Older Adults Seeking Emergency Care:

An Examination of Unplanned Emergency Department Use, Patient Profiles, and Adverse Patient Outcomes Post Discharge

by

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AUTHOR'S 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.

ABSTRACT

Purpose: The purpose of this dissertation was to examine the determinants of unplanned emergency department (ED) use by home care clients, the profile of older ED patients, their transitions from the ED, as well as the determinants of post discharge outcomes among older ED patients. The goal of this dissertation was to create theoretically driven, evidence-based, and practical risk identification methods for home care and the ED.

Methods: First, a multi-year, census-level cohort study was conducted on home care clients in two Canadian provinces (N=617,035). Census-level data from RAI-HC assessments were linked to census-level ED records. A needs-based decision tree model – the *ED Model* – informed by the Andersen Behavioural Model, was created using decision tree analyses. The final model was validated on a separate data partition and compared to the ERA Index and the CARS. Multilevel analyses were conducted to test regional variation in model performance. Disease stratified analyses were also conducted to test model generalizability across common disease classes. Regression analyses determined the effect of predisposing and enabling factors within *ED Model* strata.

Second, a multi-site, multi-province prospective cohort study was conducted, termed the Management of Older Persons in Emergency Departments (MOPED) Study, using a clinically representative sample of 2,101 older ED patients. The interRAI ED-CA was used to assess older ED patients, and a 90-day disposition was collected. The profile of older ED patents was examined. Best-subset regression analyses identified person-level determinants of acute inpatient admission. Two needs-based decision tree models – the *ALC/LTC* and *ED Revisit Model*s – were created using decision tree analyses to determine the risk of ALC designation or LTC placement, and unplanned repeat ED visits, respectively. Both models were validated on separate data partitions. Multilevel analyses were conducted to test site-level variation in the models' performance.

Results: Overall, 41.2% of home care clients had at least one unplanned emergency department visit within 6 months of an assessment. Previous ED use, cardio-respiratory symptoms, cardiac

conditions, and mood symptoms featured heavily in the *ED Model*. The *ED Model* provided moderate risk differentiation and clinical utility. It achieved an area under the curve of 0.62 (95% CI: 0.61-0.62) and showed clear differentiation in Kaplan-Meier plots using validation data. Multi-level analyses showed no regional variation. The *ED Model* significantly outperformed the similar tools specific to primary care with respect to overall accuracy and perceived clinical utility. Predisposing and enabling characteristics provided little added differentiation beyond evaluated need.

The majority of older ED patients were dependent on others for basic tasks of daily living, and many had fragile informal care or lived alone. Triage acuity generally did not differentiate chronic geriatric disabilities and conditions. Previous ED or hospital use was associated with chronic geriatric disabilities and conditions as well as informal caregiver distress. The *Admission Model* found that multiple factors were associated with admission to inpatient acute care, including: acuity, instability, changes in ADL function, cognition, nutrition, and anhedonia. Overall, 20.7% of older ED patients admitted to acute care were designated ALC or discharged to LTC; whereas 39.5% of older ED patients discharged home had one or more repeat ED visits within 90 days. Cognitive, functional, and informal care indicators were predictive of ALC/LTC; whereas functional status and symptoms were predictive of repeat ED use. The *ALC/LTC* and *ED Revisit Model*s provided good risk differentiation, achieving AUC's of 0.74 (95% CI: 0.69-0.79) and 0.69 (95% CI: 0.63-0.74), respectively. The *ALC/LTC* and *ED Revisit Model*s showed clear differentiation in Kaplan-Meier plots. Multi-level analyses showed no site-level variation in each models' performance.

Conclusions: This dissertation produced tangible and empirically-based risk assessment models for clinical practice in home care and the ED. The models developed in this dissertation can support the targeting of preventative services as well as better communication strategies between the ED and community supportive care, primary care, and inpatient acute care. Key questions related to the prevention of the risk pathways identified in each risk assessment model remain unanswered, and should be a focus of future research.

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DEDICATION

I dedicate this thesis to the memory of my grandparents whose lives and contributions motivate my research.

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Chapter 1

INTRODUCTION

1.1 Emergency Departments in Canada

Modern emergency departments (EDs) originate from small and simple areas of hospitals known as 'accident rooms' or 'emergency rooms'. These, commonly one or two-bed, 'rooms' were the only part of hospitals that accepted patients at all hours. Brief and minimally invasive examinations where completed by non-dedicated and, often, poorly equipped house staff, whereupon admission to the hospital was almost a certainty (Shortliffe, Hamilton, & Noroian, 1958). The increasing specialization of medicine and technological advancement of hospitals led to an increase in the use of emergency rooms for emergency complaints, accidents, and injuries. As demand for community outpatient care shifted toward hospitals, emergency 'rooms' quickly evolved into whole 'departments' or 'units', and emergency medicine emerged as a medical specialization with dedicated certification bodies (Powell, 1984).

Today, Canadian EDs provide emergency medical care at all hours without appointment, referral, user fees, or entry criteria (Canada Health Act, 1985). With open access to medical care at all hours, EDs are currently the most well positioned sector to provide timely episodic care for persons with medical emergencies or urgent health complaints. Beyond emergency medical crises, EDs are also used for high technology clinical investigation as well as a point of access to high technology outpatient care (e.g., oncology, renal dialysis), long-term supportive services, mental health care, and accessible primary care (Lowenstein, Crescenzi, Kern, & Steel, 1986; Powell, 1984; Wofford, Schwartz, & Byrum, 1993). In Canada, acute hospital care costs exceed 35 billion dollars annually and constitute the single largest area of health spending (Canadian Institute for Health Information -CIHI, 2005). Approximately 60% of patients hospitalized are admitted through the ED – accounting for over one million admissions and 65% of acute care inpatient days (CIHI, 2007a). Statistics Canada's Canadian Community Health Survey found that

one in seven Canadians had their most recent treatment for an injury or most recent contact with a health professional in an ED (CIHI, 2007).

The ongoing demographic shift in industrialized nations has led to more ED patients presenting with chronic illness, frailty, geriatric conditions, and disability. This shift is challenging the traditional role of the ED in the wider health care system by necessitating a greater emphasis on disease management and wider service integration (Kellermann & Martinez, 2011; Wofford et al., 1993; Xu, Nelson, & Berk, 2009). Now, more than ever, EDs function as a safety net when community-based care is unavailable or insufficient and when care transitions fail between health sectors (Caplan, Brown, Croker, & Doolan, 1998; Xu et al., 2009). The ability of community-based supportive care, primary care, and inpatient care to manage the growing wave of chronic illness influences the quantity and type of cases seen in the ED. Alternately, the ED influences the ability of adjacent health care sectors to address chronic illness to the extent that ED visits prompt more effective follow-up care (Kellermann & Martinez, 2011).

1.2 Older Adults and Emergency Departments

EDs function as a common access point to health care services for many older adults (defined here as age 65 and over). In addition to emergency episodic treatment, EDs are a common point of entry to acute inpatient care, psychiatric care, social services, and community care services (Aminzadeh & Dalziel, 2002; McCusker & Verdon, 2006; Veillette, Demers, Dutil, & McCusker, 2008; Wofford et al., 1993). Older adults use EDs at higher rates than younger persons (Aminzadeh & Dalziel, 2002; Caplan, Williams, Daly, & Abraham, 2004; McCusker & Verdon, 2006), representing 12-21% of all ED visits (Aminzadeh & Dalziel, 2002; CIHI, 2010; Pines, Mullins, Cooper, Feng, & Roth, 2013). In addition, Canadian and U.S. data suggest that the proportion of ED admissions accounted for by older adults has been increasing since 2005 (CIHI, 2010; Pines et al., 2013).

Older adults that access the EDs have more complex care needs and distinct patterns of presentation relative to younger adults (Aminzadeh & Dalziel, 2002; Gruneir, Silver, & Rochon, 2010; McCusker, Karp, Cardin, Durand, & Morin, 2003; Salvi et al., 2007). Also, some ED visits are

thought to be indicators for declining health and functional ability, declining informal care capacity, or poor care transitions (Caplan et al., 1998). Older adults often present to the ED with greater levels of urgency and are more likely to arrive by ambulance relative to younger persons (Baum & Rubenstein, 1987; Downing & Wilson, 2005; Ettinger, Casani, Coon, Muller, & Piazza-Appel, 1987; George, Jell, & Todd, 2006; Gerson & Shvarch, 1982; Lowenstein et al., 1986; Oates, Heslop, & Boord, 1997; Roberts, Dalton, Evans, & Wilson, 2007; Shah et al., 2003; Singal et al., 1992; Strange, Chen, & Sanders, 1992). In addition, older adults typically have longer lengths of stay compared to younger individuals, are subject to more diagnostic testing, and use more ED resources (Baum & Rubenstein, 1987; George et al., 2006; Grief, 2003; Lowenstein et al., 1986; Singal et al., 1992). Older adults admitted to inpatient acute care from the ED are more likely to be subsequently discharged to facility-based care compared to younger adults (CIHI, 2007c). Approximately 73% of alternate level of care (ALC) patients are admitted through the ED, accounting for over a million ALC bed days in Canada (excluding Quebec) (CIHI, 2007a). In addition, older adults discharged to the community from the ED are more likely to return to the ED compared to younger adults (Fan, Worster, & Fernandes, 2006; Hustey et al., 2007; McCusker, Cardin, Bellavance, & Belzile, 2000; McCusker, Healey, Bellavance, & Connolly, 1997; Moons et al., 2007; Rosenfeld, Fahey, Price, & Leeder, 1990; Rowland, Maitra, Richardson, Hudson, & Woodhouse, 1990).

Most current models of ED care are poorly suited to the characteristics of older ED patients (Aminzadeh & Dalziel, 2002; Kihlgren, Nilsson, & Sørlie, 2005; McNamara, Rousseau, & Sanders, 1992; Peterson, Fairbanks, Hettinger, & Shah, 2009; Robinson & Mercer, 2007; Salvi et al., 2007; Sanders, 1992; Schumacher, Deimling, Meldon, & Woolard, 2006). Specifically, acuity-oriented models relevant for younger adults have are speculated to be inappropriate for older adults with chronic conditions (Dove & Dave, 1986; Kihlgren et al., 2005; McNamara et al., 1992; Peterson et al., 2009; Robinson & Mercer, 2007; Salvi et al., 2007; Schumacher et al., 2006). Their unique patterns of presentation, ED care provision, and prevalence of adverse outcomes reflects, at least in part, the need for EDs to adjust to the shifting age structure of the population and prevalence chronic illness. The social and personal concerns of the elderly are frequently not addressed in

EDs (Denman, Ettinger, Zarkin, Coon, & Casani, 1989; Hedges et al., 1992; Salvi et al., 2007; Sanders, 1992; Watson, Marshall, & Fosbinder, 1999). Specifically, many older patients report that their complaints are not resolved despite the fact that they are subjected to more investigations and account for greater service expenditures (Denman et al., 1989; Hedges et al., 1992; Watson et al., 1999). In addition, many emergency physicians feel less comfortable caring for older patients and report being somewhat unprepared to provide emergency care to older adults (Kihlgren et al., 2005; McNamara et al., 1992; Peterson et al., 2009; Robinson & Mercer, 2007; Schumacher et al., 2006). The tendency of emergency physicians to overestimate daily time spent treating older adults reflects this problem (Considine et al., 2010; Schumacher et al., 2006).

Principles of emergency care for older patients have not been well defined relative to other specialty populations, such as pediatrics (a sub-specialty in emergency medicine). It is suggested that there is a paucity of research and education in geriatric emergency medicine with which to develop evidence based guidelines of care (Clevenger, Chu, Yang, & Hepburn, 2012; McNamara et al., 1992; Sanders, 1992; Shapiro, Clevenger, & Evans, 2012). In addition, some argue that that the lack of advancements in geriatric emergency care reflects the already overburdened state of daily emergency care operations and, subsequently, a limited energy to devote to adopting elder friendly care practices (Robinson & Mercer, 2007; Sanders, 1992).

1.3 Rational, Purpose, and Organization

Canadian provincial governments, local health authorities, and hospitals have recognized the pivotal role that EDs perform in the care pathways of older adults (e.g., Ministry of Health and Long-Term Care - MOHLTC, 2008). Specifically, health care planners are attempting to optimize the role of the ED within a larger model of integrated geriatric services, particularly between the ED, community-based supportive care, primary care, and acute care. In order to advance practice and policy discussions, more evidence is required to understand the determinants of ED visits by community dwelling older adults, the profiles of older ED patients, their determinants for inpatient admission from the ED, and adverse outcomes post ED discharge. Actions to prevent avoidable ED use by community dwelling older adults are likely to be un-targeted, potentially

misdirected, and poorly organized across the care continuum in the absence of a clearer picture of the determinants of ED use by frail older adults. Efforts to optimize the ED environment for older patients and initiate geriatric interventions are also likely to be misdirected or, otherwise, uninformed without a more comprehensive understanding of the needs of presenting patients and the determinants for adverse patient trajectories.

The purpose of this dissertation is to examine the unplanned use of the ED by community dwelling older adults, their profile and transitions from the ED, and their outcomes post discharge. To achieve its purpose, a temporal and multi-sector viewpoint on ED utilization by older adults is employed. The goal of this dissertation is to aid efforts to optimize the role of ED in the continuum of care for older adults by providing tangible, useful, and evidence-based risk assessment methods for clinical practice in home care and the ED.

Each chapter represents a single point of inquiry related to the overall aim of understanding the determinants and outcomes of ED use in older adults.

Chapter 2: An examination of person-level determinants of unplanned ED use among long-stay home care clients – a community perspective;

Chapter 3: A comprehensive profile of older adults in the ED and person-level determinants of acute admission – an ED perspective; and

Chapter 4: An examination of determinants of key adverse outcomes post discharge – a post-ED perspective.

1.4 Literature Review Methods

Relevant literature was identified through searches of MEDLINE (PubMed), CINAHL, Web of Science, Scopus, and Google Scholar. Medical Subjects Headings (MeSH) were used to help select search terms. Search strings included combinations of multiple search terms. In all cases, keywords in the title and abstract fields were used to search English language articles. Secondary sources were identified through a review of literature cited in the primary articles/reports. Additional grey literature was accessed through Internet searches of Canadian statistical sources

and public sector publications. Inclusion was based on abstract or full article review to determine relevance to one or more of the dissertation chapters. Research article inclusion was restricted to empirical studies. Literature reviews were included if they covered relevant topics. Publication date was not an exclusion criterion given the limited amount of relevant literature on many of the topics addressed. Relevant empirical literature was organized by topic and theme. The degree to which results varied or were congruent across the studies was described and knowledge gaps in the research were discussed throughout.

Chapter 2

PERSON-LEVEL DETERMINANTS OF UNPLANNED EMERGENCY DEPARTMENT VISITS AMONG LONG-STAY HOME CARE CLIENTS

"Identifying and modifying factors responsible for ED use during an illness episode may result in better use of emergency care and better health outcomes."
Shah et al., 2003.

"It is painfully obvious that at this point our theoretical and empirical sophistication are such that we lack the ability to fill in much of the information that the [Behavioural Model of Health Services Use] calls for. Much work remains to be done before approaches such as this one will be truly effective. In the meantime, however, policy decisions will continue to [be] made, often with very little information."
Andersen & Newman, 1973.

2.1 INTRODUCTION

2.1.1 Home Care in Canada

Home care was first introduced in Canada (Ontario) in 1970, and by 1988 all provinces and territories had home care programs for persons who were post-acute or required long-term supportive care (MacAdam, 2004; Canadian Home Care Association, 2008). Despite the lack of a national framework under the Canada Health Act, home care has been a growing sector in Canadian health care since its first introduction (Canadian Home Care Association, 2008). Provincial home care expenditures grew rapidly in the 1990's, but have not seen additional growth since 1998 (CIHI, 2007). Overall, home care still represents a small portion of provincial health care spending (CIHI, 2007). The desire of the population to receive care in their homes, the growing availability of services and treatments that were traditionally only available in institutional settings, as well as the perception of cost-efficiency serve as a rationale for the expansion of home care and establishing national standards (Commission on the Future of Health Care, 2002; Seggewiss, 2009; Canadian Home Care Association, 2008).

Home care services are currently funded and administered within provinces and territories. The role of non-governmental agencies in the delivery of publicly funded programs and services can broadly distinguish home care programs across Canada. Manitoba, Prince Edward Island, Saskatchewan, Quebec, and the Territories administer and deliver home care services entirely within the public sector. Ontario, representing the opposite scenario, administers home care within the public sector, but contracts with private agencies (for-profit and non-profit) to deliver all publicly funded services. The remaining provinces also administer home care in the public sector, but deliver services through a mix of public and private providers (Canadian Healthcare Association, 2009; Seggewiss, 2009). The public delivery of services is commonplace in the rural and remote regions of all provinces where there are no private service agencies. In Ontario, home care services are administered by 14 Community Care Access Centres (CCACs), which exists within the 14 Local Health Integration Network (LHIN) boundaries (see Appendix A).

Though the majority of home care clients are elderly, home care also serves persons with disabilities, person with mental illness, persons who are palliative, and community pediatrics (Canadian Home Care Association, 2008). Estimates of the proportion of older adults served by home care are largely incomplete. In 2003, approximately 650,000 Canadians received home care services (Statistics Canada, 2006). By 2008 approximately 900,000 Canadians received home care services (Canadian Home Care Association, 2008). Precise estimates for older adults (age 65 or older) are not reported. Based on Ontario provincial figures on population size and home care service volume, approximately 19% of all older adults in Ontario receive service from CCACs in any given year (see Appendix B).

Long-stay home care clients are defined as those who are expected to receive services for longer than 2 months. These clients account for the vast majority of home care expenditures, while accounting for a minority of client cases discharged per year. Based on a single Ontario region (accounting for approximately 11% of the Ontario population), it can be estimated that approximately 8% of all older adults in Ontario are long-stay community home care clients in any given year (see Appendix C). Approximately 33% of older adults over the age of 85 living in the community are long-stay home care clients (see Appendix D). Unlike post-acute or 'short-stay clients', all long-stay clients receive a comprehensive assessment using the Resident Assessment Instrument Home Care (RAI-HC) (Morris et al., 1997) (also see Chapter 2 Methods). The RAI-HC is used among long-stay clients in many Canadian jurisdictions, including: Alberta, British Columbia, Manitoba, Newfoundland and Labrador, Ontario, Nova Scotia, Saskatchewan, and the Yukon Territory. The availability of such census-level, comprehensive information represents a large opportunity for research (Hirdes et al., 1999). Research on home care using RAI-HC data has already expanded the evidence base in health services use among the community-dwelling older adults (Health Council of Canada, 2012a, 2012b; Hirdes, 2006).

Though the comprehensiveness of service varies across provinces, home care services available to older adults generally include post-acute services (e.g., wound care, rehabilitation), nursing, the use of home health and mobility equipment, therapies, long-term supportive care (e.g., personal support and homemaking), respite care, and access to services/programs/placements in

other sectors or agencies. The range of home care services exists to help older adults with chronic conditions and disability to return, or remain, in their private residence as well as delay, or prevent, the use of long-term care or hospital care (Canadian Home Care Association, 2008; Sarma, Hawley, & Basu, 2009). Recent trends in home care provision suggest that more nursing and specialty care services are being provided to allow for better management of chronic diseases and an increase in post-acute transfers (Wilkins, 2006). Similarly, the Ontario Ministry of Health and Long-term Care (MOHLTC) established an 'Aging at Home Strategy' in 2007, and expanded the program in 2010 (MOHLTC, 2009). The Ontario strategy, largely administered by the LHINs, was introduced to expand the range of home and community care services and provide funding for innovative regional programs that prevent the avoidable use of long-term care, EDs, and hospitals (Ontario Home Care Association, 2010). Though provincially unaccounted for, many Ontario CCAC/LHINs have introduced specialized programs with new Aging at Home funding, such as rapid response teams or nurse practitioner teams, to meet the disease management needs of home care clients living in the community.

2.1.2 Emergency Department Use among Older Home Care Clients

Close to 40% of Ontario home care clients have a hospital admission, ambulatory ED visit, or emergent care visit between their, roughly, 6 month assessment intervals (Hirdes et al., 2004). Wilson and Truman (2005) explored ED utilization among home care clients using population level ED data in Alberta. They found that home care clients have approximately double the ED utilization rate relative to nursing home residents and older adults in the community without publicly funded home care. This research suggests that provincial home care agencies serve a group of community dwelling older adults that are at very high risk for ED visits. The authors concluded that services provided by home care agencies do not adequately meet the needs of high-risk older adults. However, their findings may also reflect the risk profile of home care clients.

Home care services have the potential to reduce the risk of ED visits (Bernabei et al., 1998; Hughes et al., 1997; Landi et al., 1999; Oeseburg, Wynia, Middel, & Reijneveld, 2009; Tomita, Yoshimura, & Ikegami, 2010). Results from international studies suggest that assessment coupled

with appropriate intervention can mitigate hospitalizations among home care clients and save health care costs (Bernabei et al., 1998; Landi et al., 1999; Oeseburg et al., 2009; Tomita et al., 2010). Also, an Israeli time series evaluation found that acute care utilization increased substantially after the cancellation of home-based nursing services (Jacobs et al., 2007). Community health care schemes based on case management have also been shown to increase preventative approaches such as medication reviews (Onder, Liperoti, Bernabei, & Landi, 2008). Other research suggests that home-based services can improve health outcomes and are cost-effective, although ED or hospital use was not examined (Chappell, Dlitt, Hollander, Miller, & McWilliam, 2004; Hollander & Chappell, 2007; Markle-Reid et al., 2006; Weissert & Hedrick, 1994).

