A	Percent of residents whose bowel continence improved	Residents with a lower value for bowl incontinence on their target compared with prior assessment	Residents with valid assessments whose bowel continence could improve (did not have a minimum score on prior assessment), excluding comatose and end-of-life residents and those with ostomy present	Age younger than 65	CPS
					PSI-Subset 1-Diagnoses	

	CNT3A	Percent of residents whose bladder continence improved	Residents with a lower value for bladder continence on their target compared with prior assessment	Residents with valid assessments whose bladder continence could improve (did not have minimum score on prior assessment), excluding comatose and end-of-life residents	Age younger than 65	CPS
					PSI-Subset 1-Diagnoses	

Cognitive Function	COG01	Percent of residents whose cognitive ability worsened	Residents with a higher CPS score on their target compared with prior assessment	Residents with valid assessments whose cognitive ability could decline (did not have maximum CPS score on prior assessment), excluding comatose and end-of-life residents	Age younger than 65	CMI
	COG1A	Percent of residents whose cognitive ability improved	Residents with a lower CPS on their target compared with prior assessment	Residents with valid assessments whose cognitive ability could improve (did not have minimum CPS score on prior assessment), excluding comatose and end-of-life residents	Age younger than 65	CPS

					Full PSI	
					PSI-Subset 1-Diagnoses	
Communication	COM01	Percent of residents whose ability to communicate worsened	Residents with a higher combined score for *ability to understand others and making self understood* on their target compared with prior assessment	Residents with valid assessments whose communication could decline (did not have maximum score on prior assessment), excluding comatose and end-of-life residents	Short-term memory problem	CPS
					Long-term memory problem	
					Age younger than 65	

	COM1A	Percent of residents whose ability to communicate improved	Residents with a lower combined score for *ability to understand others* and *making self understood* on their target compared with prior assessment	Residents with valid assessments whose communication could improve (did not have minimum score on prior assessment), excluding comatose and end-of-life residents	Age younger than 65 PSI-Subset 1-Diagnoses	CPS
	DEL0X	Percent of residents with symptoms of delirium	Residents with any of the following conditions:	Residents with valid assessments, excluding comatose and end-of-life residents	Age younger than 65	DRS

			One or more behavioral symptoms that appeared different from usual functioning on their target assessment			

			One or more behavioural symptoms that appeared different from usual functioning on their prior assessment and is present on their target assessment			

			Not severely cognitively impaired on their target assessment and one or more behavioural symptoms that is present on the target that was not present on their prior assessment			

Falls	FAL02	Percent of residents who fell in the last 30 days	Residents who had a fall in the last 30 days recorded on their target assessment	Residents with valid assessments	Not totally dependent in transferring	CMI
					Locomotion problem	
					PSI-Subset 2-Non-diagnoses	
					Any wandering	
					Unsteady gait/cognitive impairment	
					Age younger than 65	

Infection	INF0X	Percent of residents with infections	Residents with at least one of the following infections or health conditions documented on their target assessment:	Residents with valid assessments excluding end-of-life residents	Age younger than 65	CMI
			Pneumonia			
			Respiratory infection			
			Septicemia			
			Urinary tract infection			

			Viral hepatitis Wound infection Fever Recurrent lung aspiration			

	RSPX2	Residents who developed a respiratory infection or have not gotten better	Residents with none of the following respiratory condition at their prior assessment and at least one of the conditions on their target assessment or residents with at least one of their respiratory conditions on their prior assessment and some or higher count of respiratory conditions on their target assessment:	Residents with valid assessments	RUG Clinical Complex	Pain scale
			Pneumonia		Age younger than 65	

			Inability to lie flat due to shortness of breath		RUG Nursing CMI	
			Shortness of breath			
			Recurrent aspirations			
Mobility	MOB01	Percent of residents whose ability to locomote worsened	Residents with worse self-performance for locomotion on unit (increased score) on their target compared with their prior assessment	Residents with valid assessments whose locomotion on unit could decline (did not have maximum score on prior assessment), excluding comatose and end-of-life residents	PSI-Subset 1-Diagnoses	CMI
					More dependence in toileting	

					Requires much assistance for eating	
					Age younger than 65	
	MOB1A	Percent of residents whose ability to locomote improved	Residents with improved self-performance for locomotion on unit (decreased score) on their target compared with their prior assessment	Residents with valid assessments whose locomotion on unit could improve (did not have minimum score on prior assessment), excluding comatose and end-of-life residents	Age younger than 65	CPS
					PSI-Subset 2-Non-diagnoses	
					CPS	
					Requires much assistance for eating	

Mood	MOD4A	Percent of residents who declined in mood from symptoms of depression	Residents with a higher DRS score on their target compared with their prior assessment	Residents with valid assessments whose depression symptoms could decline (did not have maximum DRS score on prior assessment) excluding comatose residents	Age younger than 65	CMI
Nutrition/weight	NUT01	Percent of residents with a feeding tube	Residents with a feeding tube on their target assessment	Residents with valid assessments excluding comatose and end-of-life residents	RUG Clinically Complex Swallowing problem Age younger than 65	ADL Long Form

	WGT01	Percent of residents who had unexplained weight loss	Residents with weight loss documented on their target assessment	Residents with valid assessments excluding end-of-life residents and those on a planned weight-loss program	Age younger than 65	CMI
Pain	PAI0X	Percent of residents with pain	Residents with moderate pain at least daily or horrible/excruciating pain at any frequency documented on their target assessment	Residents with valid assessments	CPS	DRS
					Long-term memory problem	

	PAN01	Percent of residents whose pain worsened	Residents with greater pain (higher Pain Scale Score) on their target assessment compared with their prior assessment	Residents with valid assessments whose pain symptoms could increase (did not have maximum Pain Scale score on prior assessment)	Age younger than 65	CMI
Pressure Ulcers	PRU05	Percent of residents who had a pressure ulcer at stages 2 to 4	Residents who had a pressure ulcer at stages 2 to 4 on their target assessment	Residents with valid assessments	RUG Cognitive Impairment	CMI
					PSI-Subset 1-Diagnoses	
					More dependence in toileting	
					Age younger than 65	

	PRU06	Percent of residents who had a worsened pressure ulcer at stages 2 to 4	Residents who had a pressure ulcer at stages 2 to 4 on their target assessment and whose pressure ulcer stage is greater on their target compared with their prior assessment	Residents with valid assessments	RUG Late-Loss ADL	CMI
					Age younger than 65	
	PRU09	Percent of residents who had a newly occurring pressure ulcer at stages 2 to 4	Residents who had a pressure ulcer at stages 2 to 4 on their target assessment and no pressure ulcer at stages 2 to 4 on their prior assessment	Residents with valid assessments, excluding those with stage 2 to 4 ulcers on their prior assessment	Age younger than 65	CMI
					PSI-Subset 1-Diagnoses	
					More dependence in toileting	

					RUG Cognitive Impairment	
Restraints	RES01	Percent of residents in physical restraints	Residents who were physically restrained daily on their target assessment	Residents with valid assessments	None	ADL Long Form
Medication	DRG01	Percent of residents on antipsychotics without a diagnosis of psychosis	Residents who received antipsychotic medication on their target assessment	Residents with valid assessments excluding those with schizophrenia, Huntington's syndrome and hallucinations, and end-of-life residents	Motor agitation	CMI
					Moderate/impaired decision-making problem	
					Long-term memory problem	
					CPS	
					Combination Alzheimer's disease/other dementia	

3.4 Sample

The sample was limited to include only residents with HF. The QIs were calculated and reported by fiscal quarter for residents assessed between January 1st, 2011 and December 31st, 2013. For example, residents assessed between April 1st, 2011 and June 30, 2011 would provide information for calculating QIs for the first quarter of 2011. Residents with HF that had an end-stage disease, an expected survival of less than six months, receiving hospice care or in palliative units at admission assessment were excluded from the study. Assessments were included if they were conducted within 93 days between quarters. The QIs were calculated and analyzed among the 14 LHINs, in Ontario within each quarter. In addition to a facility identification code, each resident was also assigned a region number within the CCRS. Therefore, residents were not necessarily followed over time. For example, the residents evaluated in quarter 2 of 2011 may not be the same residents evaluated in quarter 3 of 2011 depending on the number of deaths, discharges, and/or new admissions between quarters. This was done to ensure an appropriate denominator sample size per QI and to illustrate the variability in QI scores among and within LHINs.

3.5 Analysis

Calculating QIs

In order to calculate the raw QI, individual level assessment data was first used to calculate the numerator and denominator of each QI. Each resident was assigned a score of 1 if he or she experienced the issue of interest in the numerator (e.g., mood score got worse) and summed within each LHIN. Next, for calculating a QI score at the LHIN level, the total number of residents at risk for the QI (e.g., all residents whose mood score could get worse) was summed for the denominator. For example the following formula was applied to each LHIN to calculate the *percent of residents who fell in the last 30* days, a prevalence QI

$$= 100 \times \frac{\textbf{Number of residents with HF who had a fall in the last 30 days recorded on quarterly assessment}}{\textbf{Total number of residents with HF with a valid assessment}}$$

To calculate an incidence QI, such as *percent of residents whose cognitive ability worsened*:

$$= 100 \times \frac{\textbf{Number of residents with HF with a higher CPS score on their target compared with prior assessment}}{\textbf{Residents with valid assessments whose score on the CPS was between 0 and 5 out of 6}}$$

The 35 QI scores across all LHINs were used to demonstrate variability between them by quality domain. The comparison is helpful in determining the domains of quality in which Ontario LTCHs within each LHIN are excelling or are in need of improvement, as well as to show variance in performance amongst all LHINs. Two steps were carried out to understand the

overall variability in QI scores among LHINs over time: 1) the adjusted QI scores for each LHIN were calculated within each quarter; 2) the aggregated median, interquartile range, and range in QI scores for each LHIN were calculated and plotted in a Box and Whisker Plot. The median scores were calculated in each QI per LHIN to compare quality performance amongst LTCHs located in the same region.

Next, the adjusted QIs were calculated for each LHIN in each of the 10 fiscal quarters. The median, interquartile range, and range in LHIN QI scores were then calculated across the 10 quarters to describe the distribution of the QI scores over time for each LHIN. Scores below the first quartile represents LHIN QI scores that were ranked in the lowest 25% of all scores for that LHIN, while the upper quartile represents the highest scores achieved by that LHIN over 10 quarters.

3.6 Results

Figure 3 provides a snapshot of quality of care between 2011 and 2013, showing the range in LTCH QI scores among LHINs among 5929 residents with HF. For instance, quality of care was not consistently high or low among residents in each LHIN, differing in performance across domains of quality. Of the quality indicators, decline in ADL self-performance was highest (Median: 39.6%). Approximately a third of residents had decline in mood from symptoms of depression (26.7%) and were on prescriptions of anti-psychotics without symptoms of psychosis (29.3%), while a quarter had respiratory infections (24.7%). On the other hand, other conditions were less common such as: improvement (8.9%) and deterioration of cognitive skills (5.6%), stage 2 and 4 pressure ulcers (2.9%) utilization of feeding tube (2.1%), indwelling catheters

(3.8%), as well as bowel incontinence (1.6%). Comparison of individual QI scores over time showed that there was much variability over quarters. **Figure 3** demonstrates that for many QIs there were outliers in high and low quality performance among residents with HF, as shown by the differences between the upper and lower whiskers in the box plots. However, the interquartile ranges (25th and 75th percentile) show that the majority of the QI scores were evenly distributed above and below the median for each LHIN. However, the wider the range, the greater the variability of performance amongst LHINs, with some QIs showing greater variability in scores than others: for example rates of respiratory infection (25th percentile: 21.1%, 75th percentile: 29.4%) vs. urinary incontinence (25th percentile: 5.5%, 75th 6.8%)

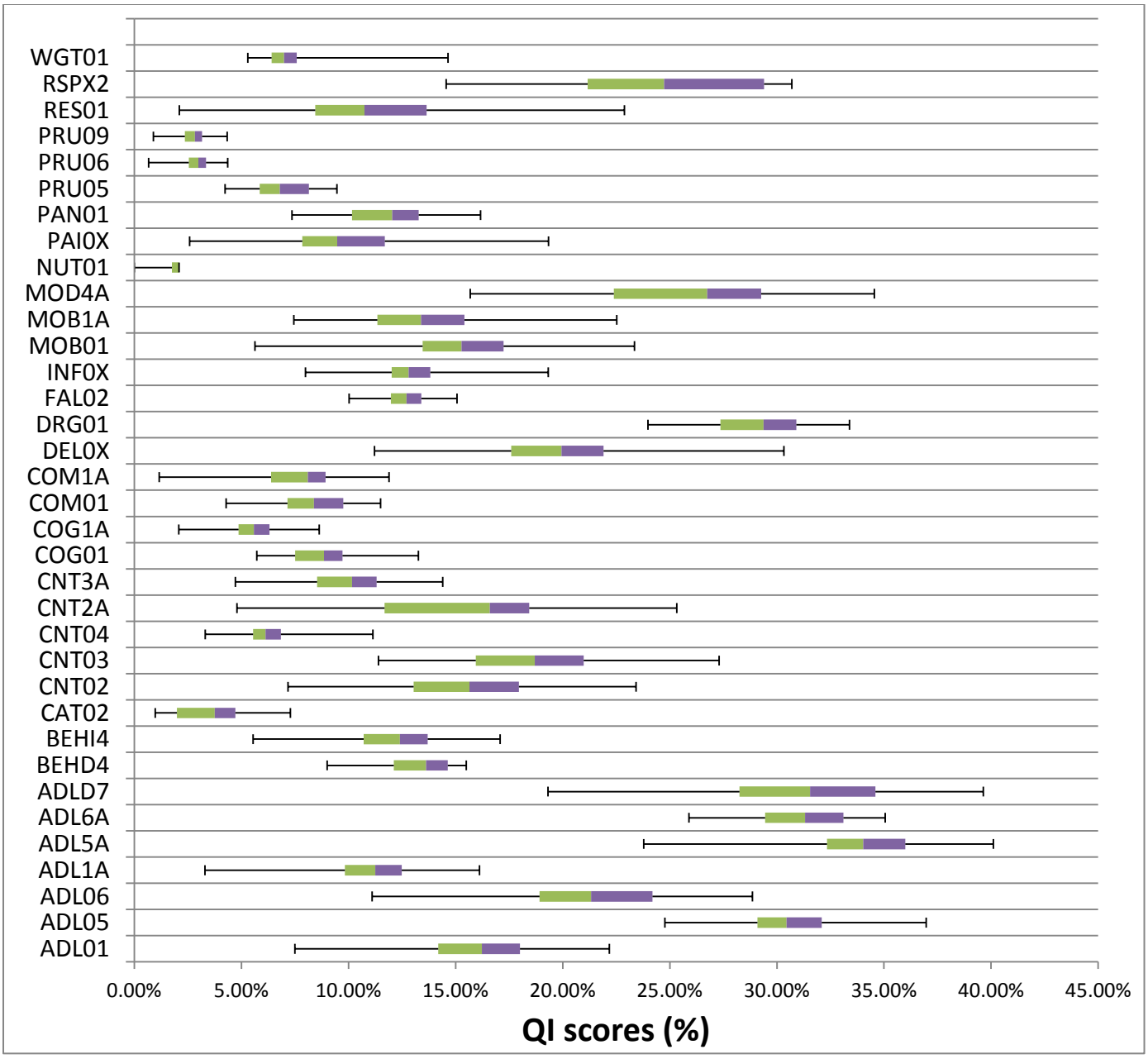

Figure 3 Aggregated median, inter-quartile range, and range in quality indicator scores among LHINs in Ontario between January 2011-December 2013 among all residents with HF.

Legend:

ADL01=	Percent of residents who had an unexpected loss of function in some basic daily activities
ADL05 =	Percent of residents whose status improved on mid-loss ADL functioning (transfer and locomotion) or remained completely independent in mid-loss ADLs
ADL06 =	Percent of residents whose status improved on early-loss ADL functioning (dressing and personal hygiene) or remained completely independent in early loss ADLs
ADL1A =	Percent of residents who had an improvement of function in some basic daily activities
ADL 5A=	Percent of residents whose status declined on mid-loss ADL functioning (transfer or locomotion) or remained completely independent in mid-loss ADLs
ADL6A =	Percent of residents whose status declined on early-loss ADL functioning (dressing and personal hygiene) or remained completely dependent in early loss ADLs
ADL7D =	Percent of residents whose ADL self-performance declined
BEHD4 =	Percent of residents whose behavioural symptoms declined
BEHI4 =	Percent of residents whose behavioural symptoms improved
CAT02 =	Percent of residents with indwelling catheters
CNT02 =	Percent of residents whose bowel continence worsened
CNT03 =	Percent of residents whose bladder continence worsened with ostomy
CNT04 =	Percent of residents with a urinary tract infection
CNT2A =	Percent of residents whose bowel continence improved
CNT3A =	Percent of residents whose bladder continence improved
COG01 =	Percent of residents whose cognitive ability worsened
COG1A =	Percent of residents whose cognitive ability improved
COM01 =	Percent of residents whose ability to communicate worsened
COM1A =	Percent of residents whose ability to communicate improved
DEL0X =	Percent of residents with symptoms of delirium

FAL02 =	Percent of residents who fell in the last 30 days
INF0X =	Percent of residents with infections
RSPX2 =	Residents who developed a respiratory infection or have not gotten better
MOB01 =	Percent of residents whose ability to locomote worsened
MOB1A =	Percent of residents whose ability to locomote improved
MOD4A =	Percent of residents who declined in mood from symptoms of depression
NUT01 =	Percent of residents with a feeding tube
WGT01 =	Percent of residents who had unexplained weight loss
PAI0X =	Percent of residents with pain
PAN01 =	Percent of residents whose pain worsened
PRU05 =	Percent of residents who had a pressure ulcer at stages 2 to 4
PRU06 =	Percent of residents who had a worsened pressure ulcer at stages 2 to 4
PRU09 =	Percent of residents who had a newly occurring pressure ulcer at stages 2 to 4
RES01 =	Percent of residents in physical restraints
DRG01 =	Percent of residents on antipsychotics without a diagnosis of psychosis

Figures 4a-4i reflect the distribution of selected QI score between the years 2011-2013 by LHINs. Some QIs scores showed very little variation over time within regions (as shown by interquartile range). For example, in the Mississauga-Halton region, the rates of anti-psychotic medication use ranged from 30.5%, at the 25th percentile, to 30.8% in the 75th percentile. On the other hand, some regions demonstrated greater variations over quarters, such as ADL decline in the Central West region, which ranged from 23.6% to 35.7% (25th and 75th percentile, respectively). When comparing QI scores among LHINs, in certain aspects of quality, some

regions had lower median rates, while others had higher scores. For example, mood decline in Toronto Central was at 17.1% in contrast to 30.3% in the Waterloo-Wellington region. Similarly, the Toronto-Central region had lower median rates of delirium in comparison to the North-West (13.2% vs. 23.9%). However, performance in some aspects of quality remained showed less variability across LHINs such as rates of falls, with median scores ranging from 11.0% in Toronto-Central to 14.9% in the Central-West region.

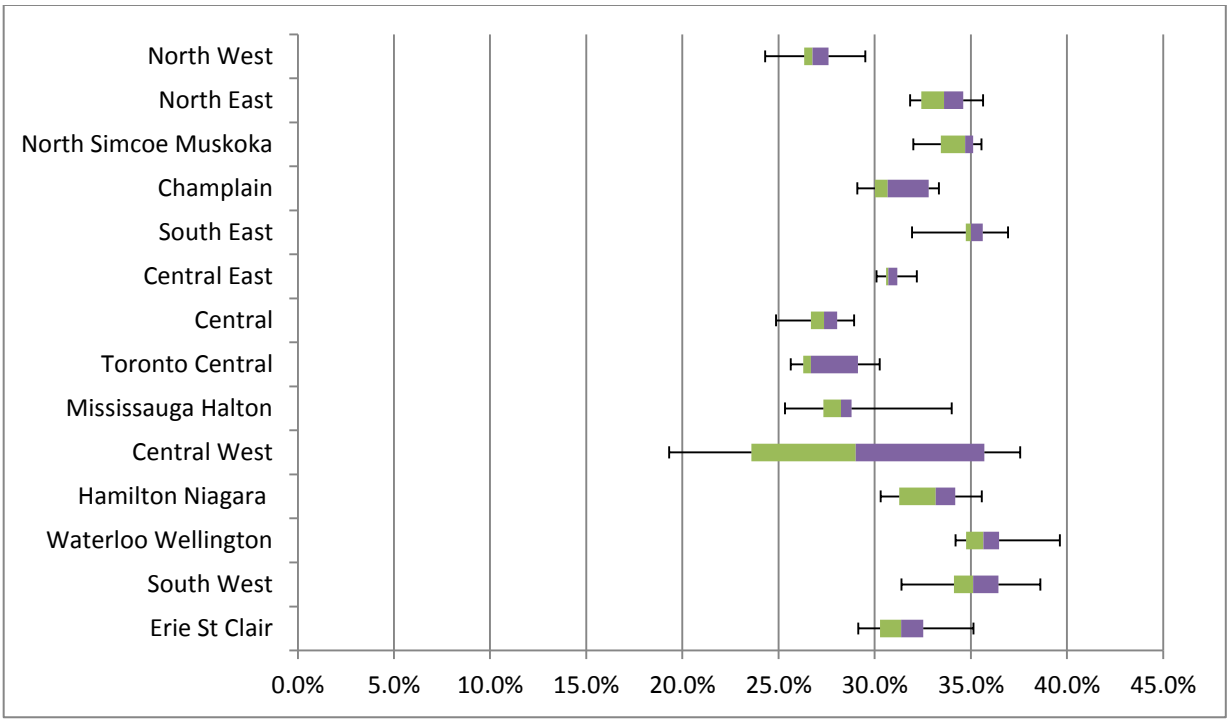

Figure 4a Median, interquartile range, and range of ADL decline QI scores for each LHIN across quarters between 2011-2013

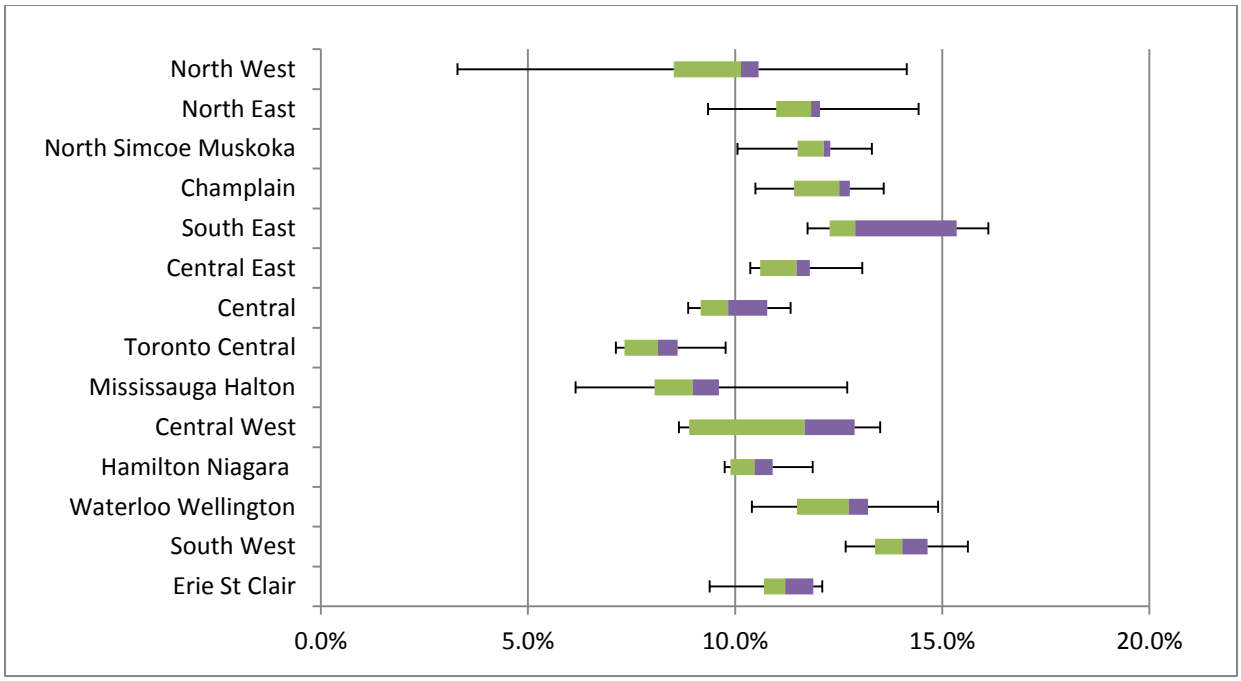

Figure 4b Median, interquartile range, and range of ADL improvement scores for each LHIN across quarters between 2011-2013