In order to be practically and financially sustainable, effective home care service provision requires a method of identifying older home care clients at risk for outcomes. The efficacy of identifying older persons at risk for poor outcomes is supported in the literature (Elkan et al., 2001; Stuck, Beck, & Egger, 2004; Thomas, Worrall, Elgar, & Knight, 2007). A systematic review and meta analysis of home-based support conducted by Elkan et al. (2001) underscored the value of simple risk stratification in the provision of services. A multi year randomized control trial by Thomas et al. (2007) tested the untargeted use of the RAI-HC for community-dwelling older adults (age 75 or older) and found no benefit. Methods to prioritize home care clients at risk for unplanned ED visits are needed to ensure the effective use of specialized home care services. In addition, hospital use has been established as quality issues in home care through home care quality indicators (Dalby & Hirdes, 2008; Dalby, Hirdes, & Fries, 2005; Hirdes et al., 2004).

Few studies have examined the determinants of ED or hospital use among home care clients. A cross-sectional study by Paddock and Hirdes (2003) found that activities of daily living (ADL) impairment, poor self-reported health, and nutritional concern was associated with a greater likelihood of past hospital admissions, ambulatory ED visits, or multiple emergent care visits (composite outcome). Research on home care quality indicators suggests that clients who are post-acute or have edema are associated with a greater likelihood of future hospital admissions, ambulatory ED visits, or emergent care visits (composite outcome) (Hirdes et al., 2004). No

published literature was found that examined the determinants ED visits specifically. General literature based on largely unclassified community dwelling older adults can suggest potential determinants for ED visits among home care clients.

2.1.3 Determinants of Emergency Department Visits among Community Dwelling Older Adults

Since 1987, eighteen separate studies have examined determinants of ED visits among representative samples non-institutionalized older adults (see Appendix E). Overall, they suggest that a large number of determinants may predict the use of EDs by long-stay home care clients.

Demographic determinants such as age, marital status, and living arrangement were found to be significant determinants of ED visits in just over half of the studies where they were employed. Detailed analyses of age showed that thresholds of 75 years and 85 years drive the overall effect (Baum & Rubenstein, 1987; Ettinger et al., 1987; George et al., 2006; Lowenstein et al., 1986; Rosenblatt et al., 2000; Salvi et al., 2007; Strange et al., 1992; Wofford et al., 1993). Specifically, multiple studies showed that persons age 75 or older as well as those age 85 or older accounted for a disproportionate number of ED visits relative to younger elderly (Baum & Rubenstein, 1987; Downing & Wilson, 2005; Ettinger et al., 1987; Rosenblatt et al., 2000). Spousal status - particularly widowhood - was been found to be a significant predictor of ED visits in some studies (Crane et al., 2010; Shah, Rathouz, & Chin, 2001; Wolinsky et al., 1983). However, results are inconsistent and effect sizes are relatively weak. Sex or gender was not found to be a significant determinant of ED visits in the five studies that examined it. Socio-economic status - expressed in terms of income, education, or occupation – is an inconsistent determinant of ED utilization. Again, studies that showed measures of socio-economic status to be significant determinants of ED visits also report relatively weak effect sizes (Ionescu-Ittu et al., 2007; Shah et al., 2001).

Conditions that are directly or indirectly associated with cognitive deficits were often significant predictors of ED visits, including: dementia, stroke, and memory difficulty (Crane et al., 2010; Walker, Jamrozik, & Wingfield, 2005). Measures of functional status – including restrictive activities or use of home health aids – were occasionally found to be significant determinants of

ED visits (Gill, Allore, & Guo, 2003; Shah et al., 2001; Walker et al., 2005; Walter-Ginzburg et al., 2001). The prognostic value of functional status was often tested given that functional performance is a common pathway through which physical, cognitive, and psychosocial illness also materialize. However, half of the studies that examined measures of functional status did not find a significant relationship with ED visits (Hansell, Sherman, & Mechanic, 1991; Parboosingh & Larsen, 1987; Shelton, Sager, & Schraeder, 2000; Wolinsky et al., 1983). Sensory deficits related to vision were significant determinants of ED visits (Bazargan, Bazargan, & Baker, 1998; Walker et al., 2005). With the exception of one study (Parboosingh & Larsen, 1987), a significant and consistent predator of ED visits across the studies was self-reported health (Bazargan et al., 1998; Ginsberg, Israeli, Cohen, & Stessman, 1996; Hansell et al., 1991; Shah et al., 2001; Walter-Ginzburg et al., 2001). Independent variables related to a declining health trajectory, including: nutritional issues, cancer, and stressful events were consistent determinants of ED utilization (Crane et al., 2010; Hansell et al., 1991; Wolinsky et al., 1983). Measures of health instability, including: cardiac conditions, diabetes, stroke, comorbidity count, and polypharmacy were inconsistently associated with ED visits. However, studies that found such measures to be significant determinants of ED visits usually reported relatively large effect sizes (Bazargan et al., 1998; Crane et al., 2010; Shah et al., 2001; Shelton et al., 2000; Walker et al., 2005; Walter-Ginzburg et al., 2001).

Measures of past health care utilization were found to be the most predictive determinants of future ED utilization. Both access to and consistency of primary care were found to be robust determinants of ED utilization where better access and more consistency predict reduced ED use (Bazargan et al., 1998; Ginsberg et al., 1996; Ionescu-Ittu et al., 2007; McCusker et al., 2009, 2012b; Rosenblatt et al., 2000; Wolinsky et al., 1983). Both IonescuIttu et al. (2007) and Rosenblatt et al. (2000) further examined the effect of primary care access and found that it was not influenced by socio-economic status and persisted across age strata. IonescuIttu et al. (2007) also found that the continuity of primary care had a stronger protective effect in urban than in rural areas. This differential effect on ED visits may be due to the greater ease of service integration in rural locations, a decrease in variability, or the increased familiarity among rural

care providers (McCusker et al., 2012a). Lishner et al. (2000) found that living in a rural location was negatively attributed with ED utilization, potentially due to the fact that the analyses did not control for primary care access. In contrast to the preventative effect of primary care, McCusker et al. (2012b) found that access to a specialist community-based physician predicted greater use of the ED. However, their finding is subject to a selection bias. By far the most predictive determinant of ED visits examined in the primary studies was that of previous hospital utilization (Crane et al., 2010; Ginsberg et al., 1996; Parboosingh & Larsen, 1987; Shelton et al., 2000). Without exception, studies that measured one or more prior hospital encounters found highly positive association with future ED utilization. A sensitivity analysis found that the inclusion of prior acute care utilization in multivariate models substantially increased the explained variance (Crane et al., 2010).

Studies of system-level determinants of ED utilization were rare. The Canadian study by Wilson and Truman (2005) found that home care clients were at highest risk for ED visits relative to nursing home residents and community dwelling older adults not receiving publicly funded home care services. Although rates of ED utilization reflect person-level health status and access to services, they may also be related to the integration of health care resources, particularly primary care. However, research has yet to determine the precise relationship of system-level determinants.

Threats to validity challenge much of the studies on determinants of ED use among community dwelling older adults. These issues primarily relate to the choice or availability of dependent measures, the comprehensiveness of independent variables, and the study designs employed. Overall, the evidence base is not robust enough to reflect the prevalence of ED visits as well as their determinants.

Dependent measures of ED utilization included dichotomous and continuous measures of ED use. Three studies used both classes of measurement to explore determinants, but ultimately used a dichotomous measure for inferential analyses (Ginsberg et al., 1996; Lishner et al., 2000; Rosenblatt et al., 2000). Those that employed a continuous measure differ from those that employed a dichotomous measure in that they are also determining predictors for multiple ED

use. One study examined ED re-visits after an index visit, which likely distorted the absolute risk of ED visits, particularly in the short-term (McCusker et al., 2009). None of the studies explore the relative benefits of the dependent measure chosen, or provide a rationale. Similarly, no study stated the rationale for the risk period used to inform the dependent measure. Risk periods varied from 90 days to up to two years. Studies that sought to determine ED use in a longer risk period were less likely to find associations between transient characteristics, and were more likely to find associations between durable socio-demographic determinants. One study that did not employ a consistent risk period may have introduced a substantial error in associations (Walker et al., 2005). No study conducted sensitivity analyses of different risk periods. Many studies utilized a self-report of ED use rather than objective sources (Bazargan et al., 1998; Gill, Desai, Gahbauer, Holford, & Williams, 2001; Ginsberg et al., 1996; McGee et al., 2008; Walter-Ginzburg et al., 2001; Wolinsky et al., 1983). These studies were also more likely to find that self-rated health and access to other sources of care were significant determinates of ED use. The effect of self-rated health in such studies may reflect a self-fulfilling bias, where persons who rated poorer health may be more likely to remember past ED use. Also, many studies used physician-billing records to determine ED use rather than administrative ED records (Crane et al., 2010; Hansell et al., 1991; McCusker et al., 2009; Shelton et al., 2000). These studies may have increased random error given the difficulty in distinguishing physician access in the ED compared to in the community. Perhaps the most critical omission in the empirical studies was that no study explicitly differentiated unplanned ED visits from planned ED visits. Though unplanned visits are thought to account for the majority of ED visits, the investigators did not comment on the extent to which planned visits were included in the dependent measure. This omission could have biased the results toward finding significant relationships between particular characteristics associated with planned ED visits. For example, the use of renal dialysis, common among persons with diabetes, may bolster an association between diabetes and ED use. Also, it is conceivable that community physicians in rural areas sometimes direct their patients to visit them in the local ED while working there.

The comprehensiveness of the independent variables included in the empirical studies is also a concern. Six of the eighteen studies reported the effect of only one or two independent variables

(Gill et al., 2001; Lishner et al., 2000; McGee et al., 2008; Murphy & Hepworth, 1996; Rosenblatt et al., 2000; Soghikian, Midanik, Polen, & Ransom, 1991). Of those that reported more than two independent variables, many lacked a comprehensive set. Overall there was a systematic lack of functional-status and symptom related measures in favour of diagnoses (Crane et al., 2010; Gill et al., 2001; Ginsberg et al., 1996; Ionescu-Ittu et al., 2007; Lishner et al., 2000; McGee et al., 2008; Rosenblatt et al., 2000; Shelton et al., 2000; Soghikian et al., 1991; Walker et al., 2005; Walter-Ginzburg et al., 2001). Information sources used to collect independent variables were mainly surveys and administrative medical records. Understandably, the overreliance on diagnosis was particularly noted in studies that utilized medical records as a source of information. The lack of a comprehensive set of clinically relevant independent variables limits the evidence base.

Population samples, research designs, and analytical approaches used by some the empirical studies caused threats to validity. Mainly use of cross sectional designs in the majority of the studies introduces issues of temporal sequence between the predictors and dependent measures (Bazargan et al., 1998; Gill et al., 2001; Ginsberg et al., 1996; Ionescu-Ittu et al., 2007; Lishner et al., 2000; McGee et al., 2008; Murphy & Hepworth, 1996; Parboosingh & Larsen, 1987; Rosenblatt et al., 2000; Shah et al., 2001; Soghikian et al., 1991; Walter-Ginzburg et al., 2001). For example, it is hard to distinguish whether self-reported health, activity, and views of the health system were causes of ED utilization or the result of an ED event. Only a few studies were able to employ a population-level samples (Ionescu-Ittu et al., 2007; Rosenblatt et al., 2000; Shah et al., 2001; Walter-Ginzburg et al., 2001). Two studies utilized very specific population samples (Bazargan et al., 1998; Gill et al., 2001), and many more used primary care clinic samples (Bazargan et al., 1998; Crane et al., 2010; Mazzaglia et al., 2007; Walker et al., 2005). The use of clinical samples may have caused a bias toward those with access to primary care. The literature suggests that these individuals would have less absolute risk of ED use. Two studies that employed survey methods had substantial issues with response rates (Hansell et al., 1991; McGee et al., 2008). With respect to analytical approaches, some studies used ED visit counts in as their dependent measure but gave no indication that they considered the use of Poisson regression rather than linear regression (Crane et al., 2010; McGee et al., 2008).

Despite some limitations, empirical studies of ED utilization among non-institutional older adults identified multiple determinants of ED utilization. However, the studies showed that much of the variance in utilization remained unexplained. Clearly, the information requirements and study designs necessary to improve on the existing literature are prohibitive, particularly for those employing primary collection. The secondary use of existing census-level data in Canada, particularly in home care, represents an opportunity to improve on existing studies without substantial investment in primary data collection.

2.1.4 Conceptual Frameworks

The Andersen Behavioural Model of Health Services Use, initially developed in the late 1960's, remains the dominant conceptual framework used to examine health service utilization (Andersen & Newman, 1973; Andersen, 1995). Andersen, a medical sociologist, developed a framework to describe why persons use health services. Specifically, he was interested in describing ambulatory physician use among families (Andersen & Newman, 1973). His was the first model to conceptualize components of health service utilization in a coherent multi-level and multi-dimensional model that integrated the best evidence at the time. Since its publication in 1973, the Andersen Behavioural Model has been applied to many types of health services use and many sub-populations (Andersen, 1995; Babitsch, Gohl, & von Lengerke, 2012). The Andersen Behavioural Model of Health Services Use suggests that characteristics of a society influence the health care system, and that both the society and the health care organization influence how persons use health services. Andersen further delineates the model by categorizing a person's use of health care services as a reflection of three domains: their predisposition, enabling factors, and need for care (see Appendix F). Predisposing factors are those that, relatively fixed, make someone inclined to use a particular health service. Enabling factors are those, external to the person, which encourage or impede a person from accessing the particular health service. Finally, need characteristics are perceived or evaluated health status of the person. The model suggests a process where predisposing and enabling factors are somewhat exogenous, and need factors are necessary components to any health services use (Andersen & Newman, 1973).

Five of the eighteen empirical studies that examined determinants of emergency department visits explicitly utilized the Andersen Behavioural Model to conceptualize their independent variables (Bazargan et al., 1998; Parboosingh & Larsen, 1987; Shah et al., 2001; Walter-Ginzburg et al., 2001; Wolinsky et al., 1983). With the exception of the study by Parboosingh et al. (1987), all of the studies that employed the Andersen Behavioural Model found that the 'need' determinants were the most powerful class of predictors (Bazargan et al., 1998; Shah et al., 2001; Walter-Ginzburg et al., 2001; Wolinsky et al., 1983). Bazargan et al. (1998) found that need determinants accounted for half of the explained variance in their Andersen-based model. Enabling factors were the least useful domain accounting for 5% more explained variance and 3.5% variance more explained variance when combined with predisposing factors. It is suggested that the extent to which need determinants account for variance in utilization beyond enabling factors (e.g., local supply) reflects greater equitable access (Andersen, 1995; McCusker et al., 2009).

McCusker et al. (2003) modified the Andersen Behavioural Model to better represent ED utilization among older adults (see Appendix G). Specifically, their modified framework better accounted for the relationship between primary care use and ED use by separating predisposing and enabling factors that drive these separate pathways. Their model suggests that need factors and unspecific predisposing and enabling determinants will result in ED utilization only in the absence of predisposing and enabling determinants for primary care utilization. Where primary care predisposing and enabling determinants exist, then ED utilization is less likely. The strength of this adaptation is its ability to account for the demonstrated modulating effect of primary care access and continuity on ED utilization (Bazargan et al., 1998; Ionescu-Ittu et al., 2007; McCusker et al., 2012b), notwithstanding that predisposing and enabling determinants for both end points vary greatly by the model of primary care available (Glazier, 2012).

Use of the original Andersen Behavioural Model or McCusker's adaptation is not without some potential drawbacks. With limited research available on ED utilization it is difficult to judge the accuracy of these models, especially their application to risk assessment at the point of care. Also, it is unclear whether many predisposing and enabling factors such as age, sex, socio-economic

status and education are not proxies to an unmeasured or poorly measured characteristic of need. For example, many studies found that age is a predisposing determinant of ED utilization, yet chronology is unlikely to represent a true predisposing pathway to ED utilization – need and enabling factors likely underlie the relationship. Need might also reflect social phenomena. For example, perceived need may also be related to a person's education, social status, and other predisposing or enabling factors. Ultimately, the apparent correlation between predisposing, enabling, and need determinants suggests that many determinants represent the similar underlying phenomenon (Bazargan et al., 1998). Also, it is difficult to categorize many of the most predictive empirically derived determinants within the Andersen Behavioural Model or McCusker's adaptation. For example, researchers have categorized past ED utilization discrepantly (see Mccusker et al., 2003, and Parboosingh et al., 1987). Past ED utilization could be considered a reflection of all three Andersen domains as it may suggest a persistent deterioration in health, favourable access to the ED, or a strong preference toward ED care. The inconsistent categorization of determinants within the Andersen Behavioural Model has been found in other utilization research (Babitsch et al., 2012).

Given the inherent subjectivity of the Andersen Behavioural Model, Grunier et al. (2010) proposed an alternate framework of ED utilization based on McCusker et al.'s adaptation (see appendix H). This model conceptualizes 'need' and the necessity for ED care as a function of inadequate proactive primary and supportive care. Their model also conceptualizes re-presentations to the ED as a function of continued unmet care needs. However, Gruneir et al.'s model while representing more measurable pathways, does not account for ED use for medical emergencies that cannot be moderated by reasonably defined proactive care. That is, some unavoidable emergency needs may represent stochastic events that are not influenced by enabling determinants (as in McCusker's adaptation).

The current state of knowledge concerning person-level determinants of ED utilization among older adults cannot improve or refute popular conceptual models. Empirical investigations should advance existing conceptual models by testing their assumptions. The use of conceptual models

to drive practice and policy in health care related to ED utilization is limited without empirical validations and elaborations of predisposing, enabling, and need determinants.

2.1.5 Risk Assessment Models

Four studies of ED utilization among non-institutional older adults have developed or validated practical risk models to predict ED utilization among non-institutionalized older adults (see Appendix I). A study by Shelton et al. (2000) developed the first method to predict ED utilization (as well as hospital utilization) known as the Community Assessment Risk Screen (CARS). The CARS was based on a self-report survey sample where three items were found to be highly predictive based on a multivariate logistic regression model. The adjusted effect size (odds ratio) of each item was summed to produce a score. Scores range from 0 – 7, and the authors suggest that collapsing scores greater than or equal to 4 as high risk', all others as 'low risk'. Shelton et al. (2000) reported an AUC value of 0.67 based on the suggested split. Crane et al. (2010) developed the Elders Risk Assessment Index (ERA) based on the use of existing electronic medical records. The weighted index relied on nine items (determined by stepwise regression) weighted according to each item's parameter estimate. The ERA produced 5 risk groups representing ranked quartiles in the derivation sample where the highest quartile was further split by the top decile. The validation sample yielded an area under the ROC curve (AUC) value of 0.64.

Two other studies tested existing tools that were not originally developed to predict health services utilization. McGee et al. (2008) tested a Vulnerable Elders Survey (VES). The VES is an assessor driven survey, containing mostly functional measures, developed by Saliba et al. (2001) to predict future functional decline or death. McGee et al. (2008) tested this 13 –item/13-point scale by comparing high and low scores based on a two-level split. The authors show that there is some ability to differentiate based on relative frequency results but do not report any information on relative risk or predictive accuracy. Similarly, Walker et al. (2005) tested the Sherbrooke Questionnaire - a six-item tool developed by Hébert et al. (1996) to predict functional decline. Based on the best two-level score split the authors report an odds ratio of 1.94 (95% CI: 1.6-2.4) for ED attendance and 2.62 (95% CI: 2.0-3.5) for ED admission. No indication of predictive accuracy was provided.

All of the predictive tools reported in the literature are based on an additive approach to scoring (items or effect sizes). Additive and indexing methods of risk screening may limit use in point-of-care clinical decision-making because of the difficultly to comprehend the risk pathway and clinical profile of persons at risk. It is difficult to identify the most appropriate intervention without a clear understanding of the risk pathway that underlies a person's relative risk. Given that risk tools typically support decision-making for referral, which can include consideration of eligibility, the ability to ascertain the clinical profile of at risk persons is also a crucial component. With exception to the most basic among them, additive methods of risk assessment can be difficult to translate in clinical practice.

The usability of some existing risk tools at the point of care is also problematic. For example, the CARS and the Sherbrooke Questionnaire were developed based on client driven approaches (where the client completes the tool independently). The practicality and reliability of client driven tools in community care practice is largely untested. However, a recent study compared the psychometric properties of three self-report 'frailty' tools and determined that the Sherbrooke Questionnaire had poor internal consistency as well as poor construct validly (Metzelthin et al., 2010). Further, ED geriatric screeners originally developed for a patient driven process are rarely, if ever, used as such in actual clinical practice (McCusker et al., 2001). The ability of non-clinicians to comprehend screening questions and to complete a clinical self-assessment objectively makes for unusable information in most health care settings. Finally, the lack of validation severely limits the use of some existing risk tools. In particular, the validity of the VES and the Sherbrooke Questionnaire as predictive tools for ED utilization is unknown given their alternate development and the lack of adequate validation, whereas both the ERA and CARS show moderate performance in split sample validation studies. Any effort to improve existing risk models should demonstrate improved prediction in head-to-head validations with the ERA and CARS as well as demonstrate practical enhancements for users at the point of care.