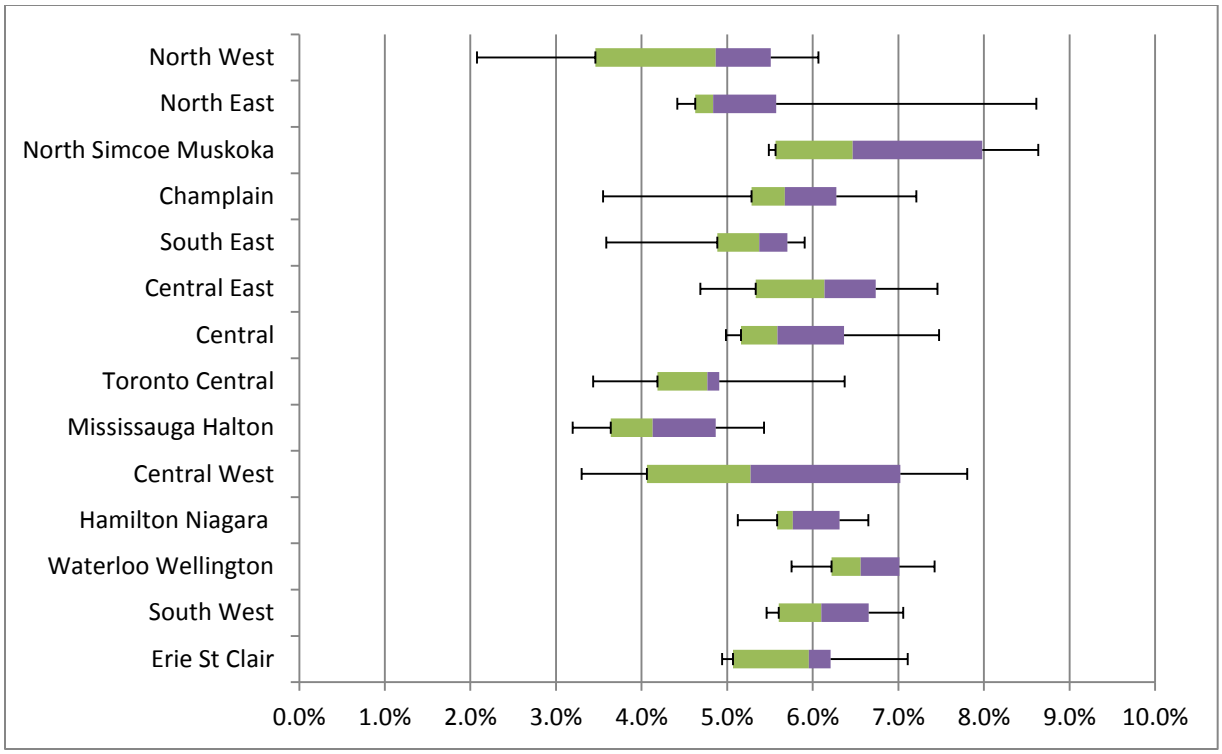

Figure 4c Median, interquartile range, and range of cognitive improvement scores for each LHIN across quarters between 2011-2013

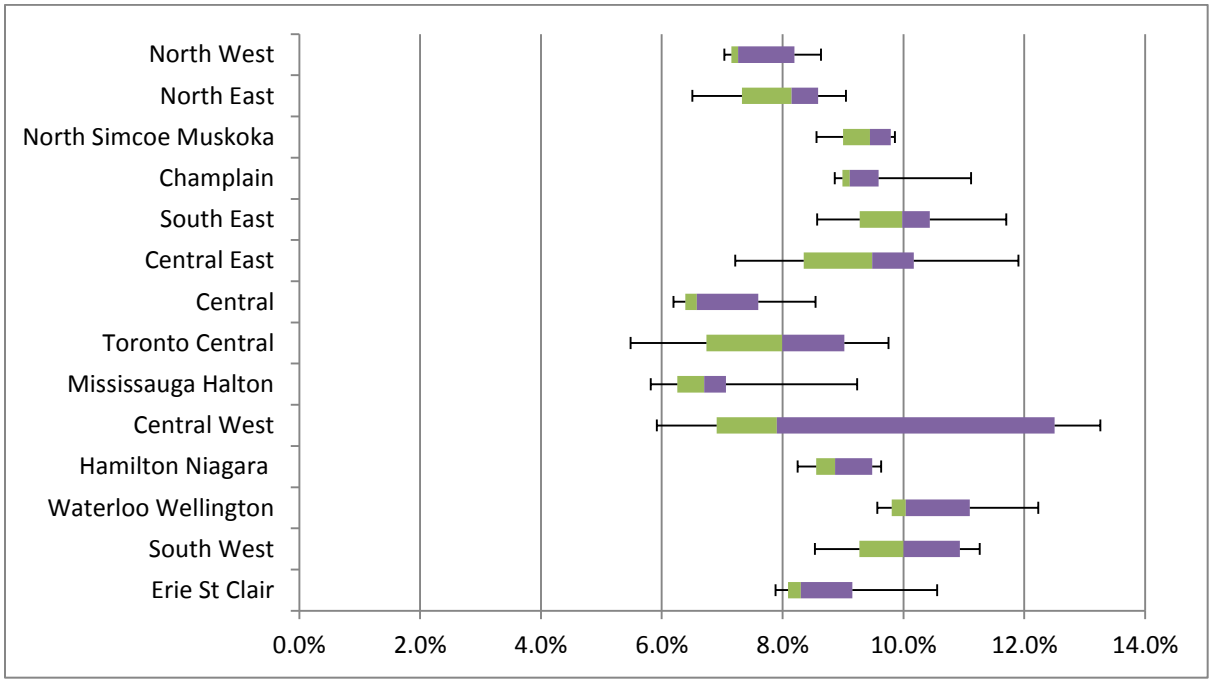

Figure 4d Median, interquartile range, and range of cognitive decline scores for each LHIN across quarters in 2011-2013

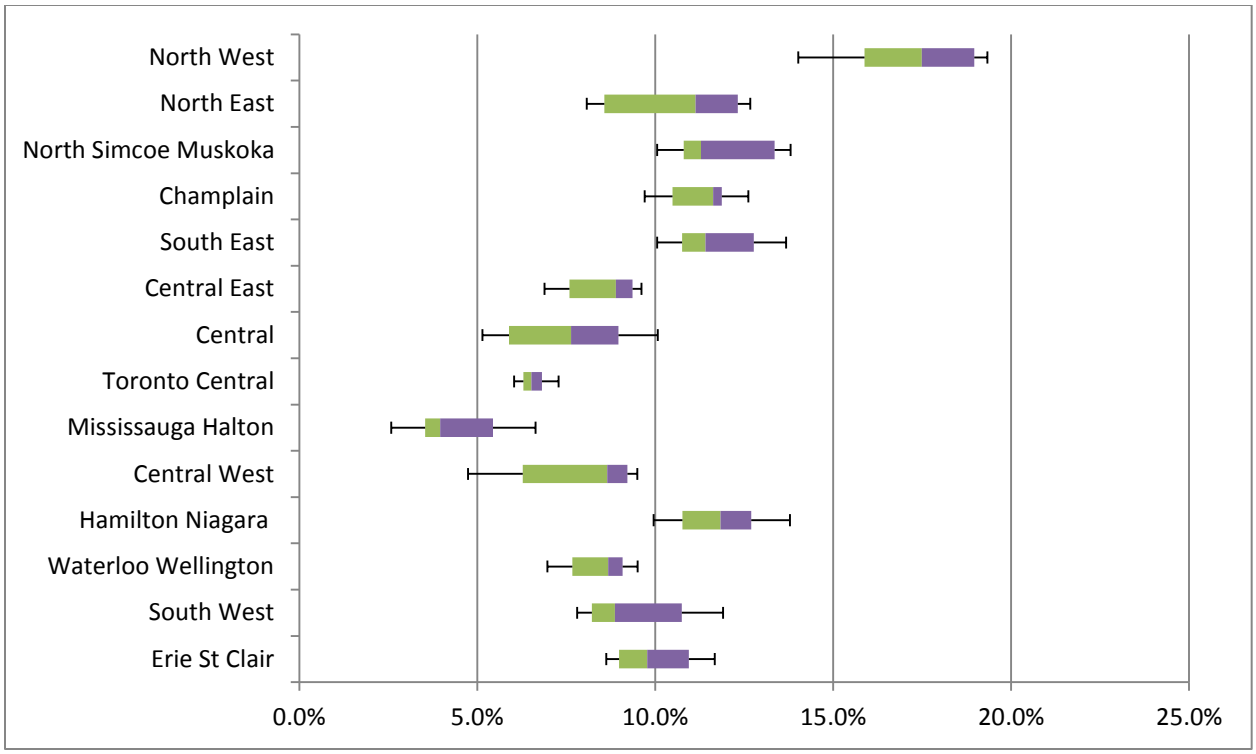

Figure 4e Median, interquartile range, and range of pain scores for each LHIN across quarters between 2011-2013

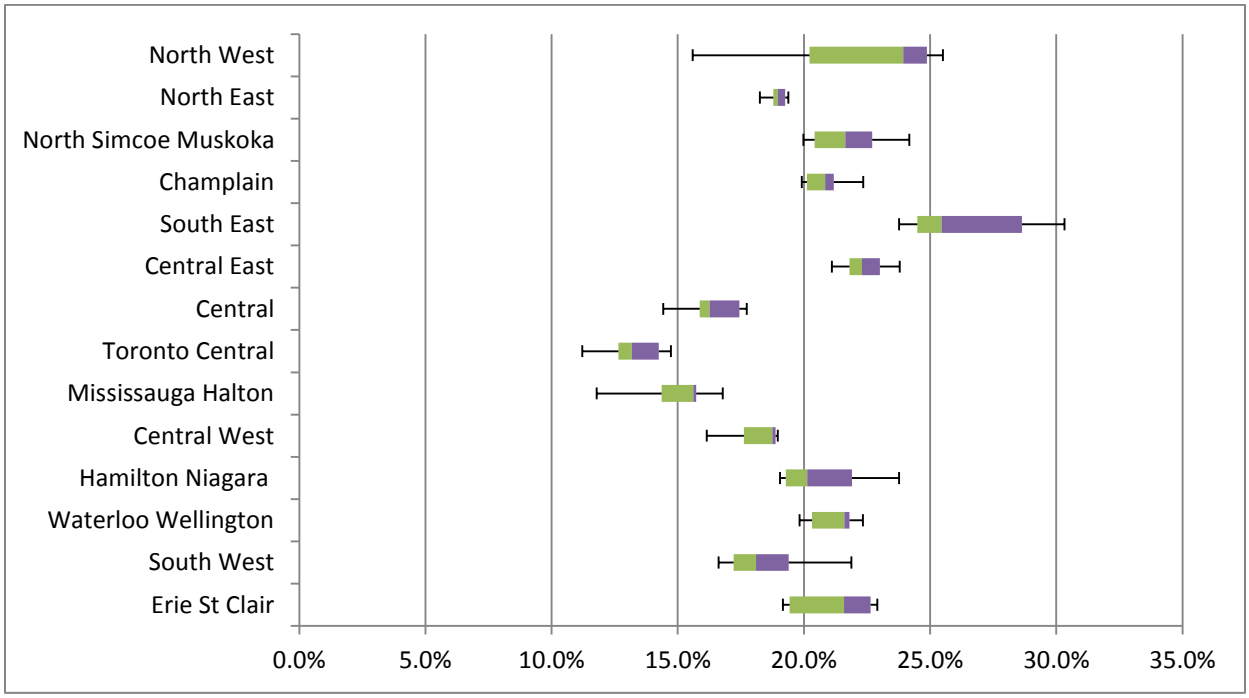

Figure 4f Median, interquartile range, and range of delirium QI scores for each LHIN across quarters between 2011-2013

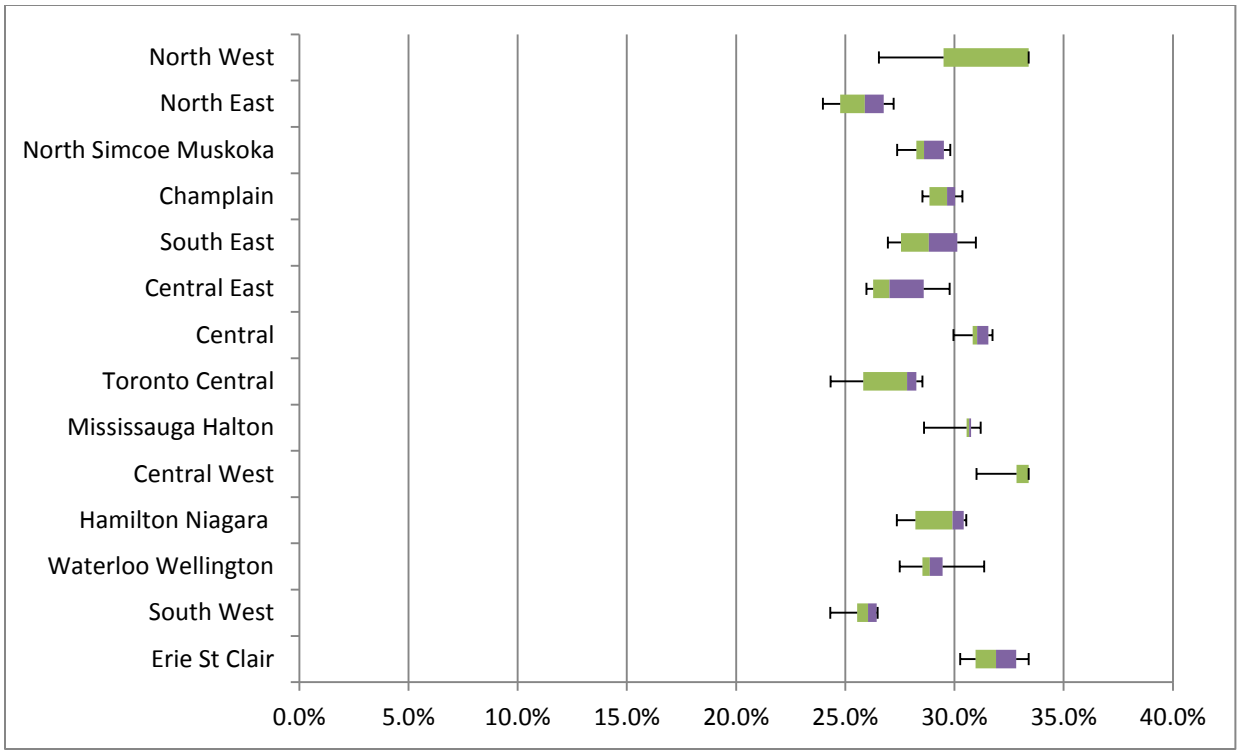

Figure 4g Median, interquartile range, and range of anti-psychotic medication QI scores for each LHIN across quarters between 2011-2013

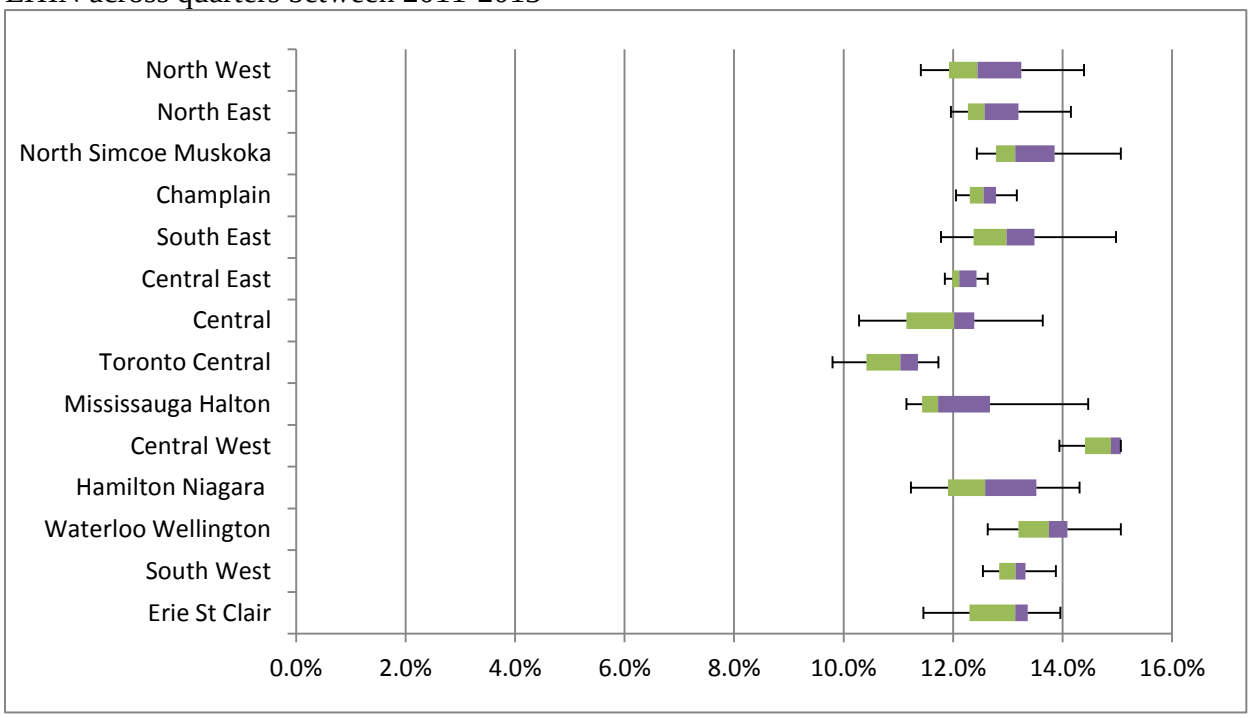

Figure 4h. Median, interquartile range, and range of falls in the last 30 days QI scores for each LHIN across quarters between 2011-2013

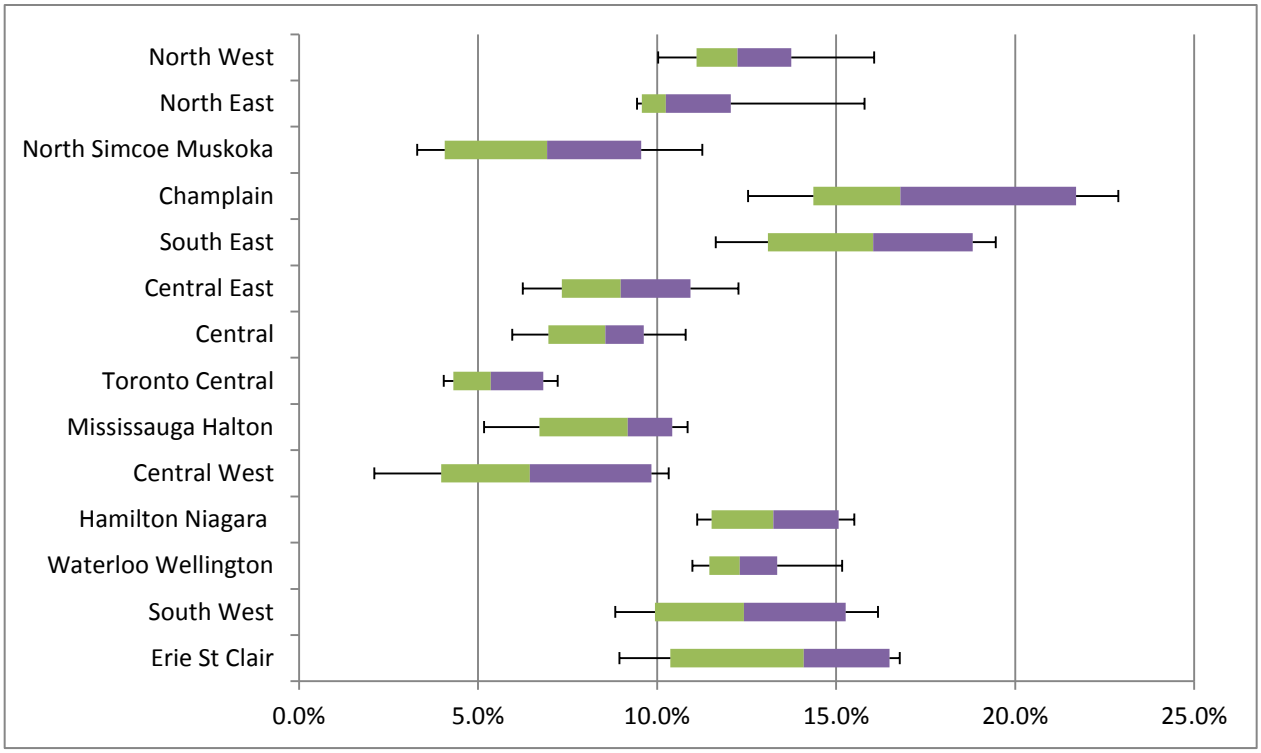

Figure 4i Median, interquartile range, and range of restraint use QI scores for each LHIN across quarters between 2011-2013

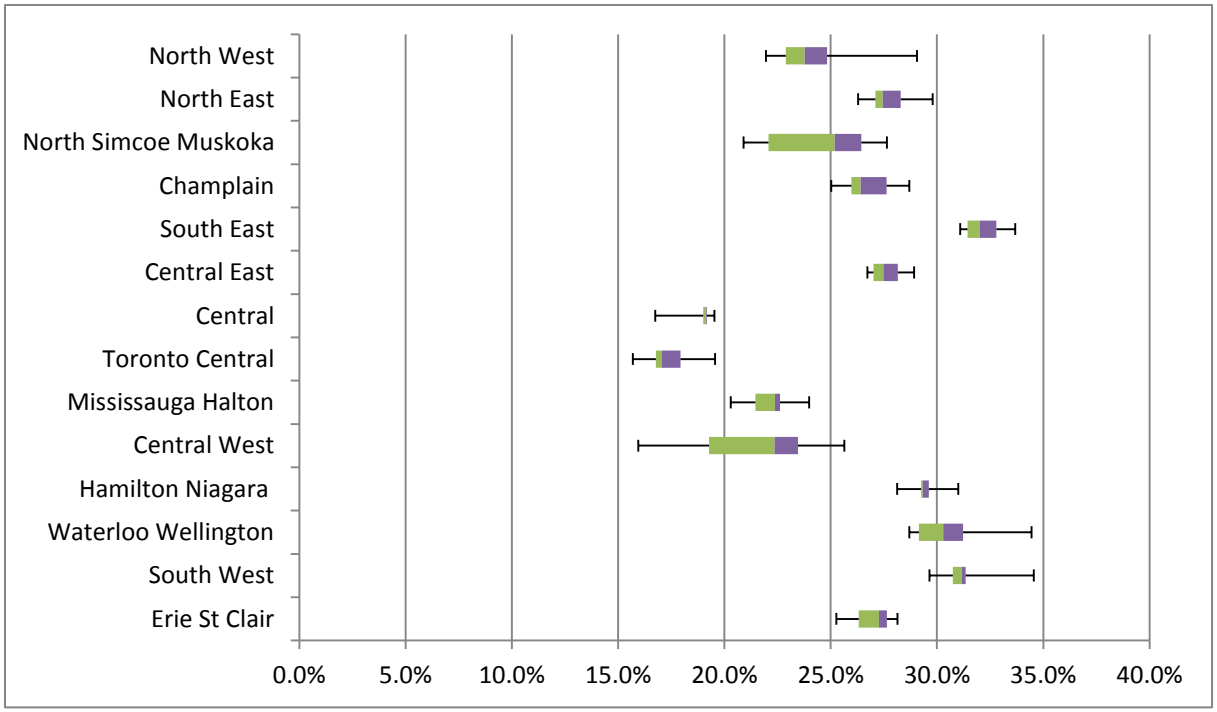

Figure 4j Median, interquartile range, and range of mood decline scores for each LHIN across quarters between 2011-2013

V. DISCUSSION

This study described the clinical characteristics of residents living with HF in Ontario LTCHs. Findings from this study are consistent with those of previous studies describing the complex clinical profile of residents with HF in LTCH. Residents were found to have high levels of polypharmacy, comorbidities, health instability and functional limitations (Heckman et al. 2004, Foebel et al., Hutt et al., Gambassi et al. 2000). However, some divergent findings also exist. The prevalence of HF in was 12.3%, which is lower than what has been found by other studies (Hancock et al., 2013; Foebel et al., 2013; Daamen et al., 2010). The difference in prevalence may be related to how a diagnosis was determined. In other studies the diagnosis was determined through medical charts and guideline based physical assessments. The MDS items on HF have been found to have high sensitivity to HF diagnosis in LTC in comparison to hospital administrative databases (Wodchis et al., 2008). Given that the MDS is used for assessment purposes, it may be argued that under optimal diagnostic settings, individuals with HF would be accurately identified. However, poor implementation of HF screening guidelines and lack of knowledge of HF symptoms in nursing staff has been documented in nursing homes (Marcella et al., 2012). Previous studies have cited poor communication between nursing homes and hospitals: given that a significant proportion of residents with HF are admitted from hospitals, it could be that inadequate sharing of clinical information between the care settings could result in further difficulty in HF detection (Heckman et al., 2013). In addition, HF in frail older adults may show atypical symptoms such as delirium and impairment in cognition, thus complicating detection and increasing likelihood of under-diagnosis (Heckman et al., 2004). Other HF symptoms such as fatigue, low energy and appetite might be misdiagnosed as depression and result in treatment with anti-depressants (Heckman et al., 2006). On the other hand, anti-

depressant use among patients with HF has been previously associated with death and other adverse outcomes such as femoral fractures (Huybrechts et al. 2011). This may be concerning in this sample as a high rate of anti-depressant use (41.8%) was found among residents with HF.