2.2 RATIONALE AND OBJECTIVES

Home care agencies serve a group of community-dwelling older adults that are likely at high risk for ED use. A lack of knowledge concerning the absolute and relative ED utilization among home care clients is a large gap in the literature. Empirical studies that employ a comprehensive set of independent variables and utilize contemporary modeling methods are also required to improve existing theoretical frameworks and practical risk models. A model to identify home care clients at risk for unplanned ED use, informed by the Andersen Behavioural Model, would represent a useful advancement in the research literature and refine clinical reasoning in home care.

The objective of this chapter is to examine ED utilization among long-stay home care clients and develop a theoretically driven, prospective model to differentiate their risk of unplanned ED use. The following phases will be employed:

Phase 1: An examination of the prevalence of home care clients in the emergency department. This phase will determine the volume of unplanned ED visits by older adults accounted for by home care clients. This examination will provide a staging ground to phase 2 by determining to what extent home care clients contribute to overall ED utilization among older adults. In this phase the following questions will be evaluated:

- What is the prevalence of home care clients (long-stay vs. short-stay) among unplanned ED visits stratified by time and age category, respectively?
- Does the prevalence of home care clients among unplanned ED visits suggest that preventative strategies in home care have the potential to influence overall ED utilization among older adults?

Phase 2: The development of an explanatory model to determine the risk of unplanned ED use among long-stay home care clients. The resulting risk model will articulate the person-level determinants of ED use among home care clients and contribute to the theoretical frameworks of unplanned ED use among non-institutionalized older adults. As well, the creation of risk assessment method can contribute to the prevention of unplanned ED visits in home care. In this phase the following questions will be evaluated:

- What person-level factors best reflect the risk of unplanned ED use?
- Do the determinants of unplanned ED visits among long-stay home care clients vary by health region/Local Health Integration Network (LHIN)?
- How well do existing prognostic tools validate against the final explanatory model among long-stay home care clients?
- What is the relative contribution of predisposing, enabling, and need factors in the final explanatory model?
- How does the final model for long-stay home care clients reflect that of the general literature and the Andersen Behavioural Model?

2.3 METHODOLOGY

2.3.1 Secondary Data Sources

2.3.1.1 The Canadian Institute for Health Information (CIHI) National Ambulatory Care Reporting System

The CIHI National Ambulatory Care Reporting System (NACRS) is a core clinical administrative database in Canada. It is the national standard and contains information on hospital ambulatory care since 1997, including: EDs, outpatient clinics, and surgical procedures. The main elements include demographic, clinical, service (diagnoses, procedures), and administrative episode data (e.g., length of stay, disposition). NACRS includes information on all ED visits in Ontario and is currently in jurisdictional use in British Columbia, Nova Scotia, Prince Edward Island, and the Yukon (Canadian Institute for Health Information, 2011). ED and outpatient clinic electronic information systems populate the NACRS data standard. Information is collected and entered by a clinical team that includes physicians, nurses, allied health workers, and clerical staff.

NACRS data represent the only source for census-level regional and provincial ED information, and is the 'gold-standard' source for ED episode information. It has been used within major ED research programs in Canada (Gruneir et al., 2010; Guttmann, Schull, Vermeulen, & Stukel, 2011; Khan, Glazier, Moineddin, & Schull, 2011; Li et al., 2007; Schull, Kiss, & Szalai, 2007; Schull, Lazier, Vermeulen, Mawhinney, & Morrison, 2003). Regional health authorities, provincial governments, and CIHI store NACRS data. In Ontario, NACRS data are also stored within selected LHINs and the Institute for Clinical and Evaluative Science (ICES). NACRS datasets from the Hamilton Niagara Haldimand Brant (HNHB) LHIN and CIHI were used in Phase 1 and Phase 2, respectively, as a source for dependent variables.

2.3.1.2 The Resident Assessment Instrument Home Care (RAI-HC)

interRAI (interrai.org) is a multinational network of clinicians and researchers from over 30 countries that develops and studies comprehensive clinical assessment instruments for multiple health sectors (Bernabei & Gray, 2009). Internationally, interRAI instruments are used extensively.

In Canada, they form the basis for clinical health information systems in long-term care, complex continuing care, inpatient mental health, and home care, with other instruments in jurisdictional use only (Hirdes et al., 1999). Each interRAI instrument provides information for care planning, risk assessment, case-mix, outcome measurement, as well as quality measurement, and common elements between the entire suite of instruments allows for the integration of health information across the continuum of care (Gray et al., 2009; Hirdes et al., 1999). The interRAI suite of assessment instruments has demonstrated reliability and validity (Carpenter et al., 2001; Hawes et al., 1995; Hirdes et al., 2008, 2002; Poss et al., 2008; Wellens et al., 2011).

Developed by interRAI, the RAI-HC is a comprehensive assessment of a person's strengths, preferences, and needs. As one of four interRAI instruments mandated for use in Ontario, the RAI-HC reliably documents important domains of a person's well-being, including: health, function, social support, diagnoses, service use and health related quality of life (Morris et al., 1997; Poss et al., 2008). A comparison of the RAI-HC to the International Classification of Functioning, Disability, and Health (ICF) showed substantial overlap in content (Berg et al., 2009). Subsets of RAI-HC items are used to generate summary and risk scales, including: the Cognitive Performance Scale (CPS) (Morris et al., 1994), the Depression Rating Scale (DRS) (Burrows, Morris, Simon, Hirdes, & Phillips, 2000; Koehler et al., 2005; Martin et al., 2008), the Changes in Health, End-stage Disease, and Signs and Symptoms (CHESS) Scale (Armstrong, Stolee, Hirdes, & Poss, 2010; Hirdes, Frijters, & Teare, 2003), and the Method for Assigning Priority Levels (MAPLe) (Hirdes, Poss, & Curtin-Telegdi, 2008) (see Appendix J). The RAI-HC includes care-planning protocols, referred to as Clinical Assessment Protocols (CAPs) (InterRAI*,* 2008). These CAPs were created for interRAI instruments in use for community health, home care, assisted living, and LTC. CAPs are automatically generated from the assessment items to guide comprehensive care and service planning. CAPs can be triggered for resolving problems, reducing the risk of decline, or increasing the potential for improvement (see Appendix K). At the individual level, CAPs facilitate need-based referral and longitudinal outcome assessment. At an aggregate level, they can be used as a basis for population needs assessment. The RAI-HC data elements combined with its applications contain close to 300 characteristics.

The RAI-HC assessment was mandated regionally or provincially in Alberta, British Columbia, Manitoba, Newfoundland and Labrador, Nova Scotia, Ontario, Saskatchewan, and the Yukon Territory for long-stay (expected to be on service for greater than 2 months) home care clients and nursing home placement applications. Trained case managers, who usually are registered nurses or social workers, complete assessments in all jurisdictions that use the RAI-HC. Assessment information is gathered from multiple sources, including: clinical observation and discussion with the client, corroborating information sources[1], and available medical records. For long-stay clients, a RAI-HC assessment is completed at admission and then at roughly six month intervals thereafter. Assessments may be conducted before the 6-month interval if a significant change in health has occurred. Also, it is not uncommon for reassessments to occur beyond 6 months, as case managers deal with competing priorities among their caseloads.

The comprehensiveness, scale, reliability, and validity of RAI-HC assessment in home care make these data ideal for public health and health services research. Particularly, the long-stay home care clients represent an impaired, frail subgroup of community-dwelling older adults that are highly relevant to contemporary topics in health services and policy. Electronic, census-level RAI-HC data from Ontario, Winnipeg Regional Health Authority (WRHA), Nova Scotia, and the Yukon are stored at both CIHI and interRAI at the University of Waterloo. RAI-HC data from Ontario are stored at the Ontario Association of Community Care Access Centres (OACCAC), ICES, CCACs, and the interRAI Canada at the University of Waterloo. Datasets from the HNHB CCAC and interRAI at the University of Waterloo were used in Phase 1 and Phase 2, respectively, as a source for independent variables.

2.3.1.3 The OACCAC Client Health Related Information System (CHRIS)

In Ontario, all community based discharges and admissions (including palliative care, home care, and LTC) as well as home care services are coordinated through CCAC's and require an electronic receipt for each client's admission, discharge, and service utilization. An individual record consists of a client identifier, sex, responsible CCAC, referral site, discharge information, and receipt of

[1] Including formal and informal caregivers, as well as family.

care. Across Ontario this information is collected in the Client Health Related Information System (CHRIS) software and stored electronically in relational data sets. These data can be expected to be highly reliable, as there is an incentive on the part of the CCACs to have accurate information concerning the location/discharge and services provided for their clients for performance accountability, financial accountability, and reconciliation of billed services. CHRIS databases are stored by each CCAC as well as the OACCAC. CHRIS datasets from the HNHB CCAC were used in Phase 1 as a source for ED patient stratification.

2.3.2 Phase 1: An examination of the prevalence of home care clients in the emergency department

2.3.2.1 Design and Setting

A cross sectional study was conducted using existing NACRS data for patients age 65 or older in the HNHB LHIN who were registered in the ED between April 1st 2008 and March 31st 2012. Each unique case was used as the unit of analysis in order to reflect ED case volumes. The HNHB LHIN serves over 1.3 million people, accounting for approximately 11% of the population in the province of Ontario as well as the largest number of adults over the age of 65 years. It contains 12 municipalities with wide variations in population density (rural and urban) and socioeconomic status. There are 12 hospital corporations in HNHB – including small community, regional, and large tertiary academic centers. Ethics clearance was granted from the University of Waterloo Office of Research Ethics (ORE#16597).

2.3.2.2 Data Sample and Analytic Strategy

A unique HNHB LHIN region-wide business intelligence system containing data from all hospitals and the HNHB CCAC was used to access linkable NACRS, RAI-HC, and CHRIS records from April 1st 2008 to March 31st 2012. Case level NACRS records were restricted to ED records by excluding those related to ambulatory care, therapies, and urgent care clinics. ED records from planned visits (using the visit type codes), and for persons younger than age 65 were also excluded. Planned ED visits (accounting for less than 3% of overall ED visits) were excluded to eliminate

physician directed ED utilization, particularly in rural areas. ED patients less than age 65 were excluded in order to best reflect the demographic profile of home care clients in HNHB: mean age 74, Inter Quartile Range 65-86). The eligible ED records were then stratified by fiscal year and conventional age categories. CHRIS administrative home care records were restricted to those that were assigned to admitted home care referrals.

NACRS ED records and CHRIS home care records were combined using many-to-many methods. Each record match was then evaluated to determine if the person was on an active home care at time of ED registration. A patient was identified as a 'home care client' in this study if the patient was on an active home care caseload for at least 7 days before ED registration. The use of a 7-day window was established through consultation with HNHB CCAC Decision Support Unit in order to reflect the opportunity of the home care agency to assess and intervene prior to the ED visit. ED records identified as a home care client were further stratified by client status as (either long stay or short stay) using the service recipient code that was assigned at 7 days preceding the ED registration. RAI-HC assessment records were also linked with the ED records flagged as a home care client in order to corroborate each client's status as either long or short stay.

The prevalence of home care clients (stratified by client type) among unplanned ED cases age 65 or older was stratified by fiscal year and age category, respectively. In addition, the proportion of long-stay home care clients admitted to acute care was stratified by fiscal year and age category, respectively, in order to establish rough estimates of subsequent acute inpatient utilization. All confidence intervals were calculated at the 95% level and based on binomial estimation of the standard error of a proportion. The statistical significance between each fiscal year and age category was ascertained by comparing the 95% confidence intervals of the proportions. Data manipulation and analyses were performed using SAS® Version 9.2 for Windows (SAS Institute, Inc., Cary, NC).

2.3.2.3 **Phase 2: The development of an explanatory model to determine the relative risk of unplanned ED use among long-stay home care clients**

2.3.2.4 Design and Settings

A retrospective cohort study was conducted using RAI-HC assessment records linked prospectively to NACRS ED records in Ontario and WRHA from April 1st 2007 to September 29th 2010 and January 1st 2006 to September 29th 2009, respectively. Each unique RAI-HC assessment was used as the unit of analysis to reflect decision-making at the point of assessment, and to maximize explanatory power. Ontario is Canada's most populous and fourth largest province or territory, representing approximately 39% of the Canadian population (2012 estimates). WRHA encompasses the city of Winnipeg and its surrounding rural municipalities, accounting for over half of the population in the province of Manitoba. Ethics clearance was granted from the University of Waterloo Office of Research Ethics (ORE #17045).

2.3.2.5 Outcome Data (Dependent Variables)

NACRS records from Ontario and WRHA housed at the University of Waterloo were used as the source for dependent variables. These records were not census-level; representing only the NACRS records that were related to home care clients. The NACRS records were restricted to unplanned ED records. Each RAI-HC assessment record was linked prospectively to unplanned ED records using unique personal level identifiers and many-to-many merge methods. A 6-month risk period was chosen to reflect the assumed durability of time-sensitive, transient independent measures, as well as current assessment intervals in home care. Flags were created for RAI-HC records that were linked to one or more unplanned ED records within 6 months of assessment, and the time (in days) to first unplanned ED visits was calculated for flagged RAI-HC records. All unplanned ED visits after 183 days were right censored. Also, deaths within 6-months of the assessment, and not proceeding an unplanned ED visits, were censored at the date of discharge. The absolute distribution of unplanned ED visits, within 6-months of assessment, was tabulated. Also, a Kaplan-Maier survival curve for days to first unplanned ED visit was plotted.

Any unplanned ED visit within 6 months (183 days) after the RAI-HC assessment date (baseline) was chosen as the primary dependent variable given that the goal of conceivable preventive initiatives is to preempt any future ED use. However, two or more unplanned ED visits within 6 months of a RAI-HC assessment date was chosen as a secondary dependent variable to ensure that explanatory models are sensitive to persons with multiple unplanned ED visits. ED visits from persons with multiple visits are more likely to be preventable given that one or more visits were did not result in a death or discharge to a higher level of care. The distribution of unplanned ED visits suggested that two or more ED visits was a more feasible, and therefore informative, target compared to three more ED visits. Finally, time (in days) to first unplanned ED visit from RAI-HC assessment date was chosen as a tertiary, ad hoc, dependent measure for model evaluation.

2.3.2.6 Baseline Data (Independent Variables)

Census-level RAI-HC assessment records from Ontario and WRHA housed at the University of Waterloo were used as the source for candidate independent variables at the time of assessment (baseline). Only RAI-HC assessment records related to community-dwelling home care clients were included in order to eliminate hospital and long-term care (nursing home) based assessments. Hospital assessment records were excluded to best represent community-dwelling older adults. Chronological age was not used as an exclusion category given that 80% of long-stay home care clients were over the age of 65, 95% were over the age of 50, and those less than 65 in home care were likely to represent a similar frailty level (or 'biological age') as those over the age of 65 (Rockwood, Fox, Stolee, Robertson, & Beattie, 1994).

A 7-member, 5-country clinical panel was recruited to inform analytical decision-making throughout this dissertation (see Appendix L). This group, primary derived from the interRAI Network of Excellence in Acute Care, contained 5 geriatricians, 2 emergency physicians, and 1 member who practiced in geriatric and emergency medicine. In addition, 5 members led research programs and were familiar with data sources and methods employed in this dissertation. All who were invited to join the clinical panel accepted the invitation.

The clinical panel was used to pre-select independent variables given that the RAI-HC assessment contains approximately 229 candidate independent variables. The RAI-HC assessment was used to produce an independent variable ranking survey (see Appendix M). Through an emailed survey, the clinical panel was asked to rank each RAI-HC item from 1 (Expected to be Least Predictive) to 3 (Expected to be Most Predictive) of future unplanned ED use. The goal of this process was to conservatively reduce the number of candidate variables to a more manageable number according to clinical face validity. Rankings were received from 6 members (1 was unable to respond), collated, and averaged. RAI-HC items that achieved a mean ranking of 2 or greater, or achieved 2 or more '3' (Most Predictive) rankings were selected for inclusion as independent variables. The unadjusted odds of any ED visit within 6 months of assessment was calculated for each selected RAI-HC variable using logistic regression in order to assess the predictive validity of the selections made by the clinical panel. The RAI-HC's 10 scalar summary measures and 26 CAPs were included without selection in order to capture the entire breadth of health domain summaries, risk measures, and service/referral need triggers. This approach to variable exclusion was deliberately used to include all potentially important independent variables, and it provided valuable information on the face validity of RAI-HC assessment variables. In addition to variable selection, the clinical panel was asked to suggest patient 'phenotypes' (specific combinations of characteristics) that they believed belonged to frequent ED users. Additional combinations were included based on views expressed informally and garnered from the literature.

2.3.2.7 Decision-tree Analysis

The main analytic technique was decision-tree modeling, also known as classification tree modeling, which is a data mining method that hierarchically classifies independent variables together to explain a dependent variable using a chain of decision rules. Decision-tree modeling is particularly useful for the development of explanatory models in health care, relative to common regression methods, given that they are visual progressions of clinical logic. These visual progressions should be statistically durable and clinically plausible in order to be used for conceptual, educational, and clinical decisions support purposes. This method exceeds in its

ability to create models that have structures and features that are interpretable and intuitive to persons in clinical practice (Hirdes et al., 2008). Also, given that no parametric assumptions are necessary, decision-tree modeling can compute very large amounts of varied (binary, ordinal, and continuous) data without extensive variable preparation or pre-selection. Decision-tree methods are also better able to account for independent and dependent variable outliers, relative to traditional regression. Their only disadvantage is their tendency to become complex. The overall hierarchical classification is termed a 'tree', and each decision point a 'node'. The first decision point on the tree is known at the 'root node', and progressions from any node are termed a 'branch'. Terminus (final classifier) ends of the tree are termed 'leaves'.

The specific decision-tree method employed was supervised Chi-squared Automatic Interaction Detection (CHAID). CHAID, originally proposed by Kass (1980), ranks independent variables at each node based on the Pearson Chi-square statistic for categorical targets, and F-test for continuous targets. CHAID allows for multi-level splits at each node, and is suited to binary dependent measures. The CART (Classification And Regression Tree) method was not employed given that it is restricted to binary splits and better suited to continuous dependent measures (Breiman, Friedman, Olshen, & Stone, 1984). The Chi-square statistic was selected over the Gini coefficient and entropy calculation (likelihood ratio) to inform each CHAID split given that the latter methods tend to suggest relatively uneven splits and do not adjust for degrees of freedom (Breiman, 1996). SAS® Enterprise Miner Client 6.2 was used to perform CHAID analyses (SAS Institute, Inc., Cary, NC). This analytical software employs a graphical interface and allows for target switching during decision-tree analyses. Candidate split variables at each node were listed in order of the Chi-square likelihood statistic for all independent variables that achieved 95% probability. The sensitivity, specificity, and positive predictive value for each candidate variable split were also used to select split criteria for each node. A given branch (series of nodes) was complete when candidate variables did not reach 95% probability.

Analyses began by creating random, regionally stratified derivation and validation samples using SAS® Enterprise Miner Client 6.2 (SAS Institute, Inc., Cary, NC). Specifically, 75% of the data were allotted for model derivation and 25% for model validation in order to maximize variability

in the derivation data set. SAS® Enterprise Miner Client 6.2 interactive decision-tree randomly selected a maximum of 10,000 cases from the derivation sample to create derivation and test samples for analysis. The critical first step in the creation of the decision tree is determining the root node. Root nodes have a substantial effect on the structure of the proceeding tree branches as they tend to act as organizing principles. Candidate root nodes were evaluated based on discriminatory power (sensitivity, specificity, positive predictive value) and conceptual organization. Discriminatory power was a necessary criterion to avoid the use of organizing variables that do not discriminate the primary or secondary dependent variables. The inclusion of relatively non- discriminatory root nodes compromised the clinical coherence of the tree and made for more complicated trees (duplicate branches with less node homogeneity). This approach differs from that of case mix classifications, as case mix systems also strive to reflect existing descriptions of the population (e.g., by hospital clinical service type), whereas explanatory/prediction models strive to be parsimonious and one-dimensional in focus. The ability to conceptually organize the tree was partly judged based on the ability of the candidate variable to simplify the tree without reducing overall discriminatory power. Input from the literature and clinical panel was also used to aid decision-making.

Subsequent nodes and branches were selected based on an iterative process, and using discriminatory power (sensitivity, specificity, PPV) and clinical coherence as evaluation criteria. Independent variables were grouped where there were multiple, nearly-equal variables that indicated similar but separate risk pathways (e.g., symptoms, under nutrition). Sensitivity analyses were performed to establish the most parsimonious and discriminatory variable groupings. Input from the clinical panel was used to ensure clinical coherence. The *ED Model* decision tree was then coded in SAS® 9.2, and the LOGISTIC procedure (logistic regression) was used to determine the class-level odds ratio for each leaf in the full derivation sample partition. Nodes were collapsed if their class-level odds ratio split did not achieve 95% significance in the full derivation sample (2 instances). The class-level odds ratios for each in the final *ED Model* were graphed, and model scores were established by combining leaves with similar odds ratios. A sensitivity analysis was completed to establish the most discriminatory and coherent model scoring based on the

precision of the class-level odds ratios and overall discriminatory power (ROC area under the curve - AUC).