Interestingly, residents had slightly lower levels of cognitive impairment in comparison to those without HF, despite literature indicating this to be a significant aspect of HF manifestation in older adults (Heckman et al., 2007). A study by Foebel and colleagues (2013) compared levels of cognitive performance in the two populations and did not find a significant difference. A potential explanation is that cognitive impairment is difficult to screen in older adults living with HF and as a result, it can be often misidentified as dementia (Heckman et al., 2007). Further, it could be possible that residents with undetected HF (misclassified as 'non-HF') were more accurately identified as cognitively impaired than those previously diagnosed. It should be noted however, that in both residents with and without HF, a high proportion had scores of over three (40% vs. 52.3%), suggesting that mild to high cognitive impairment is a prevalent issue that needs to be addressed in all residents living in LTCHs.

Another important finding was that residents with HF were significantly more likely to be admitted from hospitals to LTCHs than those without HF, this was also the case in studies by Foebel and colleagues (2013) and Heckman and colleagues (2004). Previous literature suggests that some of the contributing reasons of institutionalization is the lack of coordinated and specialized HF care in the community (Aldred et al., 2005). Others attribute this to difficulties with disease management faced by community dwelling older adults living alone with functional impairment (Mahoney et al., 2000). Indeed, admission from a hospital into LTC was found to be the strongest predictor of subsequent hospitalization in our study. Older adults that are hospitalized for HF and that are more likely to be discharged into nursing homes, have poorer

health in comparison to those discharged to the community (Allen et al., 2011). This could explain the increased likelihood of further hospitalization upon admission. It should also be noted that in our sample, health instability and frailty, as measured by the CHESS scale, also increased likelihood of hospitalization. However, since we excluded residents in palliative or hospice care, as well as residents that did not have a full admission assessment (within 14 days of admission), it may be that our sample did not include residents with greater instability who would have died soon after admission to LTC. In a study by Hutt and colleagues (2003), 21.1% of residents with HF died within 90 days of admission, suggesting high attrition rates in this population.

There is evidence that resident admissions to hospitals generally occur after an acute medical incident in nursing homes (Bowman et al. 2001). Our results showed that monitoring of acute medical illness and frequent physician visits predicted hospitalization. This suggests that prior to discharge to a hospital, residents with HF are receiving clinical attention for acute conditions. It should be noted that since we lacked information on exact time since hospitalization, it is difficult to ascertain whether residents were hospitalized soon after receiving medical care or long after. Similarly, details on the type of acute illness were also lacking. Interestingly, Bowman and colleagues (2001) determined that a significant proportion of hospital admissions due to acute illness were avoidable through effective management of HF. This is problematic given that over a third of residents living with HF in our sample had at least one hospitalization. While guideline recommended treatment of HF using therapies such as ACE inhibitors and beta-blockers have been shown to improve the functional status of residents and reduce probability of adverse events such as hospitalization, studies show that HF management

remains suboptimal in LTCHs (Foebel et al., 2013, Marcella et al., 2012, Shibata et al., 2005, Pedone et al., 2004, Gambassi et al., 2000).

Evidence from our results of QI performance among LHINs suggests that there continues to be room for improvement in providing care for residents with HF, particularly in terms of functional decline, symptoms of depression and prescription of anti-psychotics. Hirdes and colleagues (2011) measured quality of care in all nursing home residents of Ontario between 2009-2010 and found similar rates of QI scores in these domains of care. What this suggests is that some nursing homes within regions face particular challenges in addressing these aspects of quality uniformly across conditions. However, special considerations need to be given to the complex care needs for residents living with HF. Functional declines, a risk factor for frailty, is a particular issue for residents with HF given it's interaction with other geriatric syndromes. Evidence shows that they are associated with death in nursing homes, therefore suggesting the need for adequate monitoring (Lee et al., 2009, Tjam et al., 2012). In addition, functional decline could also influence other processes of care, with poor ADL status previously documented to increase likelihood of restraint use (Phillips et al., 1998). Perhaps the most troubling were the high rates of anti-psychotic use without indication of psychosis in our sample. Atypical symptoms of HF such as delirium and agitation from cognitive decline may result in treatment with antipsychotics, which have been shown to increase risk of adverse outcomes such as death (Foebel et al., 2013). The National Health Service of UK commissioned a report on the use of antipsychotics to treat dementia and highlighted their excessive prescription, suggesting the need to reform this clinical practice in nursing homes through better training and improving interdisciplinary care delivery (Banerjee, 2009).

Another important finding was the variability of quality of care among LHINs, with some regions demonstrating low QI scores on certain aspects of quality in comparison to others. Larger urban regions such as the Toronto-Central LHIN and Mississauga-Halton LHIN tended to have lower rates of depression symptoms and delirium in comparison to regions with comparatively smaller sized towns such as the Southeast and Waterloo-Wellington region. It should be noted that this pattern was not consistently found across other QIs, suggesting that performance is not uniform across quality domains or regions. Literature has found quality of care to vary by geographic locations of nursing homes (Kleijer et al., 2013; Coburn et al., 2002). Differences in quality of care between rural and urban homes have been previously documented, with hospitalization rates significantly higher in rural LTCHs. Coburn and colleagues (2002) found that rural residents had a significant risk for multiple hospital admissions in the U.S. Another study by Phillips and colleagues (2004) demonstrated that clinical outcomes such as pressure ulcers and urinary tract infections occurred more frequently in nursing homes located in large towns compared to urban cities. The authors suggest that these disparities in care quality can be attributed to the care setting, rather than the physical location of the nursing home (Phillips et al., 2004). Kang and colleague (2011) explain that rural nursing homes are less likely to have specialized care programs for residents, high staffing levels, or accreditation: all important structural measures of care. Indeed, nursing homes with special care units, higher physicians and other staff ratio such as nurse practitioners and physician assistants, are better equipped to provide optimal care to residents and therefore less likely to hospitalize residents (Intrator et al., 1999). Phillips and colleagues (1996) note that the differences in regional LTC performance highlight the importance of understanding the complex context of nursing homes and its influence on care. These differences could be rooted in various individual, environmental

and organizational factors of the long-term care system, including: interprofessional cultures, role of leadership, provider self-efficacy and skills, internal facility or external government policies, reimbursement incentives, presence of a champion of quality improvement initiatives, and strict accountability and regulatory structures (Phillips et al., 1996, Berta et al., 2005). It should be noted that because this study pooled MDS assessments from nursing homes and stratified the QI scores by region; information was lacking on specific facility characteristics that could potentially explain the variability in quality of care. Rather, the study identified issues facing residents with HF in LTC across different regions; however, further research is needed to explore what aspects of the nursing home contribute to poor quality.

VI. LIMITATIONS

This study has several limitations. As previously discussed, HF diagnosis was ascertained from secondary retrospective MDS admission assessments; this may have led to undetected cases. A recent study by Heckman and colleagues (2013) demonstrated the utility of using LTC admissions data to correctly diagnose HF. Some of the information used in that study included medical history information, demographic data, HF signs and symptoms and most recent diagnostic investigations. Potentially, future studies can use similar MDS items in conjunction with assessments from trained nurses and reviews from medical records to accurately ascertain HF diagnosis. Our study also categorized scores on clinical scales rather than using continuous measures to describe the clinical characteristics that predicted hospitalization. This may have led to loss of information from dividing scores into different categories. However, categorizing the scales was beneficial for ease of interpretation and in classifying residents by severity of conditions through cut points.

We found that previous admission from hospital settings to be the strongest predictor of subsequent hospitalization from LTC. However, residents who were previously admitted to LTCHs from a hospital setting were not excluded from our sample: one of the reasons for doing so was that they comprised a significant proportion of residents with HF. As well, previous studies investigating hospitalization as an outcome of interest in LTCHs did not exclude this subset of the population (Hutt et al., 2011, Ahmed et al., 2003).

The scope of this study was limited and did not investigate the association of HF management practices with hospitalization. However, aside from the information on medications, the MDS assessments contained significant amounts of missing data on the specific

types of medication residents were prescribed, making this difficult to ascertain for the purpose of our study.

There were several limitations with the analysis of QIs. It is possible that the QIs underestimated the prevalence of some conditions in the facilities. For instance, the depression QI was found to under-report the condition, particularly in homes that had low prevalence rates (Simmons et al., 2004). Although approximately a third of residents with HF showed symptoms of depression, evidence indicates this rate could be an underestimation of the actual rate. Schnelle and colleagues (2001) suggest that the inadequacy of staff skills in detecting depression symptoms, rather than the depression QI that could influence the reporting of the condition.

Another limitation is that distribution of QI scores were demonstrated over quarters to show variability. However, box and whisker plots were used to depict distribution of quarterly scores over two fiscal years. Therefore, without showcasing specific scores per quarter, it is difficult to analyze trends in quality domains over time. For instance, we could not determine whether residents in each LHIN in Ontario showed a decline in restraint use in residents with HF from a specific quarter to another. Secondly, the analysis showed a cross-sectional view of QI scores as residents were not followed over time; with the exception of incidence QIs, which required a target quarter and a previous quarter for calculation. Therefore, this provided a snapshot of quality of care for residents with different lengths of stay in LTCHs, rather than following a specific cohort over time.

VII. STRENGTHS AND IMPLICATIONS

This is one of the first studies to examine similarities and differences in the characteristics of residents with and without HF. The data included all homes regulated by MOHLTC, submitting MDS data to CCRS. Therefore, a representative group of facilities and residents with HF were included and the results may be generalizeable to provinces with a similar LTC system to that of Ontario.

To date, prevalence of HF in nursing homes has only been established in three regions of Ontario (Hamilton, Cambridge and Kitchener-Waterloo): little is known of other geographic locations (Heckman et al., 2004; Foebel et al., 2013). One of the objectives of this study was to establish the disease prevalence through representing LTCFs in all regions of Ontario. Literature on care quality of this population in LTC has solely focused on HF-specific outcomes and processes of care (Heckman et al, 2004; Gambassi et al., 2000; Hutt et al, 2003; Hutt et al., 2002; Dolansky et al., 2013; Quinn et al., 2013; Foebel et al., 2013). Despite hospitalization in older adults with HF being extensively measured, it is currently not a validated and risk adjusted QI in the MDS. Hospitalization is an important aspect of quality of care in residents with HF. This is particularly so given that literature has shown that majority of hospitalizations are avoidable through adequate disease management in nursing homes (Bowman et al., 2001). Admission to hospitals also increases risk of adverse outcomes from poor transitions between care settings, further suggesting the need to monitor this practice. Our study can contribute to future research on developing hospitalization as an indicator of care by providing insight on the admission clinical characteristics that predict this outcome. This can also serve as beneficial in identification and care planning of residents that are likely to be hospitalized.

The MDS QIs provided an opportunity to consistently assess and compare quality for residents with HF across regions, as well as to identify areas that should be targeted by quality improvement initiatives. Studies have shown that the QI are sensitive to differentiating prevalence of conditions in facilities scoring in upper and lower quartiles such as prevalence of pain and pressure ulcers (Cadogan et al., 2004; Bates-Jensen et al., 2003). Identifying regions that are poor performers in certain quality domains is helpful to inform large-scale priority planning for quality improvement initiatives in the province. While the purpose of our study was not to identify definite quality problems, results of QI scores can serve as indicators of potential issues in LTC. This can contribute to future systematic efforts of determining the underlying causes for some of the care problems (Zimmerman, 1997).

Finally, comparison of quality by region is an important aspect of policy planning and resource allocation. However, because QI scores were aggregated to the LHIN level and information on structural measures of LTCHs such as staffing levels and training, availability of resources, was not available. Future research should explore these factors in order to identify what aspects of the facilities are associated with quality deficiencies.

VIII. CONCLUSION

This work shows that residents with HF living in Ontario comprise a subset of the LTC population with complex clinical characteristics. Study findings on admission characteristics predictive of hospitalization can inform future research developing a risk adjusted QI measuring hospitalization in this population. The implications of this include early identification of residents facing higher likelihood of hospitalization, as well, detection of LTC practices that result in avoidable admissions. Outcomes and processes of care in nursing homes for residents with HF show that there is a need for improvement in domains of functional ability, anti-psychotic use, anti-depressants and depressive symptoms. This highlights the need to explore the aspects of LTC settings that contribute to these findings. While little is known about the role of geography and quality of care, variability in quality of care across and within LHINs emphasizes the need to further explore the role of contextual factors, particularly at the systems, organizational and provider level.

REFERENCES

1. Ahmed, A., Allman, R. M., & DeLong, J. F. (2003). Predictors of nursing home admission for older adults hospitalized with heart failure. *Archives of gerontology and geriatrics*, *36*(2), 117-126.

2. Aldred, H., Gott, M., & Gariballa, S. (2005). Advanced heart failure: impact on older patients and informal carers. *Journal of advanced nursing*, *49*(2), 116-124.

3. Allen, L. A., Hernandez, A. F., Peterson, E. D., Curtis, L. H., Dai, D., Masoudi, F. A., ... & Fonarow, G. C. (2011). Discharge to a skilled nursing facility and subsequent clinical outcomes among older patients hospitalized for heart failure. *Circulation: Heart Failure*, *4*(3), 293-300.

4. American Heart Association Heart Failure. (2014). AHA: Texas. Retrieved from: http://www.heart.org/HEARTORG/Conditions/HeartFailure/HeartFailure_UCM_002019_SubHomePage.jsp

5. Arling, M. L. (1997). Management of heart failure in nursing facility residents according to AMDA guidelines. *Nurs Home Med*, *5*, 374-80.

6. Arnold, J. M. O., Liu, P., Demers, C., Dorian, P., Giannetti, N., Haddad, H., ... & White, M. (2006). Canadian Cardiovascular Society consensus conference recommendations on heart failure 2006: diagnosis and management. *Canadian Journal of Cardiology*, *22*(1), 23-45.

7. Arnold, J. M. O., Howlett, J. G., Ducharme, A., Ezekowitz, J. A., Gardner, M. J., Giannetti, N., ... & White, M. (2008). Canadian Cardiovascular Society Consensus Conference guidelines on heart failure–2008 update: Best practices for the transition of care of heart failure patients, and the recognition, investigation and treatment of cardiomyopathies. *Canadian Journal of Cardiology*, *24*(1), 21-40.

8. Armstrong, J. J., Stolee, P., Hirdes, J. P., & Poss, J. W. (2010). Examining three frailty conceptualizations in their ability to predict negative outcomes for home-care clients. *Age and ageing*, *39*(6), 755-758.

9. Aronow, W. S. (2006). Epidemiology, pathophysiology, prognosis, and treatment of systolic and diastolic heart failure. *Cardiology in review*, *14*(3), 108-124.

10. Banerjee, S. (2009). The use of antipsychotic medication for people with dementia: Time for action. *London: Department of Health*.

11. Barents, M., Boersma, F., Van Der Horst, I. C., Hillege, H. H., & de Jongste, M. J. (2011). Increase of Help at Activities of Daily Life Given to Frail Elderly With Chronic Heart Failure in a Nursing Home. *Activities, Adaptation & Aging*, *35*(2), 98-110.

12. Bates-Jensen, B. M., Cadogan, M., Osterweil, D., Levy-Storms, L., Jorge, J., Al-Samarrai, N., ... & Schnelle, J. F. (2003). The minimum data set pressure ulcer indicator: does it reflect differences in care processes related to pressure ulcer prevention and treatment in nursing homes?. *Journal of the American Geriatrics Society*, *51*(9), 1203-1212.

13. Berta, W., Laporte, A., & Valdmanis, V. (2005). Observations on institutional long-term care in Ontario: 1996–2002. *Canadian Journal on Aging*, *24*(01), 71-84.

14. Boockvar, K., Signor, D., Ramaswamy, R., & Hung, W. (2013). Delirium during acute illness in nursing home residents. *Journal of the American Medical Directors Association*, *14*(9), 656-660.

15. Bleumink, G. S., Knetsch, A. M., Sturkenboom, M. C., Straus, S. M., Hofman, A., Deckers, J. W., ... & Stricker, B. H. C. (2004). Quantifying the heart failure epidemic: prevalence, incidence rate, lifetime risk and prognosis of heart failure The Rotterdam Study. *European Heart Journal*, *25*(18), 1614-1619

16. Bliesmer, M. M., Smayling, M., Kane, R. L., & Shannon, I. (1998). The relationship between nursing staffing levels and nursing home outcomes. *Journal of Aging and Health*, *10*(3), 351-371.

17. Bowman, C. E., Elford, J., Dovey, J., Campbell, S., & Barrowclough, H. (2001). Acute hospital admissions from nursing homes: some may be avoidable.*Postgraduate Medical Journal*, *77*(903), 40-42.

18. Boyd, K. J., Murray, S. A., Kendall, M., Worth, A., Benton, T. F., & Clausen, H. (2004). Living with advanced heart failure: a prospective, community based study of patients and their carers. *European journal of heart failure*, *6*(5), 585-591.

19. Braunstein, J. B., Anderson, G. F., Gerstenblith, G., Weller, W., Niefeld, M., Herbert, R., & Wu, A. W. (2003). Noncardiac comorbidity increases preventable hospitalizations and mortality among Medicare beneficiaries with chronic heart failure. *Journal of the American College of Cardiology*, *42*(7), 1226-1233.

20. Brocco, S., Zamboni, M., Fantin, F., Marchesan, M., Schievano, E., Zambon, F., ... & Spolaore, P. (2010). Quality of care in congestive heart failure in the elderly: epidemiological evidence of a gap between guidelines and clinical practice. *Aging clinical and experimental research*, *22*(3), 243.

21. Brown, M. N., Lapane, K. L., & Luisi, A. F. (2002). The management of depression in older nursing home residents. *Journal of the American Geriatrics Society*, *50*(1), 69-76.

22. Brizioli, E., Bernabei, R., Grechi, F., Masera, F., Landi, F., Bandinelli, S., ... & Ferrucci, L. (2003). Nursing home case-mix instruments: validation of the RUG-III system in Italy. *Aging clinical and experimental research*, *15*(3), 243-253.

23. Buckley, N. A., & Sanders, P. (2000). Cardiovascular adverse effects of antipsychotic drugs. *Drug Safety*, *23*(3), 215-228.

24. Burrows, A. B., Morris, J. N., Simon, S. E., Hirdes, J. P., & Phillips, C. H. A. R. L. E. S. (2000). Development of a minimum data set-based depression rating scale for use in nursing homes. *Age and ageing*, *29*(2), 165-172.

25. Central Local Health Integrated Networks (2013). Creating Caring Communities: Advancing Excellence in Local Health Care Together. An Integrated Health Service Plan for the Central Local Health Integration Network 2013-2016. Central LHIN. Retrieved from: http://www.centrallhin.on.ca/goalsandachievements/~/media/sites/central/uploadedfiles/Home_Page/Integrated_Health_Service_Plan/ENG-Central_LHIN-IHSP-13-16_web.pdf

26. Cacciatore, F., Abete, P., Mazzella, F., Viati, L., Della Morte, D., D'Ambrosio, D., ... & Rengo, F. (2005). Frailty predicts long‐term mortality in elderly subjects with chronic heart failure. *European journal of clinical investigation*, *35*(12), 723-730

27. Canadian Institute for Health Information (2010). New Continuing Care Reporting System Quality Indicators by Quality Domain. CIHI: Canada.

28. Canadian Institute for Health Information (2012). A performance Measurement Frame for the Canadian Health System. CIHI: Canada. Retrieved from: https://secure.cihi.ca/free_products/HSP-Framework-ENweb.pdf

29. Caplan, G. A., Meller, A. Canadian Institute Health Institute. (2013). *National health expenditure trends, 1975-2013* .CIHI: Ottawa.

30. , Squires, B., Chan, S., & Willett, W. (2006). Advance care planning and hospital in the nursing home. *Age and ageing*, *35*(6), 581-585.

31. Castle, N. G. (2006). Mental health outcomes and physical restraint use in nursing homes {private}. *Administration and Policy in Mental Health and Mental Health Services Research*, *33*(6), 696-704.

32. Carruthers, E., Lewis, K., McCue, T., & Westley, P. (2008). Generalized linear models: model selection, diagnostics, and overdispersion

33. Cronin, H., & Kenny, R. A. (2010). Cardiac causes for falls and their treatment. *Clinics in geriatric medicine*, *26*(4), 539-567.

34. Creditor, M. C. (1993). Hazards of hospitalization of the elderly. *Annals of internal medicine*, *118*(3), 219-223.

35. Coburn, A. F., Keith, R. G., & Bolda, E. J. (2002). The impact of rural residence on multiple hospitalizations in nursing facility residents. *The Gerontologist*, *42*(5), 661-666.

36. Cadogan, M. P., Schnelle, J. F., Yamamoto-Mitani, N., Cabrera, G., & Simmons, S. F. (2004). A minimum data set prevalence of pain quality indicator: is it accurate and does it reflect differences in care processes?. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *59*(3), M281-M285.

37. Chesteen, S., Helgheim, B., Randall, T., & Wardell, D. (2005). Comparing quality of care in non-profit and for-profit nursing homes: A process perspective. *Journal of Operations Management*, *23*(2), 229-242.

38. Creditor, M. C. (1993). Hazards of hospitalization of the elderly. *Annals of internal medicine*, *118*(3), 219-223.

39. Dalby, D., Hirdes, J., & Fries, B. (2005). Risk adjustment methods for Home Care Quality Indicators (HCQIs) based on the minimum data set for home care. *BMC health services research*, *5*(1), 7.

40. Daamen, M. A., Schols, J. M., Jaarsma, T., & Hamers, J. P. (2010). Prevalence of heart failure in nursing homes: a systematic literature review. *Scandinavian journal of caring sciences*, *24*(1), 202-208.

41. Dodson, J. A., & Chaudhry, S. I. (2012). Geriatric Conditions in Heart Failure. *Current Cardiovascular Risk Reports*, *6*(5), 404-410.

42. Donabedian, A. (1966). Evaluating the quality of medical care. *The Milbank memorial fund quarterly*, 166-206.

43. Donabedian, A. (1997). The quality of care. How can it be assessed? 1988. *Archives of pathology & laboratory medicine*, *121*(11), 1145.

44. Dolansky, M. A., Zullo, M. D., Hassanein, S., Schaefer, J. T., Murray, P., & Boxer, R. (2012). Cardiac rehabilitation in skilled nursing facilities: A missed opportunity. *Heart & Lung: The Journal of Acute and Critical Care*, *41*(2), 115-124.

45. Dolansky, M. A., Hitch, J. A., Piña, I. L., & Boxer, R. S. (2013). Improving Heart Failure Disease Management in Skilled Nursing Facilities Lessons Learned. *Clinical nursing research*, *22*(4), 432-447.