2.3.2.8 Analysis of the Final Decision-tree Model

The class-level odds ratios for the final *ED Model* were graphed for the primary and secondary dependent variables using the derivation sample partition and the LOGISTIC procedure. The class-level odds ratios, AUC, and Hosmer and Lemeshow Goodness-of-Fit Test for the primary dependent variable were also calculated using the derivation and validation partitions in order to establish model fit and performance. Deviance residual plots were also plotted to assess model goodness of fit using the derivation and validation partitions. Kaplan-Meier survival curves were calculated using the LIFETEST procedure and plotted for the tertiary dependent variables in order to test and validate time to event performance.

It was plausible that home care clients' relative risk of unplanned ED visits was correlated by shared residence in a health region/LHIN. Though it would not violate any assumption in the decision-tree analysis (e.g., independence of the measurements, multicollinearity), the generalizability of the *ED Model* would be diminished. The relationship between the model and the primary dependent variable was evaluated with Generalized Estimating Equation (GEE) logistic regression using the GENMOD procedure in SAS® 9.2 (multilevel modeling). GEE logistic regression controls for potentially correlated independent variables by including a clustering indicator as a source of random error and averaging the parameter estimates across clustered groups (Goetgeluk & Vansteelandt, 2008; Hu, Goldberg, Hedeker, Flay, & Pentz, 1998). The health region/LHIN identifier was entered into the GEE logistic regression model using the exchangeable correlation structure. The exchangeable correlation structure is suggested unless different correlation matrices are known to exist between clustered groups (Westgate, 2012). A 10% random sample, stratified by health region/LHIN, was used for multi-level modeling given the extreme computing requirements necessary to analyze the entire data set. The class-level odds ratios for the multilevel model were compared to the ordinary logistic model to test for model generalizability across health regions/LHINs.

The performance of the *ED Model* was compared to prognostic tools already validated on community-based samples, the CARS and ERA, based on the entire data sample. Both the CARS and ERA were coded in SAS® 9.2 using the RAI-HC items corresponding to the published calculations reported in Shelton et al. (2000) and Crane et al. (2010), respectively. The proportion of clients triggered and proportion with a future ED visit within each prognostic model category were graphed in order to estimate the relative sensitivity, specificity, and PPV of each prognostic tool. Particularly, the degree to which the models' distribution was positively skewed indicated their relative potential to be used for intervention. Logistic regression, using the LOGISTIC procedure, was also run for each prognostic tool in order to compare overall predictive accuracy (AUC). The performance of the *ED Model* was also compared across selected neurological conditions and classes of disease diagnoses, including: cardiovascular conditions, musculoskeletal conditions, and psychiatric illnesses. Specifically, the distribution of the *ED* Model, the proportion with a future ED visit within each prognostic model category, and overall accuracy was compared across the disease diagnoses in order to determine the generalizability of the *ED Model*. Analyses were performed using SAS® Version 9.2 (SAS Institute, Inc., Cary, NC).

2.3.2.9 Examination of Predisposing and Enabling Characteristics

The effect of predisposing and enabling characteristics available in the RAI-HC (see Appendix S) were examined using logistic regression, stratified by the *ED Model*. Any unplanned ED visits within 6-months was used as the dependent variable. Analyses began by creating random, regionally stratified derivation and validation samples using SAS® Enterprise Miner 4.2 (SAS Institute, Inc., Cary, NC). Best subset logistic regression was employed to determine the best multivariate model that represented the effects of predisposing and enabling characteristics within each of the three model strata. Decision tree modeling was not used for this examination given that the objective was to develop basic explanatory models rather than a single explanatory model that could be translated into clinical practice. This semi-automated method of model generation was employed to eliminate problematic order-of-entry, deletion effects, and high potential for multicollinearity that are inherent in stepwise regression (Hosmer, 2000; King, 2003). Ordinal and continuous independent variables were dichotomized with their most optimal split

before regression analyses. The best candidate models were selected based on the Chi-square likelihood score statistic, Akaike Information Criterion, AUC, and parsimony. Two-way interactions among the predisposing and enabling characteristics were tested. The logistic models were validated on the validation samples. Hosmer and Lemeshow Goodness-of-Fit Test was completed on the logistic models using the derivation and validation sample partitions in order to establish model fit. Analyses were performed using SAS® Version 9.2 (SAS Institute, Inc., Cary, NC).

2.4 RESULTS

2.4.1 Phase 1: An examination of the prevalence of home care clients in the emergency department

A total of 436,539 unplanned ED visits from persons aged 65 or older were registered in HNHB LHIN from April 1st, 2008 to March 31st 2012. Each fiscal year consistently had over 105,000 visits from persons aged 65 or older. Long-stay home care clients[2] consistently accounted for approximately three in every 20 registrations (15%) in each of the four fiscal years; whereas short-stay clients[1] consistently accounted for almost one in every 20 registrations (3.5%) (see Table 2-1). Age stratified analysis showed a greater prevalence of long-stay clients among older age strata, whereas the prevalence of short-stay clients was stable or declining. Less than one in 10 ED visits by persons age 65-75 were long-stay home care clients, whereas one in every four ED visits by persons age 85 or older where long-stay clients (see Table 2-2). Very little deviance in prevalence estimates was noted by adjusting the days-on-service criterion[1] used to classify home care status.

A total of 64,426 unplanned ED visits from long-stay home care clients[1], aged 65 or older, were admitted to an acute hospital in HNHB LHIN between April 1st, 2008 and March 31st 2012. Close to half of all unplanned ED visits by long-stay home care clients[1] aged 65 or older were subsequently admitted to acute care in fiscal years 2008-2011. A slight increase in the proportion admitted occurred in fiscal years 2010-2011 (see Figure 2-1). The proportion of long-stay home care clients admitted to acute care from the ED in all fiscal years increased by age strata. Specifically, 6% more long-stay home care clients aged 85 or older were admitted from the ED compared to those age 65-75 (see Figure 2-2).

[2] Those on an active home care caseload for at least 7 days prior to the ED visit.

Table 2-1: **Proportion of Unplanned ED Visits among Home Care Clients by Fiscal Year, ED Patients Age 65+, HNHB LHIN**

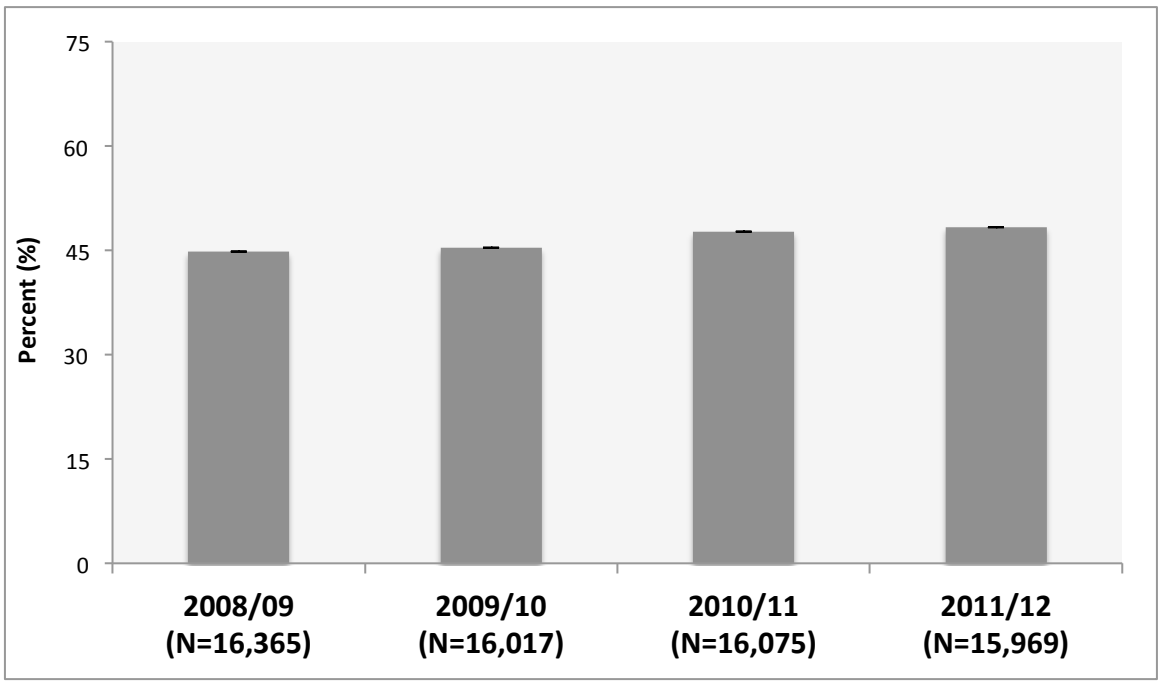
	2008/09		2009/10		2010/11		2011/12	
Group	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N
Long-Stay Home Care Client*	15.1 (±0.2)	16,365	15.0 (±0.2)	16,017	14.8 (±0.2)	16,075	14.3 (±0.2)	15,969
Short-Stay Home Care Client*	3.4 (±0.1)	3,697	3.4 (±0.1)	3,613	3.6 (±0.1)	3,859	3.7 (±0.1)	4,068
Not a Home Care Client	81.5 (±0.2)	88,728	81.6 (±0.2)	87,395	81.7 (±0.2)	89,226	82.0 (±0.2)	91,527
TOTAL	100.0	108,790	100.0	107,025	100.0	109,160	100.0	111,564

*Client was placed on a home care caseload for service at least 7 days before date of ED registration.

Table 2-2: **Proportion of Unplanned ED Visits from Home Care Clients by Age, HNHB LHIN, Fiscal 2008/09 – 2011/12**

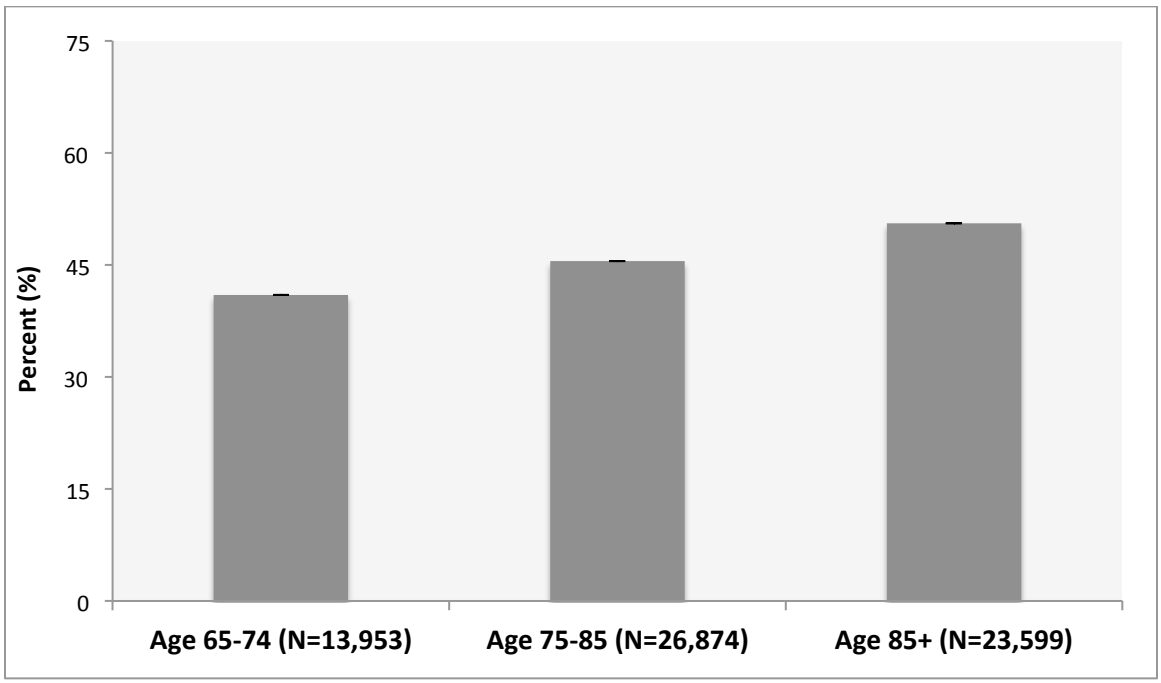
	Age 65-74		Age 75-85		Age 85+	
Group	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N
Long-Stay Home Care Client*	8.0 (±0.1)	13,953	15.4 (±0.2)	26,874	27.2 (±0.3)	23,599
Short-Stay Home Care Client*	3.6 (±0.1)	6,372	3.5 (±0.1)	6,189	3.1 (±0.1)	2,676
Not a Home Care Client	88.4 (±0.2)	154,581	81.1 (±0.2)	141,992	69.7 (±0.3)	60,303
TOTAL	100.0	174,906	100.0	175,055	100.0	86,578

*Client was placed on a home care caseload for service at least 7 days before date of ED registration.



Note: All confidence intervals are 95%.

Figure 2-1: **Proportion of Long-Stay Home Care Clients Admitted to Acute Care from the ED by Fiscal Year, HNHB LHIN**



Note: All confidence intervals are 95%.

Figure 2-2: **Proportion of Long-Stay Home Care Clients Admitted to Acute Care from the ED by Age, HNHB LHIN**

2.4.2 Phase 2: The development of an explanatory model to determine the relative risk of unplanned ED use among long-stay home care clients

2.4.2.1 Sample Characteristics and Baseline Variable Selection

A total of 566,418 assessments where completed in Ontario from April 1st 2007 to September 29th 2010; whereas, 50,617 assessments were completed in WRHA from January 1st 2006 to September 31st 2010 (see Table 2-3). A total of 617,035 assessments were used for analyses, representing 279,879 long-stay home care clients in Ontario and WRHA. The average age of the long-stay home care client sample was 75.9 (IQR: 70.0-85.9) and 63.8% were female.

Overall, 41.2(±0.1)% of long-stay home care clients had one or more unplanned ED visits and 17.6 (±0.3)% had multiple unplanned ED visits within 6 months of an assessment. The proportion with any unplanned visits was slightly higher in Ontario, whereas the proportion with multiple

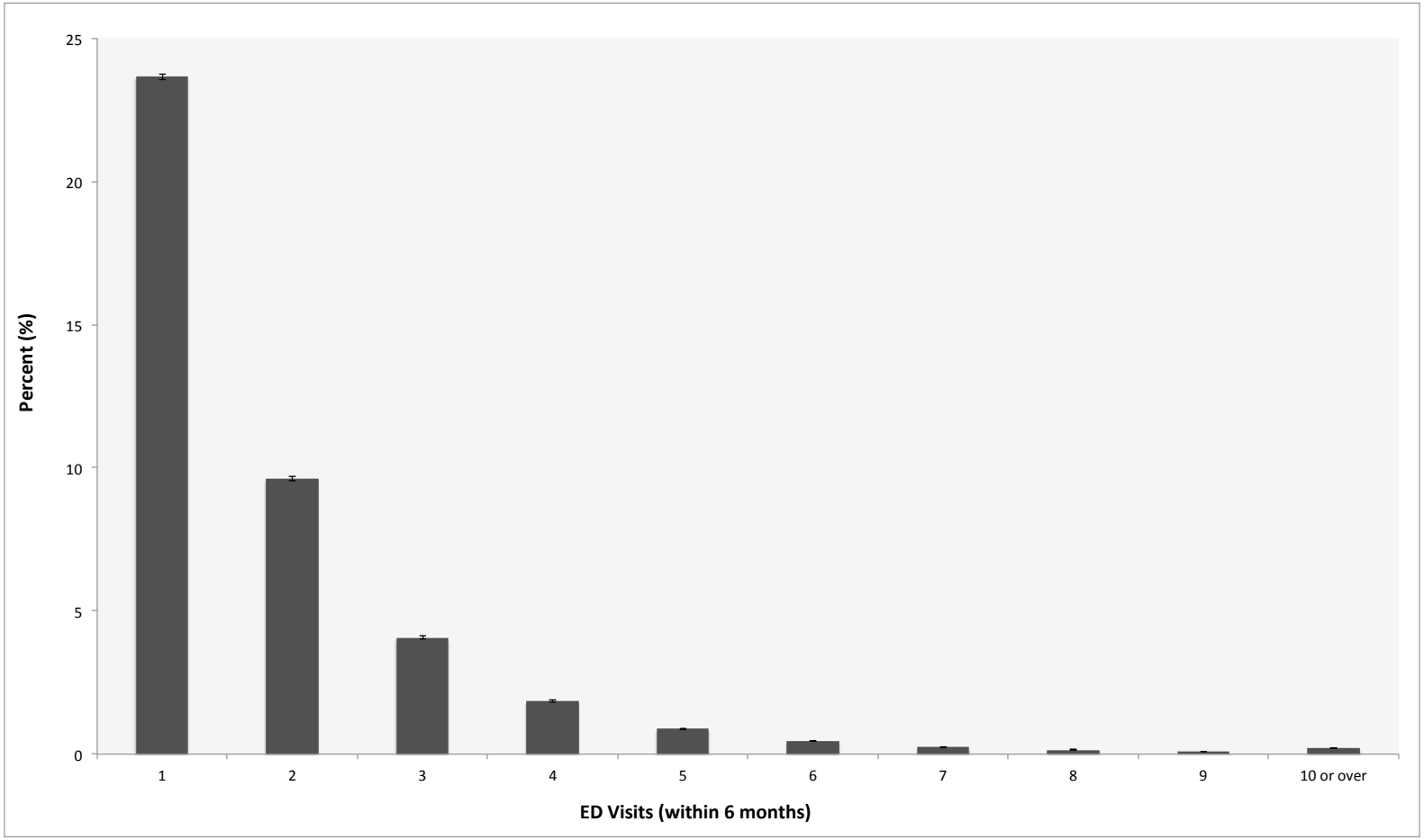
unplanned visits was slightly higher in the WRHA (see Table 2-3). Close to one-quarter of long-stay home care clients had an ED visit within 6 months of an assessment (145,985 visits), one in 10 had two visits (59,366 visits), and about one in 20 had three visits (25,116 visits). Having greater than four or more unplanned ED visits with 6 months and an assessment was rare (see Figure 2-3). The absolute risk of an unplanned ED visit from an assessment was roughly proportional to time from assessment. Approximately 13%, 21%, and 27% of long-stay home care clients had an ED visit within 30 days, 60 days, and 90 days, respectively (see Figure 2-4).

Average rankings of RAI-HC assessment items by the clinical panel ranged from 1.0 (for 26 items) to 3.0 (for nine items) (see Appendix N). Items related to demographics, communication, vision, social functioning, dental status, and the client's environment were generally rated lower compared to other domains, particularly diseases, conditions, and previous hospital use. RAI-HC items pertaining to changes in health, cardiac, neurological, and infectious diseases, as well as chronic and acute symptoms were generally rated high by the panel. Changes in mental status, caregiver breakdown, ADL decline, acute symptoms, poor prognosis, and previous hospital use achieved the highest possible rankings.

A total of 95 RAI-HC items were selected as potential independent variables (see Appendix O, also Methods 2.3.2.5). The unadjusted odds ratio point estimates for each of the 95 variables ranged from 0.78 to 2.02, and 3 failed to reach significance at the 95% probability level. Overall, the effect sizes for each point estimate ranged from moderate to weak, and approximately half had point estimates greater than 1.3 or below 0.8. The distribution of the odds ratios across candidate variables was broadly consistent with clinical panel rankings. Notable discrepancies, where panel members did not identify predictive RAI-HC items, were observed with respect to disease treatments (generally), nutrition, and bowel symptoms. In total, 10 phenotypes were recorded, coded from the RAI-HC, and included in the independent variable list (see Appendix P). A total of 141 independent variables were incorporated for analyses, including: selected RAI-HC Items, summary scales, CAPs, as well as pre-coded predictive 'phenotypes'.

Table 2-3: **Population Sample Summary**

	Ontario	**Winnipeg Regional Health Authority (WRHA)**	**Total**
Time Period	01 April 2007 – 29 Sept. 2010	01 Jan. 2006 – 29 Sept. 2009	-
Sample Size (N)	566,418	50,617	617,035
Any unplanned ED visit with 6 months of assessment (95% CI)	41.5 (±0.1)	37.7 (±0.4)	41.2 (±0.1)
Two or more unplanned ED visit with 6 months of assessment (95% CI)	15.0 (±0.1)	17.8 (±0.1)	17.6 (±0.3)
Three of more unplanned ED visit with 6 months of assessment (95% CI)	6.4 (±0.1)	8.1 (±0.1)	7.9 (±0.2)



Note: Confidence intervals are 95%.