46. Engberg, J., Castle, N. G., & McCaffrey, D. (2008). Physical restraint initiation in nursing homes and subsequent resident health. *The Gerontologist*, *48*(4), 442-452.

47. Ensrud, K. E., Ewing, S. K., Taylor, B. C., Fink, H. A., Stone, K. L., Cauley, J. A., ... & Cawthon, P. M. (2007). Frailty and risk of falls, fracture, and mortality in older women: the study of osteoporotic fractures. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *62*(7), 744-751.

48. Feng, Z., Hirdes, J. P., Smith, T. F., Finne‐Soveri, H., Chi, I., Du Pasquier, J. N., ... & Mor, V. (2009). Use of physical restraints and antipsychotic medications in nursing homes: a cross‐national study. *International Journal of Geriatric Psychiatry*, *24*(10), 1110-1118.

49. Fisher, E. S., Wennberg, D. E., Stukel, T. A., Gottlieb, D. J., Lucas, F. L., & Pinder, E. L. (2003). The implications of regional variations in Medicare spending. Part 2: health outcomes and satisfaction with care. *Annals of internal medicine*, *138*(4), 288-298.

50. Foebel, A. D., Heckman, G. A., Hirdes, J. P., Tyas, S. L., Tjam, E. Y., McKelvie, R. S., & Maxwell, C. J. (2011). Clinical, Demographic and Functional Characteristics Associated with Pharmacotherapy for Heart Failure in Older Home Care Clients. *Drugs & aging*, *28*(7), 561-573.

51. Foebel, A. D., Heckman, G. A., Ji, K., Dubin, J. A., Turpie, I. D., Hussack, P., & Mckelvie, R. S. (2013). Heart Failure–Related Mortality and Hospitalization in the Year Following Admission to a Long-Term Care Facility: The Geriatric Outcomes and Longitudinal Decline in Heart Failure (GOLD-HF) Study. *Journal of cardiac failure*, 19(7), 468-477.

52. Fried, L. P., Tangen, C. M., Walston, J., Newman, A. B., Hirsch, C., Gottdiener, J., ... & McBurnie, M. A. (2001). Frailty in older adults evidence for a phenotype.*The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *56*(3), M146-M157.

53. Fries, B. E., Simon, S. E., Morris, J. N., Flodstrom, C., & Bookstein, F. L. (2001). Pain in US nursing homes Validating a pain scale for the minimum data set. *The Gerontologist*, *41*(2), 173-179.

54. Fuat, A., Hungin, A. P. S., & Murphy, J. J. (2003). Barriers to accurate diagnosis and effective management of heart failure in primary care: qualitative study.*Bmj*, *326*(7382), 196.

55. Gambassi, G., Forman, D. E., Lapane, K. L., Mor, V., Sgadari, A., Lipsitz, L. A., & Bernabei, R. (2000). Management of heart failure among very old persons living in long-term care: has the voice of trials spread?. American heart journal, 139(1), 85-93.

56. Gary, R., & Davis, L. (2008). Diastolic heart failure. *Heart & Lung: The Journal of Acute and Critical Care*, *37*(6), 405-416.

57. Gerber, Y., Melton III, L. J., Weston, S. A., & Roger, V. L. (2011). Osteoporotic fractures and heart failure in the community. *The American journal of medicine*, *124*(5), 418-425.

58. Ghisletta, P., & Spini, D. (2004). An introduction to generalized estimating equations and an application to assess selectivity effects in a longitudinal study on very old individuals. *Journal of Educational and Behavioral Statistics*, *29*(4), 421-437.

59. Glazebrook, K., Rockwood, K., Stolee, P., & Gray, J. M. (1994). A case-control study of the risks for institutionalization of elderly people in Nova Scotia. *Can J Aging*, *13*(1), 104-117.

60. Graverholt, B., Riise, T., Jamtvedt, G., Husebo, B. S., & Nortvedt, M. W. (2013). Acute hospital admissions from nursing homes: predictors of unwarranted variation? *Scandinavian journal of public health*, *41*(4), 359-365.

61. Hamers, J. P., Gulpers, M. J., & Strik, W. (2004). Use of physical restraints with cognitively impaired nursing home residents. *Journal of Advanced Nursing*, *45*(3), 246-251.

62. Hancock, H.C., Close, H., Mason, J.M., Murphy, J.J., Fuat, A., Singh, R., Wood, E., De Belder, M., Brennan, G., Hussain, N., Kumar, N., Wilson, D., Hungin, A.P.S. (2013). High prevalence of undetected heart failure in long-term care residents: Findings from the Heart Failure in Care Homes (HFinCH) study. *European Journal of Heart Failure*, 15 (2), pp. 158-165.

63. Hartmaier, S. L., Sloane, P. D., Guess, H. A., Koch, G. G., Mitchell, C. M., & Phillips, C. D. (1995). Validation of the minimum data set cognitive performance scale: agreement with the mini-mental state examination. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *50*(2), M128-M133.

64. Hawes, C., Morris, J. N., Phillips, C. D., Mor, V., Fries, B. E., & Nonemaker, S. (1995). Reliability estimates for the Minimum Data Set for nursing home resident assessment and care screening (MDS). *The Gerontologist*, *35*(2), 172-178.

65. Heckman, G. A., Misiaszek, B., Merali, F., Turpie, I. D., Patterson, C. J., Flett, N., & McKelvie, R. S. (2004). Management of heart failure in Canadian long-term care facilities. *Canadian journal of cardiology*, *20*(10), 963-969.

66. Heckman, G. A., Demers, C., & McKelvie, R. S. (2008). Heart Failure: Old Disease, Older Adults, Fresh Perspective.

67. Heckman, G. A., Patterson, C. J., Demers, C., Onge, J. S., Turpie, I. D., & McKelvie, R. S. (2007). Heart failure and cognitive impairment: challenges and opportunities. *Clinical interventions in aging*, *2*(2), 209.

68. Heckman, G. A., Boscart, V. M., McKelvie, R. S., D'Elia, T., Osman, O., Kaasalainen, S., ... & Strachan, P. (2014). Perspectives of Primary-Care Providers on Heart Failure in Long-Term Care Homes. *Canadian Journal on Aging/La Revue canadienne du vieillissement*, *33*(3), 320-335.

69. Health Council of Canada (2011). A Citizen's Guide to Health Indicators: A Reference Guide for Canadians . Health Council of Canada. Retrieved from: http://www.healthcouncilcanada.ca/rpt_det_gen.php?id=130#sthash.kuRyNNBo.dpuf

70. Health Quality Ontario (2014). Quality Improvement: Long-term Care. HQO: Ontario. Retrieved from: http://www.hqontario.ca/quality-improvement/long-term-care.

71. Health Quality Ontario (2013). Long-term Care Public Reporting Technical Table. HQO: Ontario.

72. Hernandez, A. F., Greiner, M. A., Fonarow, G. C., Hammill, B. G., Heidenreich, P. A., Yancy, C. W., ... & Curtis, L. H. (2010). Relationship between early physician follow-up and 30-day readmission among Medicare beneficiaries hospitalized for heart failure. *Jama*, *303*(17), 1716-1722.

73. Hirdes, J. P., Fries, B. E., Morris, J. N., Steel, K., Mor, V., Frijters, D., ... & Jónsson, P. (2000, February). Integrated health information systems based on the RAI/MDS series of instruments. In *Healthcare management forum* (Vol. 12, No. 4, pp. 30-40). Elsevier.

74. Hirdes, J. P., Frijters, D. H., & Teare, G. F. (2003). The MDS-CHESS Scale: A New Measure to Predict Mortality in Institutionalized Older People. *Journal of the American Geriatrics Society*, *51*(1), 96-100.

75. Hirdes, J. P. (2006). Addressing the health needs of frail elderly people: Ontario's experience with an integrated health information system. *Age and Ageing*, *35*(4), 329-331.

76. Hirdes, J. P., Mitchell, L., Maxwell, C. J., & White, N. (2011). Beyond the 'iron lungs of gerontology': using evidence to shape the future of nursing homes in Canada. *Canadian Journal on Aging*, *30*(3), 371.

77. Hutt, E., Ecord, M., Eilertsen, T. B., Frederickson, E., & Kramer, A. M. (2002). Precipitants of Emergency Room Visits and Acute Hospitalization in Short‐Stay Medicare Nursing Home Residents. *Journal of the American Geriatrics Society*,*50*(2), 223-229.

78. Hutt, E., Frederickson, E., Ecord, M., & Kramer, A. M. (2003). Associations among processes and outcomes of care for Medicare nursing home residents with acute heart failure. *Journal of the American Medical Directors Association*, *4*(4), 195-199.

79. Hutt, E., Elder, S. J., Fish, R., & Min, S. J. (2011). Regional variation in mortality and subsequent hospitalization of nursing residents with heart failure. *Journal of the American Medical Directors Association*, *12*(8), 595-601.

80. Huybrechts, K. F., Rothman, K. J., Silliman, R. A., Brookhart, M. A., & Schneeweiss, S. (2011). Risk of death and hospital admission for major medical events after initiation of psychotropic medications in older adults admitted to nursing homes. *Canadian Medical Association Journal*, *183*(7), E411-E419.

81. Hutchinson, A. M., Draper, K., & Sales, A. E. (2009). Public reporting of nursing home quality of care: Lessons from the United States experience for Canadian policy discussion. *Healthcare Policy*, *5*(2), 87.

82. Hospital Report Research Collaborative . (2001). *Hospital report - Complex continuing care, 2001* . Toronto: University of Toronto .

83. Inouye, S. K., Studenski, S., Tinetti, M. E., & Kuchel, G. A. (2007). Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept. *Journal of the American Geriatrics Society*, *55*(5), 780-791.

84. Intrator, O., Castle, N. G., & Mor, V. (1999). Facility characteristics associated with hospitalization of nursing home residents: results of a national study. *Medical care*, *37*(3), 228-237.

85. Marcella, J., Nadarajah, J., Kelley , M.L, Heckman, G.A, Kaasalainen, S., Strachan, P. ... & Catherine, D. (2012). Understanding organizational context and heart failure management in long term care homes in Ontario, Canada. *Health, 2012*.

86. Jones , R.N. , Hirdes , J.P. , Poss , J.W. , Kelly , M. , Berg , K. , Fries , B.E. , et al . (2010). Adjustment of nursing home quality indicators. *BMC Health Services Research*, *10*, 96.

87. Kang, Y., Meng, H., & Miller, N. A. (2011). Rurality and nursing home quality: Evidence from the 2004 National Nursing Home Survey. *The Gerontologist*, *51*(6), 761-773.

88. Katz, D. L., Wild, D., Elmore, J. G. & Lucan, S. C. (2013). *Jekel's Epdemiology, Biostatistics and Preventive Medicine.* New Haven, Connecticut: Saunders.

89. Kelly, K. G., Zisselman, M., Cutillo-Schmitter, T., Reichard, R., Payne, D., & Denman, S. J. (2002). Severity and course of delirium in medically hospitalized nursing facility residents. *The American Journal of Geriatric Psychiatry*, *9*(1), 72-77.

90. Kessler, C., Williams, M. C., Moustoukas, J. N., & Pappas, C. (2013). Transitions of care for the geriatric patient in the emergency department. *Clinics in geriatric medicine*, *29*(1), 49-69.

91. Kirsebom, M., Hedström, M., Wadensten, B., & Pöder, U. (2014). The frequency of and reasons for acute hospital transfers of older nursing home residents. *Archives of gerontology and geriatrics*, *58*(1), 115-120.

92. Kleijer, B. C., van Marum, R. J., Frijters, D. H., Jansen, P. A., Ribbe, M. W., Egberts, A. C., & Heerdink, E. R. (2013). Variability between nursing homes in prevalence of antipsychotic use in patients with dementia. *International Psychogeriatrics*, 1-9.

93. Konetzka, R. Tamara, Sally C. Stearns, and Jeongyoung Park. "The staffing–outcomes relationship in nursing homes." *Health Services Research* 43.3 (2008): 1025-1042.

94. Lee, J. S., Chau, P. P., Hui, E., Chan, F., & Woo, J. (2009). Survival prediction in nursing home residents using the Minimum Data Set subscales: ADL Self-Performance Hierarchy, Cognitive Performance and the Changes in Health, End-stage disease and Symptoms and Signs scales. *The European Journal of Public Health*, *19*(3), 308-312.