Figure 2-3: **Distribution of Unplanned ED Visits by Long-stay Home Care Clients among those with Any Visits, within 6-months of assessment, Ontario and WRHA (N=617,035)**

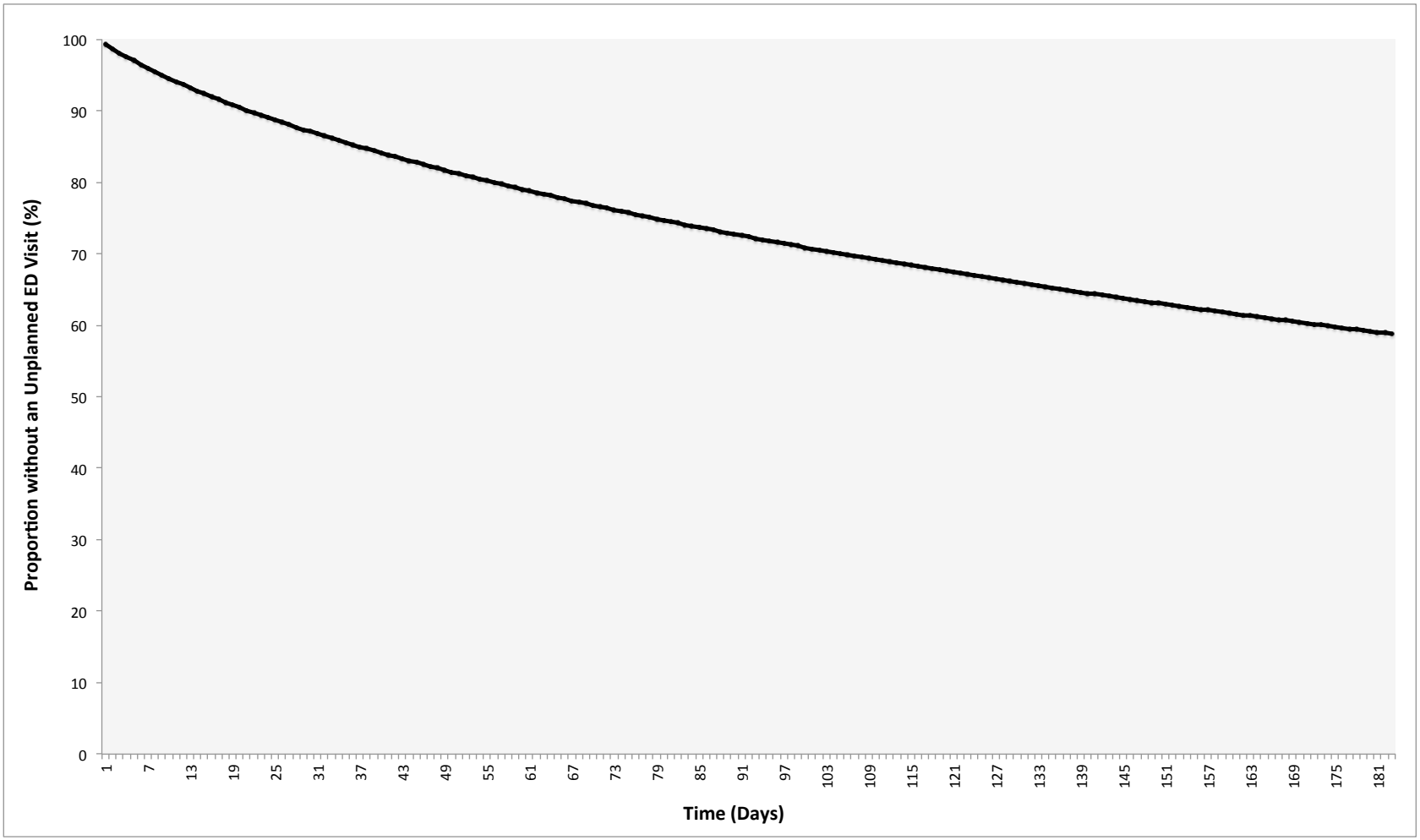


Figure 2-4: **Kaplan-Maier Survival Curve for Days to First Unplanned ED Visit by Long-stay Home Care Clients, within 6-months of assessment, Ontario and WRHA**

2.4.2.2 Decision-tree *ED Model*

Overall, 462,773 and 154,262 assessments were partitioned for decision-tree derivation and validation, respectively. The final decision-tree *ED Model* contained 19 leaves, where the proportion of clients with any ED visit within 6 months of assessment ranged from 29.5% (leaf #0) to 67.7% (leaf #17) (see Figure 2-5).

The amount of previous ED or hospital utilization (previous 90 days) showed the highest discriminatory power, as well as the best ability to organize the proceeding tree branches relative to other candidate variables (e.g., declines in cognition and ADL, cardio-respiratory symptoms). Clients that had only one ED visit and two or more ED visits in the previous 90 days were approximately 1.5 and 2 times more likely to have a future ED visit compared to clients with no previous ED or hospital use, respectively. With the exception of the interRAI Cardio-Respiratory and Medications CAPs, none of the RAI-HC scalar measures and CAPs were viable candidates for the root node, nor were the coded 'phenotypes'.

Among clients with two or more ED visits in the previous 90 days, cardio-respiratory symptoms provided the most optimal discrimination of the primary and secondary dependent variable. Such symptoms were best represented by the interRAI Cardio-Respiratory CAP. Bladder illness, and specifically use of an indwelling catheter or urinary tract inflection, was the most optimal node to differentiated clients without cardio-respiratory symptoms (see Figure 2-5). Declining vision further differentiated clients with cardio-respiratory symptoms, but did not achieve 95% significance in the full derivation sample.

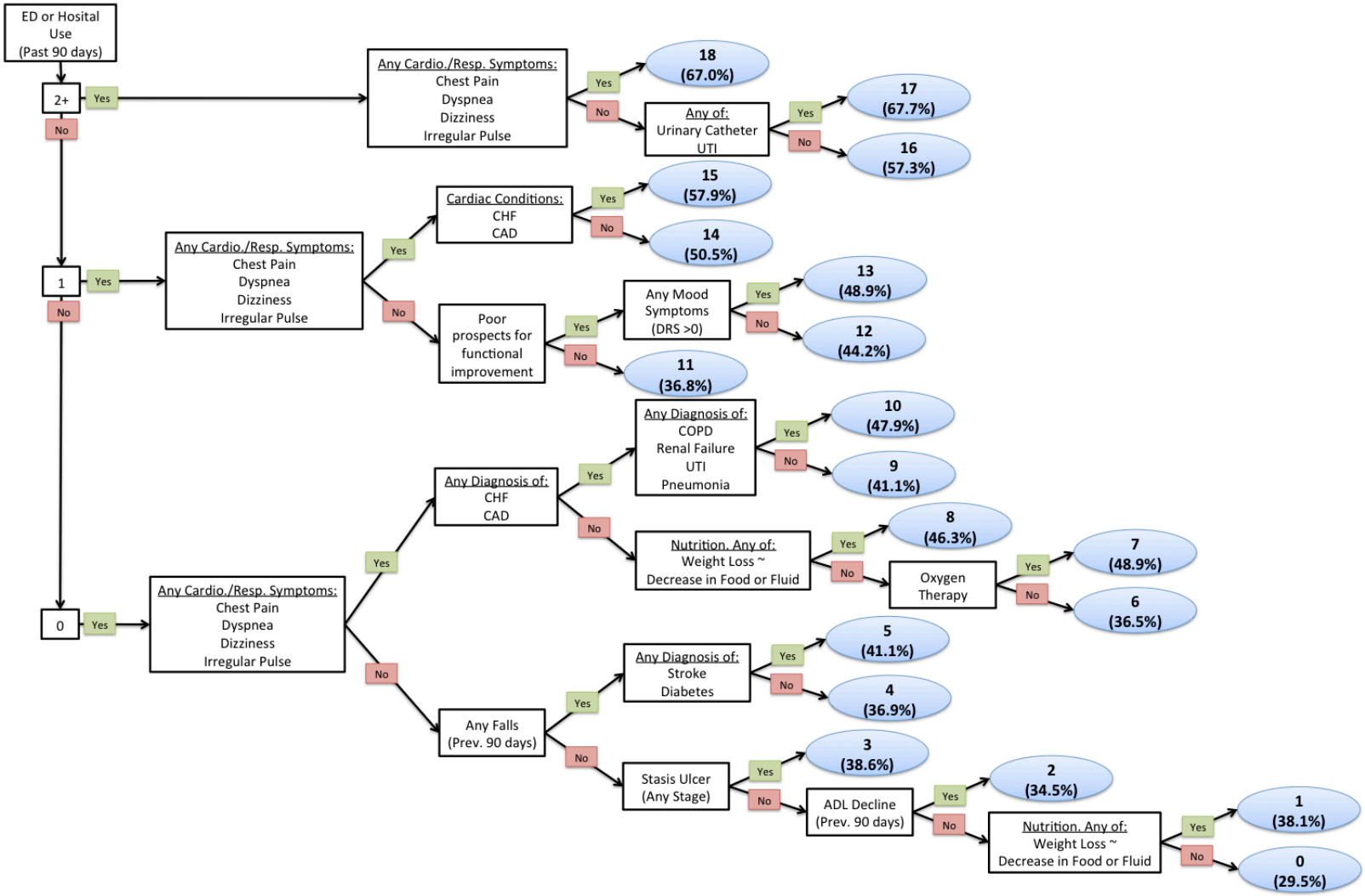
Cardio-respiratory symptoms also provided the most optimal node to discriminate the primary and secondary dependent variable among clients who had one ED visit in the previous 90 days. In clients with cardio-respiratory symptoms, the diagnosed presence of a heart condition best differentiated the primary and secondary dependent variable. Self-reported health status further differentiated clients with a heart condition, but did not achieve 95% significance in the full derivation sample. Among those without cardio-respiratory symptoms, prospects for

improvement[3] and mood symptoms experienced[4] by those with poor prospects provided the best nodes. Mood symptoms were characterized best by the interRAI DRS scale[3] (see Figure 2-5).

Among clients with no previous ED or hospital use, cardio-respiratory symptoms provided the most optimal subsequent node. The diagnosed presence of a heart condition was the most optimal node to differentiate those with cardio-respiratory symptoms. Among those with a heart condition, the presence of other complex diagnoses[5] provided the best node. Those with symptoms, but without a diagnosed heart condition, were best differentiated by nutritional insufficiency[6] and receipt of oxygen therapy, sequentially. Among clients without cardio-respiratory symptoms, any previous fall(s) specified the best node. Those with any previous fall were then differentiated by the diagnosis of a recent stroke or presence of diabetes. Those without previous falls were best differentiated by the presence of a status ulcer, recent ADL decline, and nutritional insufficiency[5], sequentially (see Figure 2-5).

The proportion triggered in each leaf of the *ED Model* was inconsistent, and the majority of the derivation sample clustered at the lower levels of the raw decision-tree model. The plotted class-level odds ratios for *ED Model* leaves showed a clear stepped progression throughout the *ED Model*, achieving an odds ratio of 5.0 at its highest level (see Figure 2-6). Leaf numbers were collapsed into six levels of differentiation, and scored hierarchically from the lowest level (see Table 2-4). The scored *ED Model* showed consistent hierarchical structures between the decision-tree branches and leaves in each branch (see Figure 2-7).

[3] Determined by the home care case manager
[4] See Appendix J for symptoms included in the DRS scale.
[5] Any of: COPD, Renal Failure, UTI, or Pneumonia.
[6] Weight loss of 5% or more in last 30 days, or 10% or more in last 180 day.



Note: ~ Weight loss of 5% or more in LAST 30 DAYS, or 10% or more in LAST 180 DAYS

Figure 2-5: **Raw *ED Model*, Any Unplanned ED Visit by Long-stay Home Care Clients, within 6-months of RAI-HC assessment, Ontario and WRHA, Derivation Sample Partition (N=462,773)**

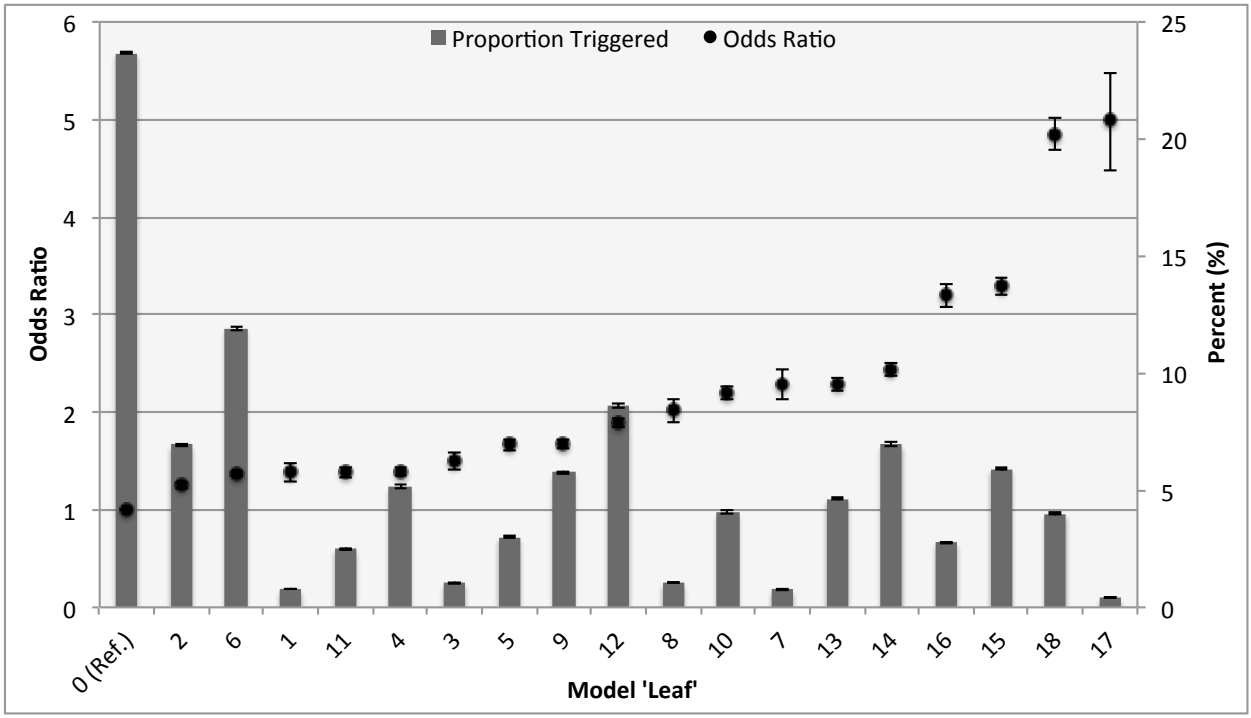
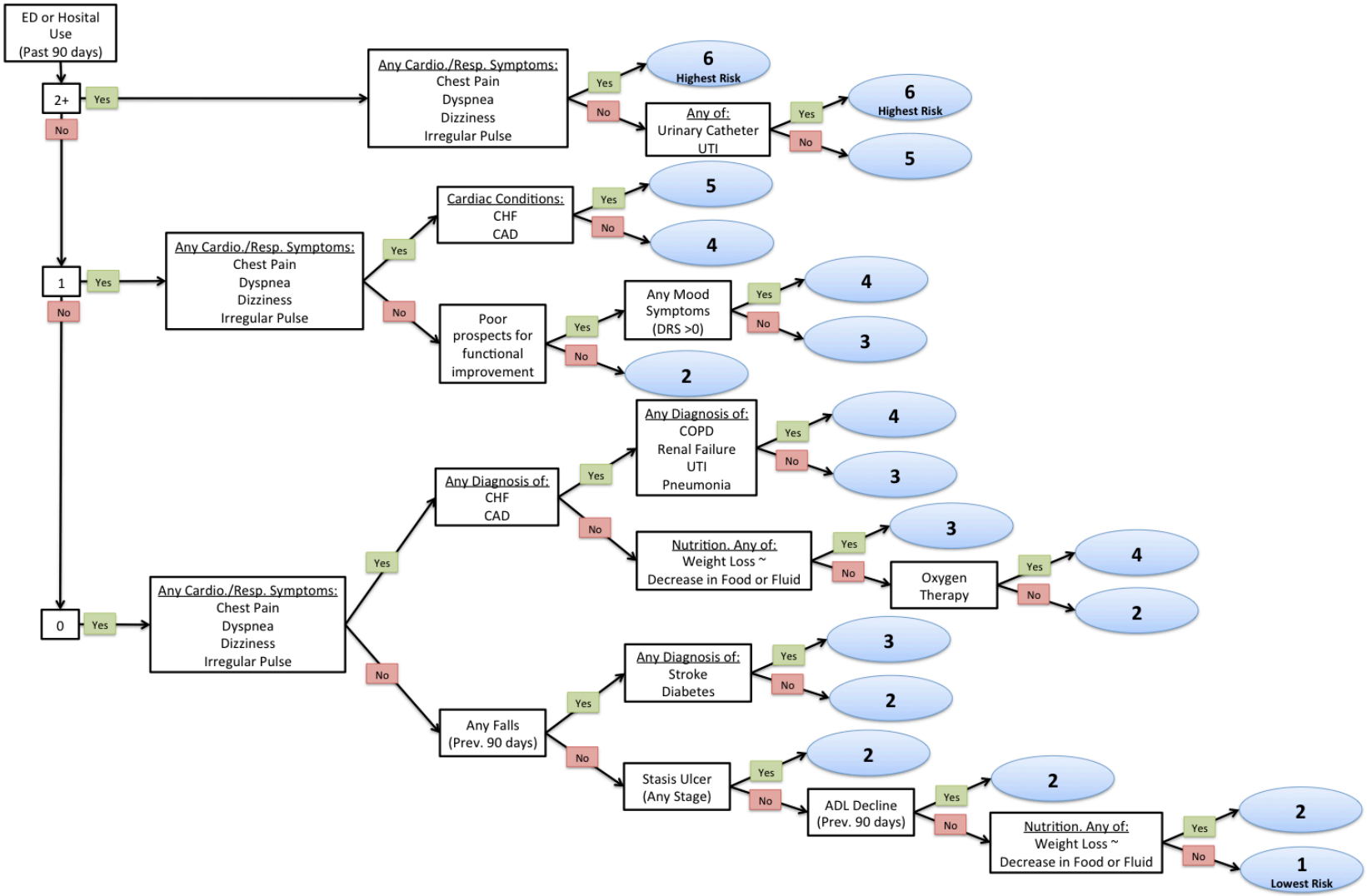


Figure 2-6: **Odds Ratios and Proportion Triggered for each Raw *ED Model* Leaf, Any Unplanned ED Visit by Long-stay Home Care Clients, within 6-months of RAI-HC assessment, Ontario and WRHA, Derivation Sample Partition (N=462,773)**

Table 2-4: **Scoring of *ED Model* Leaves, Any Unplanned ED Visit by Long-stay Home Care Clients, within 6-months of RAI-HC assessment, Ontario and WRHA, Derivation Sample Partition (N=462,773)**

Model Score	Model 'Leaf' Numbers
6	18,17
5	16,15
4	10,7,13,14,
3	5,9,12,8
2	2,6,1,11,4,3
1	0



Note: ~ Weight loss of 5% or more in LAST 30 DAYS, or 10% or more in LAST 180 DAYS

Figure 2-7: **Scored *ED Model*, Any Unplanned ED Visit by Long-stay Home Care Clients, within 6-months of RAI-HC assessment, Ontario and WRHA, Derivation Sample Partition (N=462,773)**

The class-level odds ratios for each score in the *ED Model* increased significantly through the model score hierarchy for any unplanned ED visits (primary dependent variable) and multiple unplanned ED visits (secondary dependent variable). Opposite to the slope of the odds ratios, the distribution of clients across the *ED Model* was positively skewed. The slope of the odds ratio plot for the secondary dependent variables was steeper than that of the primary dependent variable, particularly for scores *5* and *6*, indicating enhanced performance when predicting multiple ED visits (see Figure 2-8). A Kaplan-Meier survival curve for days to first unplanned ED visit (tertiary dependent variable) showed clear differentiation between *ED Model* scores throughout the risk period. Clients who scored 1 had a 30% risk of ED visits at 6 months compared to 67% for clients with a score of *6*. Higher *ED Model* scores also showed a more rapid incidence of ED visit between baseline and 90 days (see Figure 2-9).

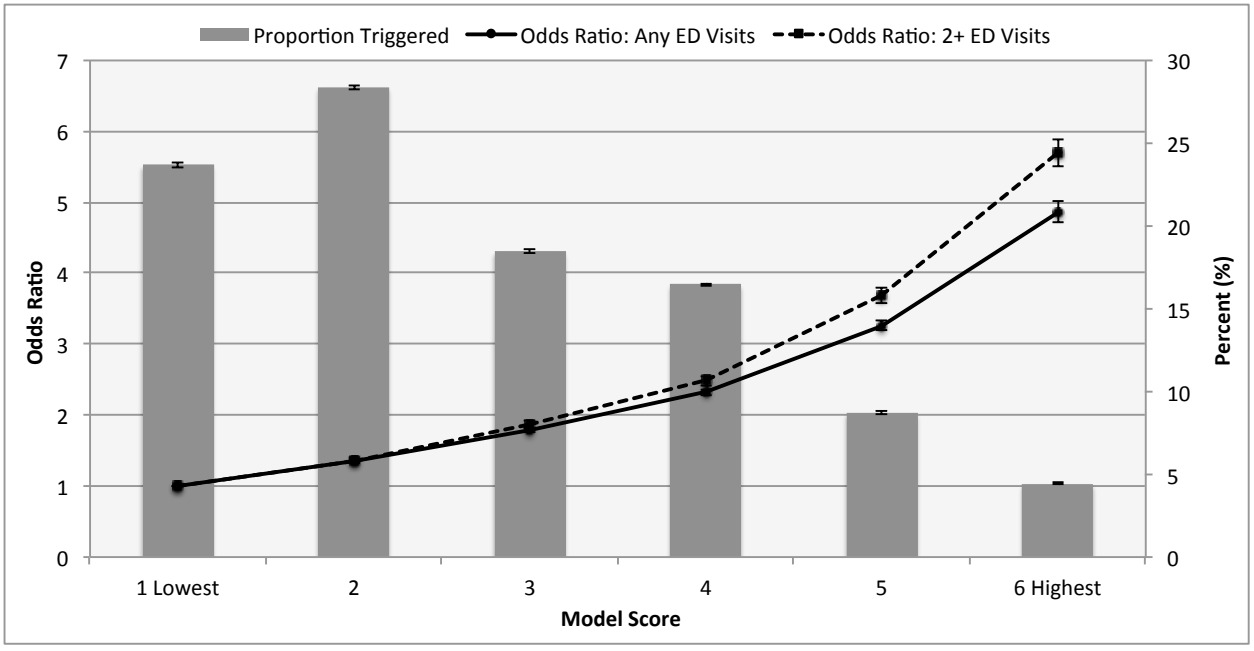


Figure 2-8: **Odds Ratios and Proportion Triggered, Scored *ED Model*, Any and 2+ unplanned ED visit by Long-stay Home Care Clients, within 6-months of RAI-HC assessment, Ontario and WRHA, Derivation Sample Partition (N=462,773)**

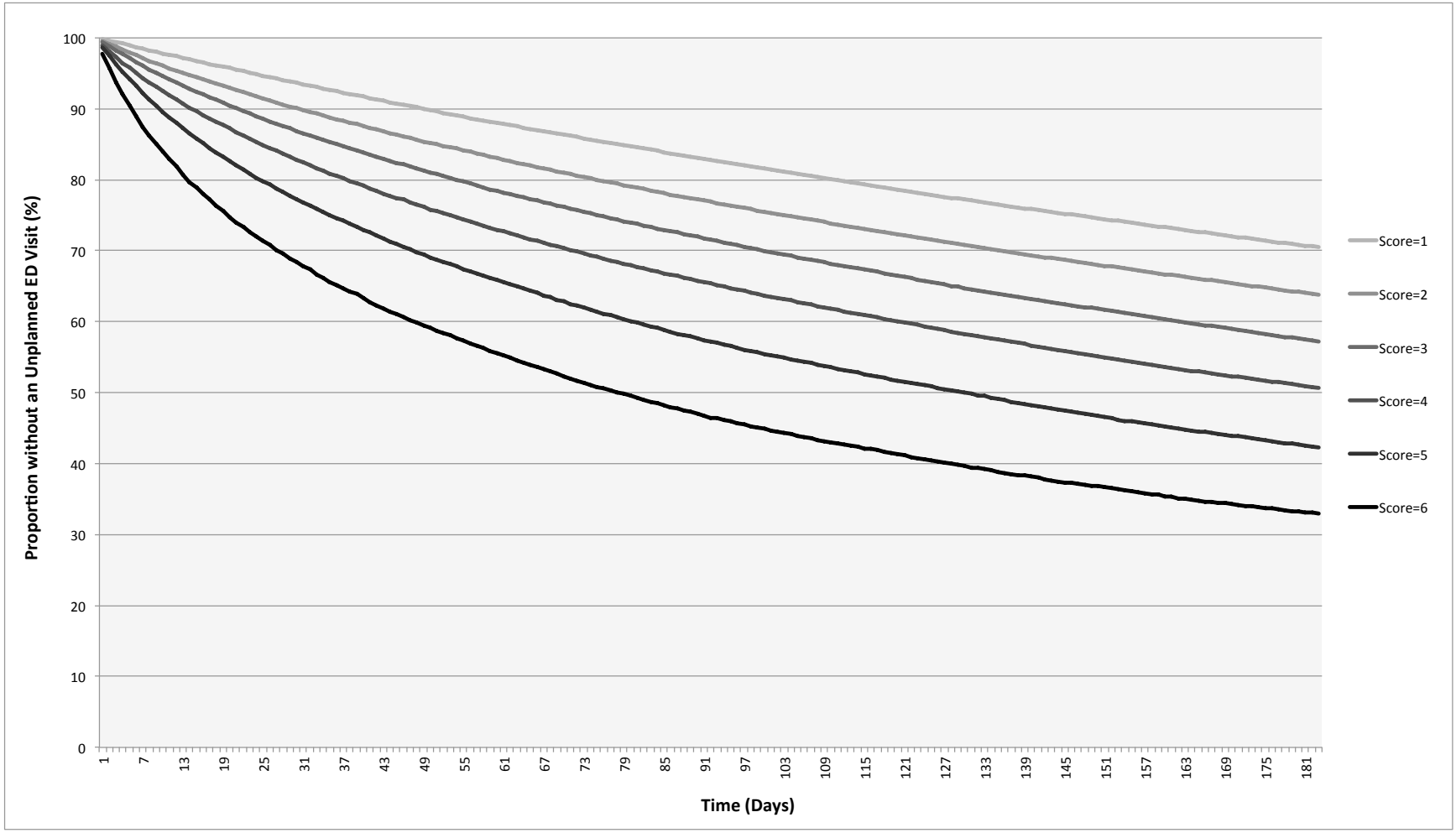


Figure 2-9: **Kaplan-Meier Survival Curve for Days to First Unplanned ED Visit by Long-stay Home Care Clients, within 6-months of RAI-HC assessment, by *ED Model*, Ontario and WRHA, Derivation Sample Partition (N=462,773)**

Class-level odds ratios and overall predictive accuracy (AUC) between the derivation and validation samples were not significantly different, and exhibited a high level of consistency. The overall accuracy of the model in both partitions, given by the AUC, was moderate. Odds ratios were highly significant in both the derivation and validation partitions ($p<0.01$). Also, odds ratios between *ED Model* scores were significantly different in both the derivation and validation partitions. The Hosmer and Lemeshow Goodness-of-Fit Test did not achieve significance in each sample partition, indicating a well-calibrated model (see Table 2-5). The deviance residual plot of the derivation and validation partitions showed even distributions (see Appendices Q and R). A Kaplan-Meier survival curve for days to first unplanned ED visit using the validation sample partition was very consistent with that of the derivation partition (see Figure 2-10).

Table 2-5: ***ED Model*** **Validation for Any Unplanned ED Visit by Long-stay Home Care Clients, within 6-months of assessment, Derivation Sample Partition and Validation Sample Partition, Ontario and WRHA**

	Derivation (N=462,773)		**Validation (N=154,262)**	
Model Score	**OR**	**95% CI**	**OR**	**95% CI**
6	4.87	(4.71 - 5.02)	5.08	(4.81 - 5.37)
5	3.26	(3.19 - 3.34)	3.25	(3.12 - 3.39)
4	2.33	(2.28 - 2.37)	2.36	(2.29 - 2.44)
3	1.79	(1.75 - 1.82)	1.87	(1.81 - 1.93)
2	1.35	(1.33 - 1.38)	1.37	(1.33 - 1.41)
1 (reference)	1.00		1.00	
AUC (95%CI)	**0.62 (0.61 - 0.62)**		**0.62 (0.61 - 0.62)**	
Goodness-of-Fit Test`	**Chi-sq=0.00, p=1.00**		**Chi-sq=0.00, p=1.00**	

OR = Odds Ratio
AUC = receiver operating characteristic (ROC) area under the curve (AUC)
`Hosmer and Lemeshow Goodness-of-Fit Test

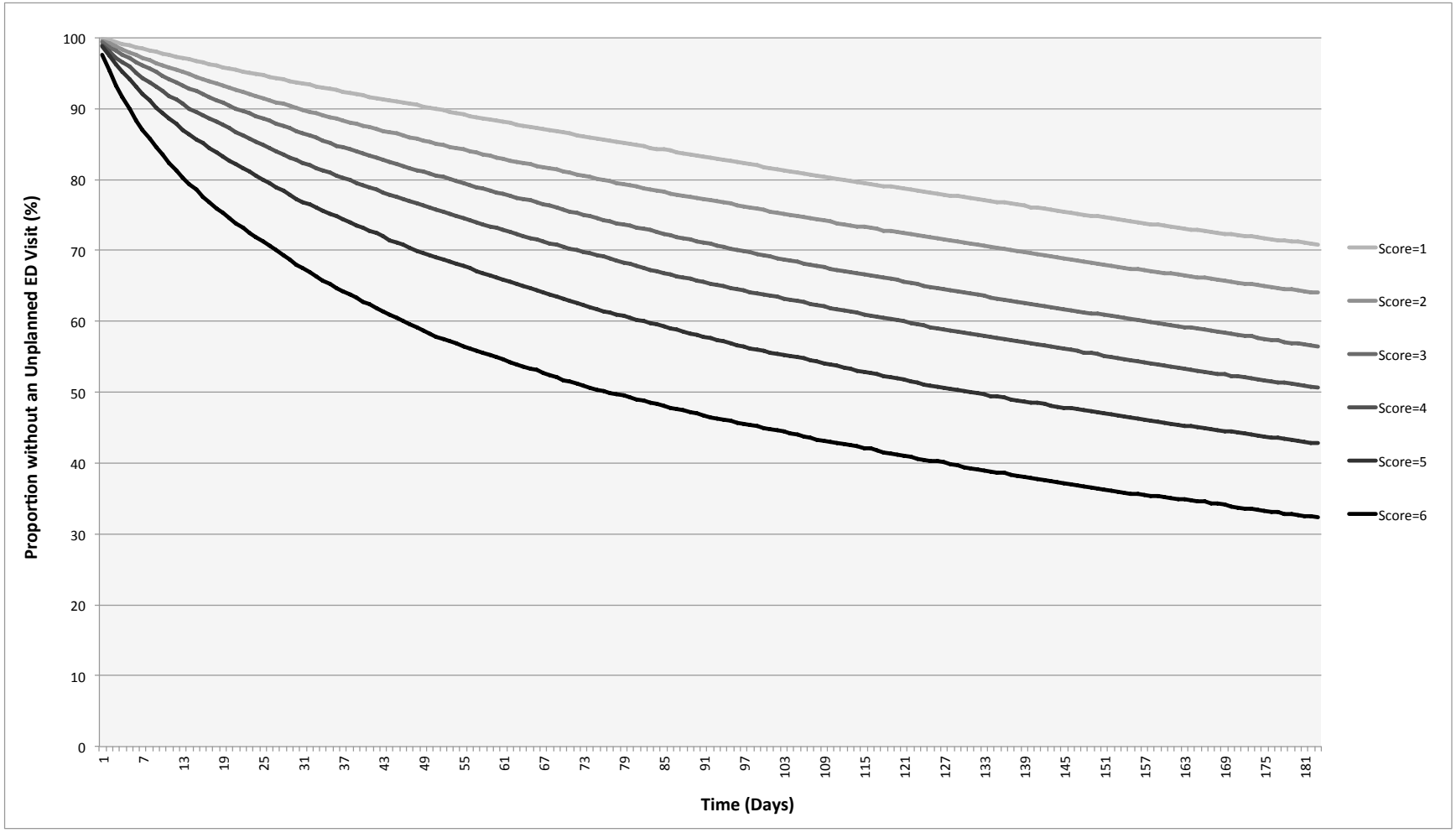


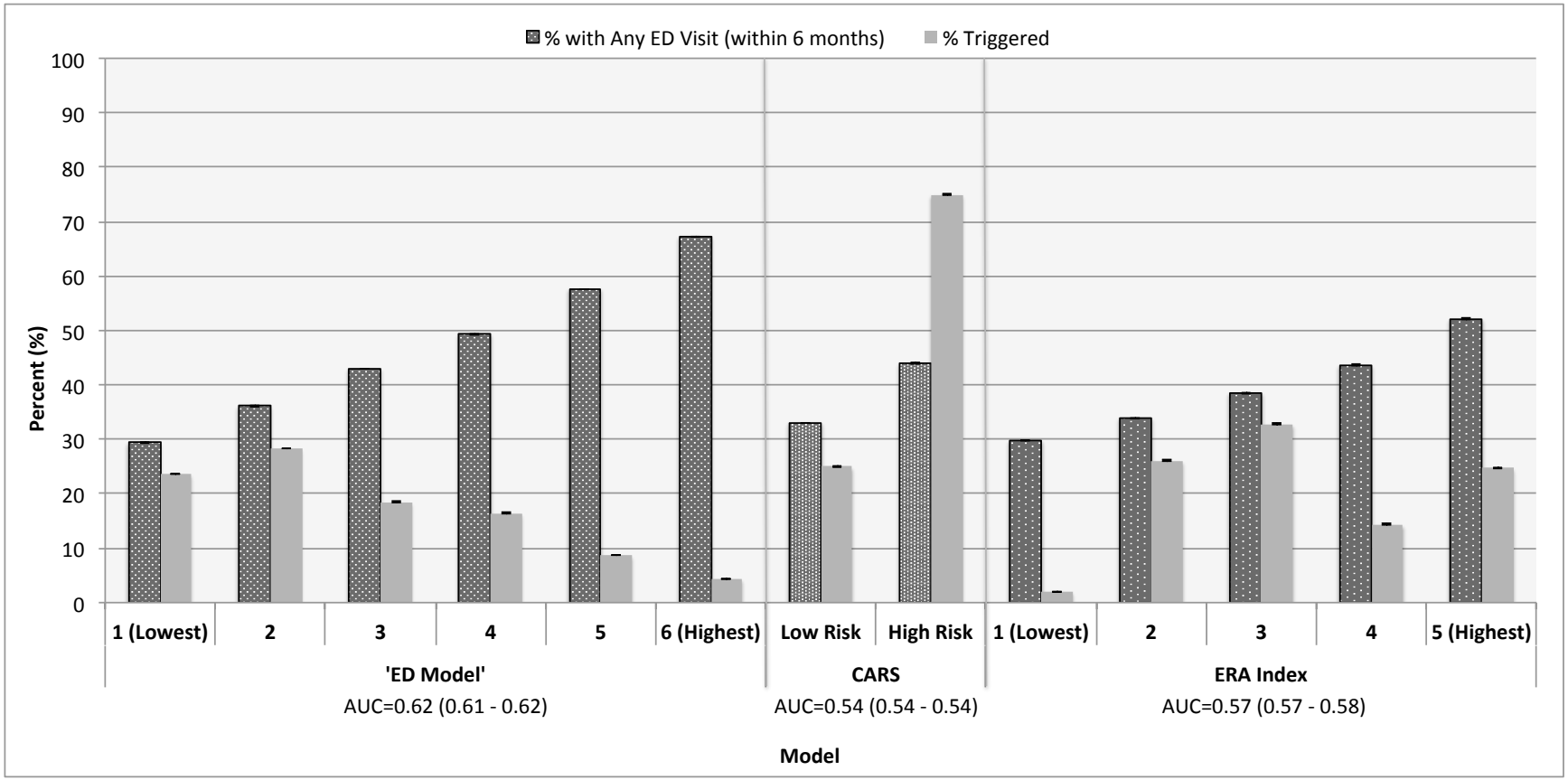
Figure 2-10: **Validation of *ED Model* Kaplan-Meier Survival Curve for Days to First Unplanned ED Visit by Long-stay home care clients, within 6-months of assessment, Ontario and WRHA, Validation Sample Partition (N=154,262)**

Table 2-6: **Multilevel Generalized *ED Model* (by Health Region/LHIN), Ontario and WRHA, Regional Stratified Sample (N=61,705)**

Model Score	Conventional Logistic			Multilevel Logistic		
	OR	95% CI	p	OR	95% CI	p
6	4.78	(4.38 - 5.21)	<0.01	4.60	(4.25 - 4.98)	<0.01
5	3.32	(3.11 - 3.55)	<0.01	3.25	(3.06 - 3.45)	<0.01
4	2.36	(2.26 - 2.49)	<0.01	2.33	(2.19 - 2.48)	<0.01
3	1.79	(1.70 - 1.89)	<0.01	1.78	(1.68 - 1.87)	<0.01
2	1.34	(1.27 - 1.40)	<0.01	1.33	(1.29 - 1.38)	<0.01
1 (reference)	1.00			1.00		

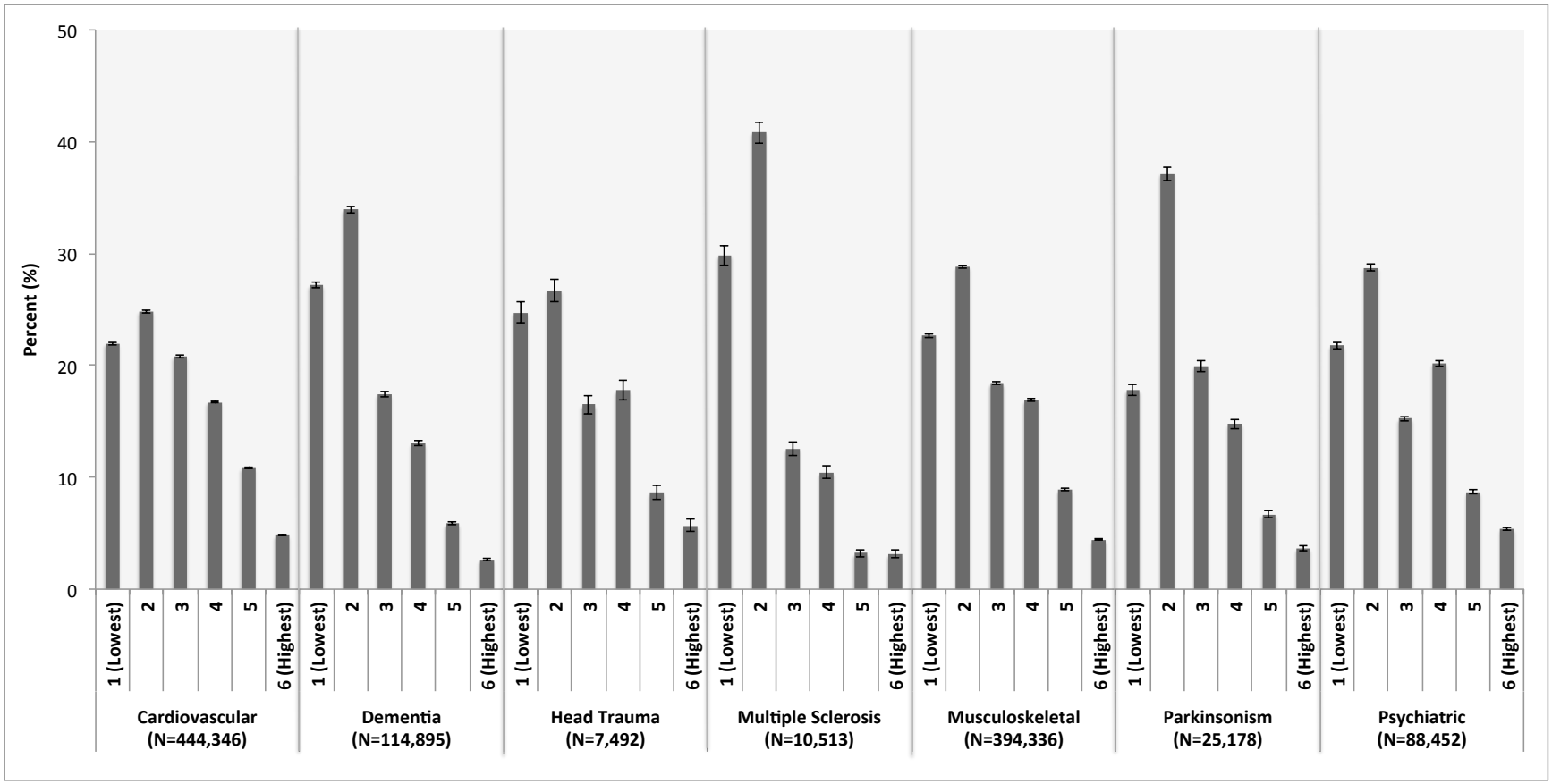
OR = Odds Ratio

Class-level odds ratios between the conventional logistic and multilevel logistic models were very similar. This consistency suggested that the *ED Model* was generalizable across health regions/LHINs, and that there were no indications of regional effects (see Table 2-6). A comparison of the performance and distribution between the *ED Model*, CARS, and ERA demonstrated a clear advantage for the *ED Model*. In terms of performance, the *ED Model* exceeded the CARS and ERA in both negative and positive prediction. The *ED Model*'s favorable accuracy (AUC) corroborated the visual representation. The positively skewed distribution of the *ED Model* also indicated enhanced overall utility relative to the center-negative and extreme negative skew of the ERA and CARS, respectively (see Figure 2-11). The distribution of the *ED Model* across disease diagnoses varied somewhat, but maintained a positive skew (see Figure 2-12). Clients with cardiovascular conditions or psychiatric illnesses were at higher risk, whereas persons with neurological or musculoskeletal conditions were at relatively less risk. Despite some variation in the distribution, the predictive performance of the model across disease diagnoses was very consistent (see Figure 2-13). In addition, performance of the *ED Model* across disease diagnoses was very similar to its performance in the entire sample.