95. Le Jemtel, T. H., Padeletti, M., & Jelic, S. (2007). Diagnostic and therapeutic challenges in patients with coexistent chronic obstructive pulmonary disease and chronic heart failure. *Journal of the American College of Cardiology*, *49*(2), 171-180.

96. Lee, D. S., Johansen, H., Gong, Y., Hall, R. E., Tu, J. V., & Cox, J. L. (2004). Regional outcomes of heart failure in Canada. *The Canadian journal of cardiology*, *20*(6), 599-607.

97. Levy, C. R., Fish, R., & Kramer, A. M. (2004). Site of death in the hospital versus nursing home of Medicare skilled nursing facility residents admitted under Medicare's Part A Benefit. *Journal of the American Geriatrics Society*,*52*(8), 1247-1254.

98. Lough, M. A. (1996). Ongoing work of older adults at home after hospitalization. *Journal of Advanced nursing*, *23*(4), 804-809.

99. Luk, J. K. H., Chiu, P. K. C., & Chu, L. W. (2009). Factors affecting institutionalization in older Hong Kong Chinese patients after recovery from acute medical illnesses. *Archives of gerontology and geriatrics*, *49*(2), e110-e114.

100. Naylor, M. D., Brooten, D. A., Campbell, R. L., Maislin, G., McCauley, K. M., & Schwartz, J. S. (2004). Transitional care of older adults hospitalized with heart failure: a randomized, controlled trial. *Journal of the American Geriatrics Society*, *52*(5), 675-684.

101. Newhouse, I. J., Heckman, G., Harrison, D., D'Elia, T., Kaasalainen, S., Strachan, P. H., & Demers, C. (2012). Barriers to the management of heart failure in ontario long-term care homes: an interprofessional care perspective.*Journal of Research in Interprofessional Practice and Education*, *2*(3).

102. Mainz, J. (2003). Defining and classifying clinical indicators for quality improvement. *International Journal for Quality in Health Care*, *15*(6), 523-530.

103. Mahoney, J. E., Eisner, J., Havighurst, T., Gray, S., & Palta, M. (2000). Problems of older adults living alone after hospitalization. *Journal of general internal medicine*, *15*(9), 611-619.

104. Mant, J. (2001). Process versus outcome indicators in the assessment of quality of health care. *International Journal for Quality in Health Care*, *13*(6), 475-480.

105. Mejhert, M., Lindgren, P., Schill, O., Edner, M., Persson, H., & Kahan, T. (2012). Long term health care consumption and cost expenditure in systolic heart failure. *European journal of internal medicine*.

106. Ministry of Health and Long-term care. (2014a). Reports on Long-term Care Homes. Ministry of Health and Long-term care, Ontario. Retrieved from:http://www.health.gov.on.ca/en/public/programs/ltc/27_pr_faq.aspx

107. Ministry of Health and Long-Term Care (2014b). Long Term Care Home Act, 2007. MOHLT. Retrieved from: http://www.health.gov.on.ca/en/common/legislation/ltcha/default.aspx

108. Ministry of Health and Long-Term Care (2014c). Ontario's Aging at Home Strategy. Retrieved from: http://www.health.gov.on.ca/en/public/programs/ltc/33_ontario_strategy.aspx

109. McNallan, S. M., Chamberlain, A. M., Gerber, Y., Singh, M., Kane, R. L., Weston, S. A., ... & Roger, V. L. (2013). Measuring frailty in heart failure: A community perspective. *American heart journal*, *166*(4), 768-774.

110. Morris, J. N., Fries, B. E., & Morris, S. A. (1999). Scaling ADLs within the MDS. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *54*(11), M546-M553.

111. Mor, V., Angelelli, J., Jones, R., Roy, J., Moore, T., & Morris, J. (2003). Inter-rater reliability of nursing home quality indicators in the US. *BMC Health Services Research*, *3*(1), 20.

112. Murray, S. A., Boyd, K., Kendall, M., Worth, A., Benton, T. F., & Clausen, H. (2002). Dying of lung cancer or cardiac failure: prospective qualitative interview study of patients and their carers in the community. *Bmj*, *325*(7370), 929.

113. Murad, K., & Kitzman, D. W. (2012). Frailty and multiple comorbidities in the elderly patient with heart failure: implications for management. *Heart failure reviews*, *17*(4-5), 581-588.

114. Okonkwo, O. C., Sui, X., & Ahmed, A. (2007). Disease-specific depression and outcomes in chronic heart failure: a propensity score analysis. *Comprehensive therapy*, *33*(2), 65-70.

115. Passmore, M. J., Gardner, D. M., Polak, Y., & Rabheru, K. (2008). Alternatives to atypical antipsychotics for the management of dementia-related agitation. *Drugs & aging*, *25*(5), 381-398.

116. Pattenden, J. F., H. Roberts, and R. J. P. Lewin. "Living with heart failure; patient and carer perspectives." *European Journal of Cardiovascular Nursing* 6.4 (2007): 273-279.

117. Pedone, C., Pahor, M., Carosella, L., Bernabei, R., & Carbonin, P. (2004). Use of angiotensin-converting enzyme inhibitors in elderly people with heart failure: Prevalence and outcomes. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *59*(7), M716-M721.

118. Perlman, C. M., & Hirdes, J. P. (2008). The aggressive behavior scale: a new scale to measure aggression based on the minimum data set. *Journal of the American Geriatrics Society*, *56*(12), 2298-2303.

119. Phillips, C. D., Hawes, C., Mor, V., Fries, B. E., Morris, J. N., & Nennstiel, M. E. (1996). Facility and area variation affecting the use of physical restraints in nursing homes. *Medical Care*, *34*(11), 1149-1162.

120. Phillips, C. D., Holan, S., Sherman, M., Williams, M. L., & Hawes, C. (2004). Rurality and nursing home quality: Results from a national sample of nursing home admissions. *American Journal of Public Health*, *94*(10), 1717-1722.

121. Proctor, E. K., Morrow-Howell, N., Li, H., & Dore, P. (2000). Adequacy of home care and hospital readmission for elderly congestive heart failure patients.*Health & Social Work*, *25*(2), 87-96.

122. Quinn, J. R., Pesis-Katz, I., & Mukamel, D. B. (2013). Variations in Patterns of Care Activities for Nursing Home Residents with Heart Failure. *Research in gerontological nursing*, *6*(1), 29-35.

123. Ramos, S., Prata, J., Gonçalves, F. R., & Coelho, R. Congestive Heart Failure and Quality of Life. (In Press). *Applied Research in Quality of Life*, 1-15.

124. Rich, M. W. (1997). Epidemiology, pathophysiology, and etiology of congestive heart failure in older adults. *Journal of the American Geriatrics Society*, *45*(8), 968-974.

125. Rich, M. W., & Kitzman, D. W. (2000). Heart Failure in Octogenarians: A Fundamentary Different Disease. *American Journal of Geriatric Cardiology*, *9*(5; SUPP/1), 97-104

126. Rich, M. W. (2001). Heart Failure in the 21st Century: A Cardiogeriatric Syndrome. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *56*(2), M88-M96.

127. Rich, M. W. (2005). Heart failure in the oldest patients: The impact of comorbid conditions. *The American Journal of Geriatric Cardiology*, *14*(3), 134-141.

128. Rockwood, K., Fox, R. A., Stolee, P., Robertson, D., & Beattie, B. L. (1994). Frailty in elderly people: an evolving concept. *CMAJ: Canadian Medical Association Journal*, *150*(4), 489.

129. Saliba, D., Kington, R., Buchanan, J., Bell, R., Wang, M., Lee, M., ... & Rubenstein, L. (2000). Appropriateness of the decision to transfer nursing facility residents to the hospital. *Journal of the American Geriatrics Society*, *48*(2), 154-163.

130. Simmons, S. F., Cadogan, M. P., Cabrera, G. R., Al-Samarrai, N. R., Jorge, J. S., Levy-Storms, L., ... & Schnelle, J. F. (2004). The minimum data set depression quality indicator: does it reflect differences in care processes?. *The Gerontologist*, *44*(4), 554-564.

131. Scharpf, T. P., & Madigan, E. A. (2010). Functional status outcome measures in home health care patients with heart failure. *Home health care services quarterly*, *29*(4), 155-170.

132. Schnelle, J. F., Wood, S., Schnelle, E. R., & Simmons, S. F. (2001). Measurement sensitivity and the Minimum Data Set depression quality indicator. *The Gerontologist*, *41*(3), 401-405.

133. Sharkey, S. (2008). People caring for people impacting the quality of life and care of residents of long-term care homes: a report of the independent review of staffing and care standards for long-term care homes in Ontario.

134. Smith, E. R., & Stevens, A. B. (2009). Predictors of discharges to a nursing home in a hospital-based cohort. *Journal of the American Medical Directors Association*, *10*(9), 623-629.

135. Stenestrand, U., & Wallentin, L. (2001). Early statin treatment following acute myocardial infarction and 1-year survival. *JAMA: the journal of the American Medical Association*, *285*(4), 430-436.

136. Stevenson, D. G., Decker, S. L., Dwyer, L. L., Huskamp, H. A., Grabowski, D. C., Metzger, E. D., & Mitchell, S. L. (2010). Antipsychotic and benzodiazepine use among nursing home residents: findings from the 2004 National Nursing Home Survey. *The American journal of geriatric psychiatry: official journal of the American Association for Geriatric Psychiatry*, *18*(12), 1078.

137. Sonnenblick, E. H. (1985). Pathophysiology of heart failure. In *The Ventricle* (pp. 209-224). Springer US.

138. Specht, J. K. (2013). Evidence Based Practice in Long Term Care Settings. *Journal of Korean Academy of Nursing*, *43*(2), 145-153.

139. Stewart, S., MacIntyre, K., Capewell, S., & McMurray, J. J. V. (2003). Heart failure and the aging population: an increasing burden in the 21st century?. *Heart*, *89*(1), 49-53.

140. Shibata, M. C., Soneff, C. M., & Tsuyuki, R. T. (2005). Utilization of evidence-based therapies for heart failure in the institutionalized elderly. *European journal of heart failure*, *7*(7), 1122-1125.

141. Szumilas, M. (2010). Explaining odds ratios. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, *19*(3), 227.

142. Tjam, E. Y., Heckman, G. A., Smith, S., Arai, B., Hirdes, J., Poss, J., & McKelvie, R. S. (2012). Predicting heart failure mortality in frail seniors: comparing the NYHA functional classification with the Resident Assessment Instrument (RAI) 2.0. *International journal of cardiology*, *155*(1), 75-80.

143. Tresch, D. D. (2000). Clinical manifestations, diagnostic assessment, and etiology of heart failure in elderly patients. *Clinics in geriatric medicine*, *16*(3), 445-456.

144. Velagaleti, R. S., Pencina, M. J., Murabito, J. M., Wang, T. J., Parikh, N. I., D'Agostino, R. B., ... & Vasan, R. S. (2008). Long-term trends in the incidence of heart failure after myocardial infarction. *Circulation*, *118*(20), 2057-2062.

145. Uemura, K., Ueyama, T., Shintani-Ishida, K., Unuma, K., & Yoshida, K. I. (2008). An Autopsy Report on Four Sudden Cardiac Death Cases by Immobilization. *International Medical Journal*, *15*(4).

146. Welch, H. G., Wennberg, D. E., & Welch, W. P. (1996). The use of Medicare home health care services. *New England Journal of Medicine*, *335*(5), 324-329.

147. Wodchis, W. P., Naglie, G., & Teare, G. F. (2008). Validating diagnostic information on the minimum data set in Ontario hospital-based long-term care. *Medical care*, *46*(8), 882-887.

148. World Health Organization. (2014). *International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM).* World Health Organization : Geneva.

149. Zuccalà, G., Onder, G., Marzetti, E., Monaco, M. R. L., Cesari, M., Cocchi, A., ... & Bernabei, R. (2005). Use of angiotensin-converting enzyme inhibitors and variations in cognitive performance among patients with heart failure. *European heart journal*, *26*(3), 226-233.

150. Zimmerman DR (1997). Power of information: using resident assessment data to assure and improve the quality of nursing home care. *Generations*, 21(4), 52-56.

151. Zimmerman, D. R. (2003). Improving nursing home quality of care through outcomes data: the MDS quality indicators. *International journal of geriatric psychiatry*, *18*(3), 250-257.