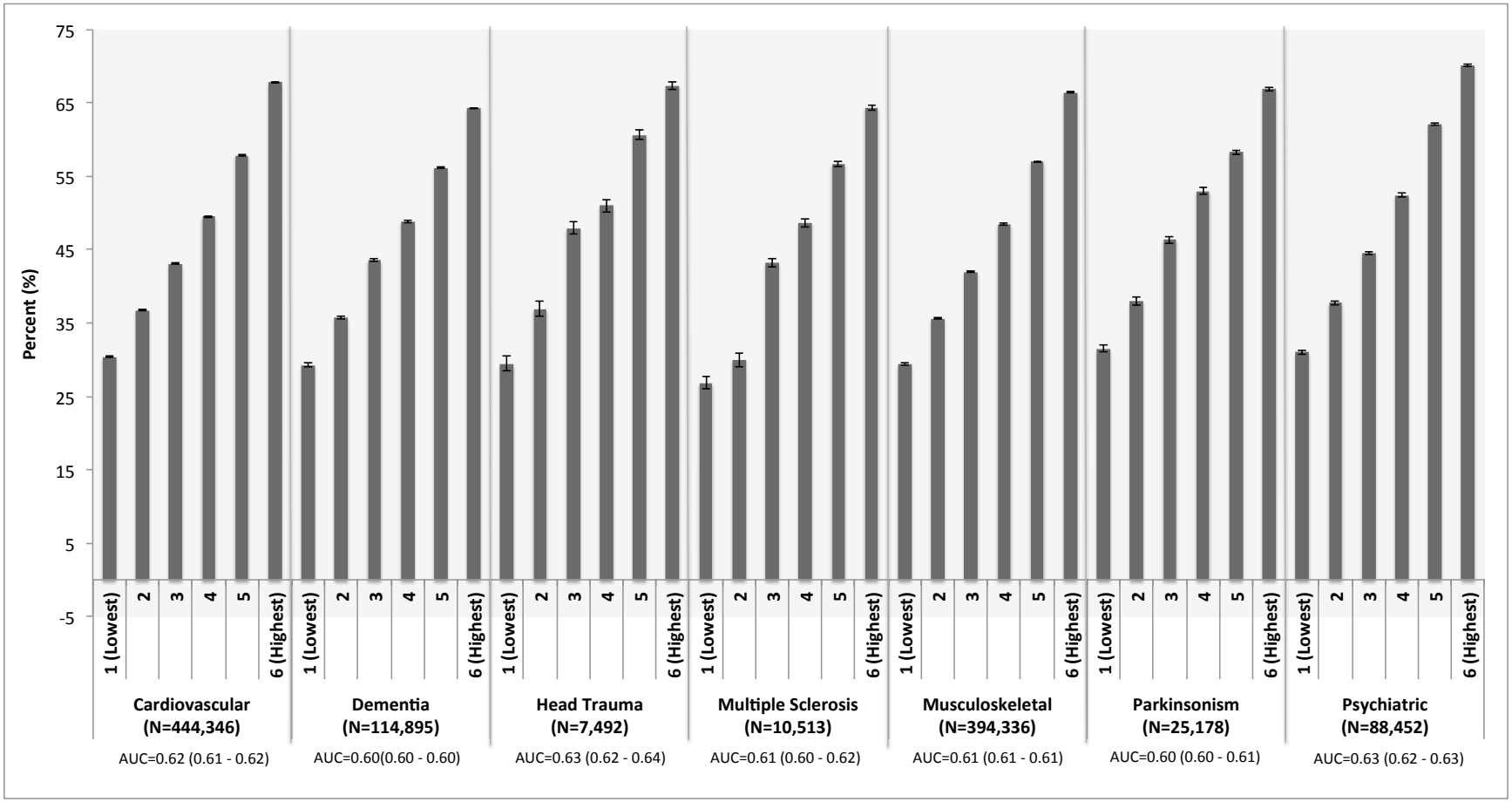
AUC = receiver operating characteristic (ROC) area under the curve (AUC)

Figure 2-11: **Comparing the Performance of the *ED Model*, Community Assessment Risk Screen (CARS), and Elders Risk Assessment Index (ERA), Prediction of Any unplanned ED visit by long-stay home care clients within 6-months of RAI-HC assessment, Ontario and WRHA (N=617,035)**



Cardiovascular = Stroke, CHF, CAD, Hypertension, Peripheral vascular disease (PVD).
Dementia = Alzheimer's disease or related dementias.
Musculoskeletal = Arthritis, Hip fracture, Fracture (non-hip), or Osteoporosis.
Psychiatric = Any psychiatric disease.

Figure 2-12: **Comparing the Distribution of the *ED Model* across Diagnoses, Ontario and WRHA**



Cardiovascular = Stroke, CHF, CAD, Hypertension, Peripheral vascular disease (PVD).
Musculoskeletal = Arthritis, Hip fracture, Fracture (non-hip), or Osteoporosis.
Dementia = Alzheimer's disease or related dementias.
Psychiatric = Any psychiatric disease.

Figure 2-13: **Proportion with Any unplanned ED visits within 6-months of RAI-HC assessment by ED Model and Diagnoses, Ontario and WRHA**

2.4.2.3 Predisposing and Enabling Characteristics

Within the high-risk level strata (*ED Model 5* or *6*), four items were included in the final model: age, sex, educational attainment, and residence type. Specifically, clients at high risk for ED visits who were also relatively young (<70), male, or had not attained a high school diploma were at higher risk, whereas living in a private residence (compared to all others) was protective. A 2-item model, including age and primary caregiver status best differentiated clients in the medium-risk level strata (*ED Model 3* or *4*). Clients at medium-risk according to the *ED Model* who were also relatively young (<70) or had a distressed primary caregiver were at higher risk for future unplanned visits. Clients at low-risk (*ED Model 1* or *2*) were further differentiated by a 4-item model that included age, sex, caregiver relationship, and primary caregiver status. Clients who were relatively old (≥ 90), male, received spousal care, or had a distressed primary caregiver were at higher risk for future unplanned visits. Though all of the model covariates achieved 95% significance in derivation and validation partitions, the strength of their effects sizes were weak and their overall accuracy (AUC) was very low or low. The Hosmer and Lemeshow Goodness-of-Fit tests did not reach significance, demonstrating that the final models were stable in both sample partitions.

Table 2-7: **Predisposing and Enabling Covariates Model, High Risk Level (*ED Model*=5,6), Derivation Sample Partition and Validation Sample Partition**

Covariates	Derivation (N=60,701)		Validation (N=20,267)	
	OR	**95% CI**	**OR**	**95% CI**
Age less than 70	1.26	(1.21 - 1.32)	1.23	(1.14 - 1.32)
Male	1.20	(1.16 - 1.24)	1.25	(1.18 - 1.33)
Less than high school education	1.17	(1.13 - 1.21)	1.07	(1.01 - 1.13)
Lives in private residence*	0.84	(0.82 - 0.87)	0.85	(0.80 - 0.90)
AUC (95%CI)	**0.55 (0.54 – 0.55)**		**0.54 (0.53 – 0.55)**	
Goodness-of-Fit Test`	**Chi-sq=9.33, p=0.32**		**Chi-sq=8.78, p=0.27**	

OR = Odds Ratio. AUC = receiver operating characteristic (ROC) area under the curve (AUC).
`Hosmer and Lemeshow Goodness-of-Fit Test. * Compared to congregate living, LTC (nursing home), or other.

Table 2-8: **Predisposing and Enabling Covariates Model, Medium Risk Level (*ED Model*=3,4), Derivation Sample Partition and Validation Sample Partition**

Covariates	Derivation (N=160,880)		Validation (N=53,687)	
	OR	**95% CI**	**OR**	**95% CI**
Age less than 70	1.12	(1.10 - 1.15)	1.09	(1.04 - 1.13)
Primary caregiver expresses distress	1.16	(1.13 - 1.20)	1.20	(1.14 - 1.26)
AUC (95%CI)	**0.52 (0.51 – 0.52)**		**0.52 (0.51 – 0.52)**	
Goodness-of-Fit Test`	**Chi-sq=0.64, p=0.42**		**Chi-sq=0.24, p=0.63**	

OR = Odds Ratio
AUC = receiver operating characteristic (ROC) area under the curve (AUC)
`Hosmer and Lemeshow Goodness-of-Fit Test

Table 2-9: **Predisposing and Enabling Covariates Model, Low Risk Level (*ED Model*=1,2), Derivation Sample Partition and Validation Sample Partition**

Covariates	Derivation (N=241,192)		Validation (N=80,308)	
	OR	**95% CI**	**OR**	**95% CI**
Age 90 or over	1.12	(1.09 - 1.15)	1.14	(1.09 - 1.20)
Male	1.16	(1.14 - 1.19)	1.14	(1.10 - 1.18)
Primary or secondary caregiver is a spouse	1.05	(1.03 - 1.07)	1.05	(1.02 - 1.09)
Primary caregiver expresses distress	1.18	(1.14 - 1.21)	1.15	(1.10 - 1.21)
AUC (95%CI)	**0.53 (0.52– 0.53)**		**0.53 (0.52– 0.53)**	
Goodness-of-Fit Test`	**Chi-sq=3.80, p=0.43**		**Chi-sq=1.09, p=0.90**	

OR = Odds Ratio
AUC = receiver operating characteristic (ROC) area under the curve (AUC)
`Hosmer and Lemeshow Goodness-of-Fit Test

2.5 DISCUSSION

This investigation uniquely examined the prevalence of home care clients in the ED and prospectively examined the determinants of unplanned ED use among assessed home care clients. The combination of census-level data, comprehensiveness of independent variables, use of 'gold-standard' dependent variables, cohort design, and multi-level validation also makes this investigation rare in the literature concerning community-dwelling older adults. The conceptual and practical implications of this chapter's findings are discussed separately.

2.5.1 Conceptual Implications

2.5.1.1 ED Model

Findings from the decision-tree analyses provide an empirically sound, visual representation of the determinants of ED visits among long-stay home care clients. The *ED Model* serves as an elaboration of person-level, need-based factors incorporated in the Andersen Behaviour Model. Consistent with studies of community-dwelling older adults, previous utilization was the most discriminatory independent variable (Crane et al., 2010; Ginsberg et al., 1996; Parboosingh & Larsen, 1987; Shelton et al., 2000). The use of previous ED and hospital utilization as the *ED Model*'s root node is prudent given that it represents an undifferentiated risk pathway that, if included between specific somatic nodes, would disrupt the clinical coherence of the *ED Model*. It is still unclear to what extent the effect of previous utilization reflects unmeasured conditions and symptoms, the behavior of the client's health care providers, or the client's care preferences. More detailed investigation is necessary to understand what components drive the relationship between previous and future ED use.

Cardio-respiratory symptoms best differentiated home care clients regardless of previous use, and represented parallel nodes in the *ED Model*. Though novel in the determinants literature, cardio-respiratory symptoms are common presenting complaints among older adults (Carter & Gupta, 2008; Dove & Dave, 1986; Downing & Wilson, 2005; Ettinger et al., 1987; Lishner et al., 2000; Salanitro et al., 2012; Singal et al., 1992). These symptoms likely reflect immediate and, often, distressing events that prompt ED use. The addition of other symptoms, such as edema or

vomiting, added no discernible benefit. Where there was adequate power, cardio-respiratory symptoms were further differentiated by the presence of common cardiac conditions: CHF and CAD. The predictive validity of cardiac conditions is supported within the community and ED-based literature (Bazargan et al., 1998; Crane et al., 2010; Lim & Yap, 1999; Lowenstein et al., 1986; Shah et al., 2001; Strange & Chen, 1998; Walter-Ginzburg et al., 2001). The presence of cardiac conditions in the *ED Model* likely differentiates the real or perceived severity of the preceding symptoms. Also, clients with a cardiac diagnosis may be more likely to seek ED care given an enhanced knowledge of their disease symptoms through past contact with care providers. Though a relationship was identified between cardio-respiratory symptoms and cardiac conditions, hypotheses concerning the precise nature of the relationship were out of scope and require more investigation. In particular, it would be interesting to examine to what extent those with symptoms, but without documented cardiac conditions, represent under-diagnosis in home care or are opportunities for early diagnosis and prevention.

Beyond the root node and the parallel cardio-respiratory nodes, the independent variables that differentiated home care clients were diverse. Plausible clinical clusters were identified from node combinations at the extremities of the *ED Model*. The combination of prospects for functional improvement and mood demonstrates that client mood moderates the effect of functional decline. The relationship between cardiac conditions and other complex conditions represents the detrimental effect of other complex conditions and infections. Though without a common definition, multi-morbidity has been identified as a challenge to the single-disease framework that underlies most medical care (Barnett et al., 2012). Finally, the grouping of previous falls with a diagnosis of diabetes or a recent stroke may represent an increase risk and, potentially, severity of future falls due to visual, spatial, and gait challenges.

Relatively unspecific nodes differentiated the risk of ED visits among clients with no previous ED use or cardio-respiratory symptoms, including: falls, ADL decline, and nutritional status. These nodes might be a reflection of underlying chronic conditions (incl. dementia, diabetes), medications, social isolation, mood, or environmental factors. The inclusion of falls, ADL decline, and nutritional status in the *ED Model* is unique relative to the disease-based factors found in the

disease-oriented literature (Crane et al., 2010; Shelton et al., 2000). A stasis ulcer, a relatively specific node, also differentiated the risk of ED visits for clients without previous ED use or cardio-respiratory symptoms. This node is not particularly surprising given that stasis ulcers account for the majority of chronic wounds among older adults (Snyder, 2005).

Independent variables related to demographics and informal care status were not statistically viable for inclusion into the model, notwithstanding the negative incentives they might generate if included in client decision-making. None of the coded 'phenotypes' or informal support variables demonstrated predictive performance in the decision-tree analyses. Functional domain summaries provided by interRAI summary scales, including cognition, instrumental activities of daily living (IADL), and ADL status, also showed poor predictive performance in the decision-tree analyses. These findings of poor performance are not without precedent in the literature (Bazargan et al., 1998; Hansell et al., 1991; Parboosingh & Larsen, 1987; Shelton et al., 2000; Walter-Ginzburg et al., 2001). More importantly they suggest that informal care exacerbations or stable functional status are not substantive risk factors of ED use among home care clients, rather the instability of symptoms and conditions are the main causes of unplanned ED use among home care clients. However, this result may be more exclusive to home care clients that have less variance in functional status given that they all, by definition, have some functional impairment.

Multilevel analyses with the *ED Model* showed no regional effect. This suggests that the effects of person-level need variables are consistent regardless of location. That the risk pathways articulated in the *ED Model* explained unplanned ED use across geographical and health services settings is somewhat surprising given that the regions/LHINs included in this study vary widely by geography as well as level of urbanization. For example, the Toronto Central LHIN represents the most urban health region in Canada, whereas the North East and North West LHINs represent among the more rural health regions in Canada. The regional stability of the *ED Model* might suggest that little is being done in all regions to modify the pathways identified in the model, or that they are difficult to modify. The *ED Model* was also generalizable across disease diagnoses, including neurological conditions. This suggests that the same risk factors influence unplanned ED use among home care clients regardless of diagnosis.

The overall accuracy of the *ED Model* should be interpreted with an appreciation of the stochastic nature of unplanned ED visits. The relatively non-deterministic nature of unplanned ED visits is the result of random precipitating events as well as the relatively few barriers to ED access. This contrasts with other health service use among older adults, such as LTC placements and hospital visits, which have formal structures to regulate access. For example, most persons can choose freely to access care in the ED, whereas need-based eligibility criteria determine access to LTC or inpatient care. Despite the stochastic nature of unplanned ED visits, the *ED Model* showed clear risk differentiation between model scores in logistic regression and time to event analyses. The *ED Model* was able to differentiated clients with a 30% and those with a 70% likelihood of unplanned ED use.

2.5.1.2 Predisposing and Enabling Characteristics

The ad hoc analysis of predisposing and enabling characteristics within collapsed *ED Model* strata produced three distinct logistic regression models. The predisposing effect of age differentiated clients within each of the three model strata. Clients who were relatively young (<70) were more likely to have an ED visit in the medium and high-risk strata, whereas clients who were relatively old (≥ 90) were more likely to have and ED visits in the low risk strata. The risk-dependent effect of age suggests that an early onset of relatively unstable conditions characterizes a more unstable overall health profile, whereas the effect of old age (≥ 90 years) among relatively stable clients suggests that they may have additional undetected frailty not accounted for in the *ED Model*. Gender differentiated clients in high and low risk strata, and specifically suggested that males are more predisposed in high and low risk strata. That the predisposing effect of being male persisted in the low risk strata, adjusted for spouse, implies that its predisposing effect is not dependent on the enabling effect of spousal support. The effect of gender might reflect that men are less likely to seek primary and preventive care (Bertakis, Azari, Helms, Callahan, & Robbins, 2000). Low educational attainment was found to predispose clients within the high-risk strata. This effect may represent lifestyle factors as well as the relative inability or education to self-manage their unstable conditions.

Living arrangement was found to be an enabling factor for clients within the high-risk strata. The protective effect of living in a private residence may reflect resilient informal support, or the tendency of staff in alternate living settings to refer clients to the ED. The enabling effect of informal care breakdown from clients in medium and low risk strata suggests that informal care may be a tipping point for clients with relatively less instability, whereas the precipitating events experienced by clients with relatively high instability are often sufficient in and of themselves. Similarly, the enabling effect of having a spousal caregiver within the low-risk strata may represent and additional tipping point for clients. That is, a spouse may be more likely to facilitate ED care relative to other informal caregivers or relative to clients with no informal support. The enabling effect of spousal informal support is consistent with some of the literature (Considine et al., 2010; Crane et al., 2010). Unfortunately, none of these proposed risk pathways for predisposing and enabling characteristics could be validated in this study and remain open to interpretation.

Though predisposing and enabling relationships were significant and validated within each model strata, they offered little additional explanatory power. Each model's effect sizes were small and each model achieved very modest overall accuracy. The weakness of each model was also expressed in relatively high Hosmer Chi-square statistics considering the large samples sizes that were employed. The analyses of predisposing and enabling characteristics suggest that their influence on unplanned ED visits among home care clients are modest in comparison to need-based predictors captured in the *ED Model*. Likewise, the enabling characteristics that were included in the decision-tree analyses also showed poor predictive performance and, thus, were not viable for inclusion into the *ED Model*. The detail and accuracy of the predisposing and enabling models in these analyses seemed to vary by the homogeneity of each *ED Model* strata. This result suggests that predisposing and enabling characteristics are inconsistent, and are more relevant to homogeneous client clusters that have more consistent exogenous factors. Examples of inconsistent predisposing and enabling characteristics are also apparent in the literature. For example, in Ontario the predisposing effect of low socio-economic status varies according to the accessibility of primary care practice models. Those of very low socio-economic status who access

community health centers are less likely to use the ED relative to others of the same socio-economic status as well as those with higher economic status who access alternate primary care practice models (Glazier, 2012). Also, there are many theoretical predisposing and enabling characteristics that should influence the overall rates of ED visits between Canadians and Americans, particularly insurance, yet studies find no statistically significant difference in utilization rates between both countries (Khan et al., 2011; Li et al., 2007). Overall, results indicate that predisposing and enabling characteristics do not represent sufficient factors for ED utilization, whereas need-based characteristics are more likely to be sufficient in and of themselves.

Overall, these results provide little support for the hypothesis that predisposing and enabling characteristics are prominent drivers of unplanned ED use within the Andersen Behavioral Model. Relevant conceptual frameworks based on the Andersen Behaviour Model should therefore reflect the higher predictive power of need-based factors given that these analyses suggest that they are a durable, necessary, and sufficient class of determinants. On the other hand, this study suggests that predisposing and enabling factors are neither necessary nor sufficient for ED use in the context of near universal access, and should be moderated within conceptual frameworks reflect these findings.

2.5.2 Practical Implications

The *ED Model* provides an empirically-based decision support system that can be used in home care to help identify a client's likelihood of unplanned ED use, and identify interventions to mitigate that eventuality. The *ED Model* had significantly better performance than both the ERA and CARS tools. Beyond predictive accuracy, the distribution of clients suggested that the *ED Model* was a more useful tool at the point of care. Its positive skew showed that it is not prone to over-triggering at high-risk levels. Tools that trigger too many individuals at high-risk levels quickly overwhelm the resources needed to intervene and, therefore, fail to differentiate persons at the point of care. The *ED Model* triggers progressively less persons throughout the hierarchy of levels. This allows home care case managers to direct limited resources to those at highest risk. That the

ED Model was also generalizable across disease diagnoses, including neurological conditions, confirms that it can be used to determine the risk of unplanned ED use across many diagnoses.

The use of the *ED Model* is necessary in home care given the pervasive predisposition to conceptualize client risks factors in terms of function, and interventions in terms of the provision of supportive and restorative care. Though a predisposition toward functional needs is a perfectly valid perspective in home care given it's role in the health care system, the *ED Model* includes determinants that are not fully captured in existing decision support tools in widespread use nor in existing client classification frameworks. For example, MAPLe – a decision tool that has been shown to predict the caregiver distress and need for LTC – is conceptually different than the *ED Model* (Hirdes et al., 2008; Noro et al., 2011) (also see Appendix J). The *ED Model* can be used to introduce a different perspective that focuses on the identification and management of the symptoms and conditions that predict ED use. However, like MAPLe, the strength of the *ED Model* in this respect is due to its use of a grouping methodology that visually articulates generalizable risk pathways that differentiate client risk. In this way the *ED Model* may be used to educate case managers on the risk pathways that differentiate a client risk levels. Treatment and intervention aimed at ameliorating specific client clusters may reduce risk. Also, with an understanding of likelihood and the underlying risk pathway, case managers can help clients and other caregivers anticipate and manage underlying causes of disease exacerbations. The use of the *ED Model* would be particularly useful to target the increasing supply of specialized home care programs, such as rapid response teams or nurse practitioner teams.

Many of the risk pathways described in the *ED Model* relate to, so-called 'ambulatory care sensitive conditions' – those that are generally agreed to be preventable by interventions in primary care (Billings, Anderson, & Newman, 1996; Caminal, Starfield, Sánchez, Casanova, & Morales, 2004). Beyond its use as a decision-support system to help direct home care resources, the *ED Model* may also be utilized as a decision-support system to notify and collaborate with primary care practitioners and primary care teams. The utility of such an approach would be to help expand disease and symptom surveillance within primary care. Referrals could be made to primary care for urgent appointments, after hours primary care access, or home visits. This is

especially pertinent in Canada given that it is amongst the countries with the highest ED use, while also having the lowest urgent and after hours primary care access (Schoen et al., 2010). For example, clients with cardio-respiratory symptoms, but without a formal diagnosis, may particularly benefit from early identification and management in primary care. Also, evidence suggests that many clients with existing diagnoses relevant to the *ED Model* are not receiving ideal pharmacotherapy. A recent study showed that only 29% of long-stay clients with diagnosed heart failure are receiving optimal pharmacotherapy (Foebel et al., 2011). A large study without a home care focus also found that 40% of persons with one or more severe chronic conditions have not made a treatment plan with their primary care provider in over a year (CIHI*,* 2009a). RAI-HC information collected on persons referred for urgent primary care management could also be shared with primary care providers to inform the development of enhanced, team-based primary care clinics for persons with unstable chronic illnesses, and particularly more cardio-respiratory conditions. Such models already exist for persons with early signs of dementia (Lee et al., 2010; Lee, Kasperski, & Weston, 2011).

Beyond its use for point of care decision-support, the *ED Model* may also be used for evaluation and monitoring at the organizational, regional, and provincial levels. Particularly, home care organizations, provincial funders, and quality measurement agencies can use the *ED Model* to stratify or adjust quality indicators and accountability metrics that target unplanned ED use among home care clients. This method can establish organizational and regional benchmarks for performance in order to learn from high performing organizations, and examine how variations in access to preventative services affects performance.

2.5.3 Limitations

Though efforts were made to improve upon the methodological limitations of previous studies reported in the literature, a few key limitations of this study deserve reflection. This study was limited to the independent variables available in the RAI-HC and may not have captured all of the relevant person-level determinants of ED use among home care clients. This is particularly relevant for disease condition severity, symptoms, and medical tests that are not a part of the RAI-HC assessment. Also, the *ED Model* best reflects the risk of unplanned ED use within 6 months

of an assessment. It is conceivable that models employing a shorter or longer duration may reflect different factors and different underlying risk pathways. It is important to emphasize that all subjects in this study were long-stay home care clients in Ontario and the WRHA. The *ED Model* may not be fully generalizable to all home care clients and community-dwelling older adults. Long-stay home care clients, by definition, represent a frailer subpopulation of community-dwelling older adults. The relative lack of geriatric syndromes in the *ED Model* may be a reflection of this sample bias, and they remain plausible predictors among general community-dwelling older adults. Also, the *ED Model* may not be fully generalizable to all frail sub-populations of community-dwelling older adults.

2.5.4 Future Research

Future research with the *ED Model* in home care should focus on examining the descriptive characteristics of clients identified across risk strata. An understanding of the characteristics of the clustered groups and the nature of their ED visits would help to develop and refine clinical protocols for those identified as being at higher risk. Also, an examination of the existing provision of home care services and access to preventative services by model risk strata would be useful to evaluate the appropriateness of existing home care provision and access. How the *ED Model* specifically relates to existing decision-support frameworks and client classifications in home care would also represent a useful addition to home care practice and research literature. Specifically, how the *ED Model* relates to the MDS CHESS scale – a risk measure for mortality – would be aid the application of both for decision-support.

Another important program of research using the *ED Model* would be to conduct randomized cluster trials to determine the modifiability of unplanned ED by one or more interventions. Outcome measures could be controlled for using the *ED Model*, or changes in expected risk within the *ED Model,* could be used as an outcome measure. Broader system-level research is also possible. For example, the use of multi-level modeling techniques that control for person-level effects represented by the *ED Model* could be used to examine system-level determinants of ED use, such as the organization of community and primary care services. This research, also based

on the Andersen Behavioural Model, could expand the evidence base on the relationships between system-level and person-level determinants for ED utilization.

Validation studies are also required to understand how well the *ED Model* predicts acute care hospital utilization. Though similar to ED visits, hospitalizations are likely to represent distinct pathways that may reflect a higher severity than what is captured in the *ED Model*. The *ED Model* also requires validation in other population samples of community-dwelling older adults. For instance, a retrospective cohort study using interRAI Community Health Assessment (CHA) records linked to ED and hospital records could be conducted to determine the generalizability of the *ED Model* to the community support population. Similarly, a prospective cohort study should be conducted in primary care samples using a stand-alone version of the *ED Model*. This work could help target interventions in primary care, and would be particularly viable in multi-disciplinary group practice models. Other national and international validations among community-dwelling older adults are also worthy research pursuits.

Chapter 3

THE PROFILE OF NON-INSTITUTIONALIZED OLDER ADULTS IN EMERGENCY DEPARTMENTS AND DETERMINANTS OF INPATIENT ADMISSION

"Those in charge of accident departments will also need to accept the importance of caring for the elderly and arrange appropriate staff training in this neglected sphere. An appreciation of the problems faced by the elderly when seeking medical attention is essential for proper development of services."
Dove & Dave, 1986.

3.1 INTRODUCTION

3.1.1 Volume and Trends

The literature on ED utilization strongly suggests that older adults use the ED substantially more than all other age groups (Aminzadeh & Dalziel, 2002; Downing & Wilson, 2005; Grief, 2003; Gruneir et al., 2010; McCusker et al., 2003; Oates et al., 1997; Salvi et al., 2007). In addition, studies show that rates of ED use among older adults has risen disproportionately over the past decade (Aminzadeh & Dalziel, 2002; McCaig, 2005; Roberts, McKay, & Shaffer, 2008). These findings are reported in North America, Europe, Asia, Australia, and Israel (Aminzadeh & Dalziel, 2002). Specifically, older adults have been found to account for 12% to 21% of all ED visits (Aminzadeh & Dalziel, 2002; Gruneir et al., 2010; McCusker et al., 2003). Wolinsky et al. (2008) explored ED utilization with a U.S. nationally representative sample. They found that 18.4% of all persons 75 years of age or older visit the ED in any given year. Two other U.S. studies suggest that the visit rate among older adults increased between 12% and 26% since 1993 (McCaig, 2005; Roberts et al., 2008).

A Canadian, census-level retrospective study using Ontario data showed that those aged 75 or older had the highest ED visit rate. That is, those aged 65-74 had an ED visit rate of 46.6 visits per 100 persons per year while those aged 75 years and older had a rate of 73.1 visit per 100 persons per year (Li et al., 2007). Ontario rates were found to be the same as that of the U.S. (Li et al., 2007). A Quebec cross sectional population-based study using provincial data found that the average rate of ED use among older adults was 2.14 days per 1000 days at risk, which translates to an absolute risk of 0.78 days per year. From 2007-2008, 35% of acute care hospitalizations in Canada (excluding Quebec) were for persons aged 75 and older. The vast majority (91%) of these patients were admitted through the ED (CIHI, 2009).

3.1.2 Patterns of Presentation

Research by Downing et al. (2005) suggests that ED patients age 65 or older are more likely to present to the ED during the morning, early afternoon, and during the winter months whereas those less than age 65 were more likely to present later in the day and very early morning. Older

ED patients were also found to be at least twice as likely to arrive by ambulance than those under the age of 65 (Downing & Wilson, 2005; Ettinger et al., 1987; George et al., 2006; Gerson & Shvarch, 1982; Shah et al., 2003; Strange et al., 1992). Downing et al. (2005) found that 64.7% of older ED patients arrived by ambulance relative to 19.9% of non-elderly patients. A U.S. study reported older patients were twice as likely to arrive by ambulance relative to the non-elderly (Gerson & Shvarch, 1982). They also found that those over the age of 75 were more likely to arrive by ambulance compared to patient's age 65-75 (Singal et al., 1982). A 10-year U.K. study found that older patients contributed to half of all observed increases in ambulance use (George et al., 2006). Despite higher rates of ambulance use, studies show that older adults are the most appropriate users of ambulance services (Downing & Wilson, 2005; Ettinger et al., 1987; Gerson & Shvarch, 1982). Specifically, older adults who arrive by ambulance were more likely to be admitted than younger users (Downing & Wilson, 2005; Ettinger et al., 1987).

The literature describing reasons for ED presentation among older adults is largely incomplete. Those studies that explored reasons for presentation or presenting complaint found that symptoms of injuries, abdominal pain, as well as cardio-respiratory and cerebrovascular illnesses are common presenting complaints (Carter & Gupta, 2008; Dove & Dave, 1986; Downing & Wilson, 2005; Ettinger et al., 1987; Lishner et al., 2000; Singal et al., 1992). Two studies found that symptoms of chronic illness were common presenting complaints among patients over the age of 75, whereas injuries were more common among the younger elderly (Ettinger et al., 1987; Singal et al., 1992). ED utilization as a result of injury has been investigated. Singal et al. (1992) found that falls were a common cause of injury among older adults, and that falls were more likely to be the cause of injury among those over the age of 75 and still more likely for those over the age of 85 (17%, 28%, and 83% respectively). In addition, research from the U.S. also found that the oldest old, females, and lower trunk fractures account for the majority of fall-related injuries among older ED patients (Orces, 2013). A large U.S. study by Carter and Gupta (2008) estimated that there were 12 injury related ED visits per 100 older adults, where fall related fractures and contusions were the most frequent. Fall rates for those aged 85 years and older were nearly double (Carter and Gupta, 2008). Only one study explored the prevalence of loss of independence

as a reason for presentation. Specifically, in a older study by Lowenstein et al. (1986) 19% of the presenting diagnoses among older adults were related to poor nutrition, falls, and psychosocial issues. The author hypothesized that many such diagnoses were related to loss of independence. This seems plausible given that another study found that many older ED patients lived alone or had weak informal care capacity (Dove & Dave, 1986).

Access to primary care is thought to be a major determinant of ED use among older adults. Older adults who present in EDs are more likely to have a personal primary care physician and to have attempted to visit their primary care physician prior to their ED visit relative to younger adults (Baum & Rubenstein, 1987; Ettinger et al., 1987; Lowenstein et al., 1986; Oates et al., 1997; Parboosingh & Larsen, 1987). A Canadian study found that just over half of all older adults who presented to the ED reported having a personal primary care physician (Parboosingh & Larsen, 1987). This difference in primary care physician association also persists within older adults, where 95% of those over the age of 75 noted a personal primary care physician Baum & Rubenstein, 1987).

Studies suggest that older adults have, on average, 20% to 58% longer lengths of stay (LOS) in the ED relative to younger adults (Baum & Rubenstein, 1987; George et al., 2006; Grief, 2003; Lowenstein et al., 1986; Singal et al., 1992). An increase in diagnostic investigations, such as blood tests and scans, has been credited with the observed increase in LOS (George et al., 2006; Singal et al., 1992). Studies show that older adults are subjected to more diagnostic investigations relative to younger adults (Baum & Rubenstein, 1987; Ettinger et al., 1987; George et al., 2006; Grief, 2003; Lowenstein et al., 1986; Singal et al., 1992; Strange et al., 1992). One study compared the rate of investigations among age groups by diagnostic code and disease category. The authors found that the increase in investigations among older adults persisted in each diagnostic and urgency category relative to younger adults (Ettinger et al., 1987). Despite the fact that older adults are subject to more investigations in the ED, there is evidence that ED diagnoses are less accurate upon review compared to younger adults (Baum & Rubenstein, 1987; Singal et al., 1992; Wofford et al., 1993). This is hypothesized to be associated with non-specific

presentations, atypical presentations, multi-morbidity, and polypharmacy (Singal et al., 1992; Wofford et al., 1993).

Studies found that between one-third and just over one-half of ED visits by older adults result in an acute admission – a rate that is 2.5 to 4.6 times higher than that for younger adults patients (Baum & Rubenstein, 1987; Downing & Wilson, 2005; Ettinger et al., 1987; George et al., 2006; Gillick & Steel, 1983; Lowenstein et al., 1986; Richardson, 1992; Singal et al., 1992; Strange et al., 1992). Studies also found that admission rates are higher among oldest adults compared to younger older adults (Carter, Datti, & Winters, 2006; Lowenstein et al., 1986). An admission to acute care is a non-discretionary event on the part of the ED patient and it is unclear what factors influence admission decision-making. It is plausible that characteristics of the patient, the ED, and the admitting hospital would influence admission rates, but studies have yet to explore determinants of admission. An admission to inpatient care represents a sentinel transition for all persons. Understanding of what factors drive admission for older ED patients is a key research priority.

3.1.3 Patient Characteristics

Older adults are more likely to have a presenting diagnosis related to cerebrovascular conditions, cardiac conditions, infections, and respiratory conditions, while less likely to have injury related or psychiatric diagnoses relative to younger adults (Downing & Wilson, 2005; Ettinger et al., 1987; Hustey, Meldon, Smith, & Lex, 2003). A 3-year U.K. study found that the most common presenting diagnoses were related to cardiac conditions, accounting for almost 10% of all ED visits among older adults. Among cardiac conditions, studies suggest that heart disease, congestive heart failure, and cardiac dysrhythmias were the most common (Lim & Yap, 1999; Lowenstein et al., 1986; Strange & Chen, 1998). Traumatic injury due to falls is the most common presenting diagnoses among surgical diagnoses (Lim & Yap, 1999; Lowenstein et al., 1986; Sanders, 1992; Singal et al., 1992). A U.S. Medicare study found that frequent ED users (6 or more visits a year) were more likely to have cardiac, diabetic, and chronic respiratory diagnoses (Belcher & Alexy, 1999). A presenting diagnosis is often a direct reflection of the presenting complaint. The presenting complaint informs the reason why the person sought ED care, whereas the presenting

diagnosis infers the underlying medical reason that underpins the presenting complaint. However, for older adults with atypical presentations and non-specific symptoms the presenting diagnosis is more likely to be inaccurate or undetermined (Singal et al., 1992; Wofford et al., 1993).

Acuity on arrival relates to the medical instability of persons at time of ED triage. Many studies that explored patterns of presentation included some measure of acuity or instability. Many EDs utilize triage classification systems to rank patients on the urgent need for medical attention. Of studies that collected the triage classification, the vast majority found that older adults were more likely to be classified in more urgent categories (frequently urgent or emergent) compared to younger adults (Baum & Rubenstein, 1987; Ettinger et al., 1987; Lowenstein et al., 1986; Oates et al., 1997; Roberts et al., 2007; Singal et al., 1992; Strange et al., 1992). Also, a few studies found that the greater urgency among ED visits increased with advanced age (Ettinger et al., 1987; Singal et al., 1992; Strange et al., 1992). An older study found that 37% and 45% of ED visits among adults aged 65-74 and over the age of 75, respectively, were triaged as urgent or emergent relative to 31% among younger adults (Lowenstein et al., 1986). Regarding the acuity of presenting illnesses, several studies found that older adults were more likely to present with an acute illness relative to younger adults (Ettinger et al., 1987; Lowenstein et al., 1986; Oates et al., 1997; Roberts et al., 2007). A study by Wolinsky et al. (2008) that utilized a service intensity classification found that approximately 29% of ED visits among older adults were classified as high intensity, whereas approximately 6% of visits were classified as low intensity. The finding that only 6% of older adults were potentially inappropriate suggested that older adults' use of the ED is largely appropriate. Two authors clearly conclude that there is very little evidence to suggest that older adults over utilize the ED for social or trivial complaints (Ettinger et al., 1987; Oates et al., 1997).

Very little research describes the functional, symptomatic, and psychosocial characteristics of older adults in ED. With a cohort study of 297 older ED patients, Hustey et al. (2002) found that 26% had a 'mental status' impairment – 10% had cognitive impairment without delirium, 10% had only delirium, and the remaining 6% had cognitive impairment and delirium. A study by Gerson et

al. (1994) broadly supports these findings. Using a single-question screen, Kumar et al. (2004) found that 21% of older adults had self-reported depression. Two studies suggest that approximately two-thirds of older adults in the ED are dependent on at least one ADL (Gerson, Blanda, Dhingra, Davis, & Diaz, 2001; Wilber, Blanda, & Gerson, 2006). Functional decline was reported by nearly three-quarters of older adults (Wilber et al., 2006). These studies found that older adults with functional decline reported that it was a factor for their ED visit (Gerson et al., 2001; Wilber et al., 2006). Polypharmacy is also an understudied characteristic among older adults in EDs. One study of 88 older ED patients found they took an average of 6 prescription medications (Chung & Bartfield, 2002). Two-thirds were not able to recall their medications, suggesting potential difficulty in medication management and cognition (Chung & Bartfield, 2002). Another study found that adverse drug reaction were noted is close to 1% of ED visits by older adults, and many were related to cardiac medications (Chen et al., 2012).

The lack of studies that comprehensively describe the functional, symptom, and psychosocial profile of older adults in the ED is a considerable gap in the literature. Also, the literature that describes older ED patients is fairly dated. Changes in practice patterns and patterns of presentation may limit the generalization of some of the literature to today's population. Repeat ED use among older adults is a strong predictor of future ED use (see Chapter 2), and older ED patients have the highest repeat ED visit rate of any age group (Hustey et al., 2007; McCusker et al., 2000; McCusker et al., 2003; McCusker et al., 1997; Rowland et al., 1990). A systematic review on frequent adult ED users concluded that they have yet to be defined adequately enough to allow for program and policy creation (LaCalle & Rabin, 2010). An examination of ED users with recent multiple visits would be particularly useful to understanding potential unmet needs. Likewise, an examination of how triage acuity relates to functional, symptom, and psychosocial characteristics would also be critical to understanding what patient characteristics are differentiated by triage acuity.

3.1.4 Overcrowding and Appropriateness

The projected increase in older adults in the population, and particularly those of advanced age, has prompted concerns about ED overcrowding in Canada and internationally (Aminzadeh &

Dalziel, 2002; Boyle, Pineault, & Roberge, 1992; Derlet, Richards, & Kravitz, 2001; Estey, Ness, Saunders, Alibhai, & Bear, 2003; Gruneir et al., 2010; Richardson & Mountain, 2009; Wolinsky et al., 2008). Generally ED overcrowding refers to periods of time where the function of an ED is obstructed by an excessive number of patients needing or receiving care. The Canadian Association of Emergency Physicians and the National Emergency Nurses Affiliation have defined ED overcrowding as a "situation in which the demand for ED services exceeds the ability to provide care in a reasonable length of time" (Canadian Association of Emergency Physicians, 2003; Ospina et al., 2007). A large scale survey of ED directors in the U.S. found that most consider ED overcrowding to include patients in hallways, complete ED bed occupancy, full waiting rooms, and acutely ill patients who wait more than an hour until first contact with a physician (Derlet et al., 2001). The same study suggests that many EDs that were historically immune to ED overcrowding are now experiencing substantial ED delays to care, where 39% of EDs surveyed reported daily overcrowding (Derlet et al., 2001). Canadian studies suggest that the consequence of overcrowding are an increased risk of adverse outcomes (including death), prolonged pain and discomfort, patient dissatisfaction, unauthorized patient departures, increased ambulance diversions, as well as lower staff productivity and job satisfaction (Bullard et al., 2009; Estey et al., 2003; Guttmann et al., 2011). Currently, there is no measurable definition for ED overcrowding in Canada, or elsewhere. The concept tends to be measured using wait times, which is typically operationalized as the time from registration to triage, triage to contact with a clinician, and triage to an ED bed among those admitted (Bullard et al., 2009; Schull, Slaughter, & Redelmeier, 2002). One study suggests that the major impediment to a measureable national definition of overcrowding is the lack of comprehensive and complete data collection in EDs (Rowe et al., 2006).

International literature suggests that the causes of ED overcrowding relate to some combination of increased ED use, a decrease in ED capacity, inpatient bed shortages, and a decrease in ED efficiency owing to an increase number of older patients (Derlet et al., 2001; George et al., 2006; McCaig, 2005; Vermeulen et al., 2009). The Canadian literature consistently reports that the greatest contributing factor to ED overcrowding is inpatient bed shortages that

quickly cause ED bed shortages (Canadian Association of Emergency Physicians, 2003; Estey et al., 2003; Kollek, 2002; Schull et al., 2003; Schull, Morrison, Vermeulen, & Redelmeier, 2003; Upfold, 2002; Vermeulen et al., 2009). The lack of inpatient beds creates a condition where patients that are admitted to acute care are 'boarded' in the ED while awaiting an open inpatient bed. The need for admission to acute care is an ED-specific cause of the lack of inpatient beds, whereas delayed discharge from inpatient wards – known as alternate level of care (ALC) – is the largest cause (Schull et al., 2002). A fairly recent CIHI report found that 10% of patients admitted through the ED wait 15 hours or longer for an inpatient bed assignment, while 4% wait longer than 24 hours (CIHI, 2007). The average age of those who waited for longer than 24 hours was 67 years (CIHI, 2007). ED restructuring and funding cutbacks have also been implicated in ED overcrowding (Canadian Association of Emergency Physicians, 2003; Schull, Szalai, Schwartz, & Redelmeier, 2001).

Concerns have been raised about the appropriateness of ED use among older adults in light of the growing number of older persons presenting to overcrowded EDs (McCaig, 2005; Roberts et al., 2008). As well, the use of EDs by older adults has been described as a contributing factor to ED overcrowding (Oates et al., 1997; Rosenblatt et al., 2000; Schumacher et al., 2006; Upfold, 2002). Oates et al. (1997) describe a situation in Australia where a national health strategy was predicated on the assertion that a substantial portion of older patients treated in the ED were 'non-acute'. Rosenblatt et al. (2000) concluded that a substantial portion of ED visits were attributable to non-emergency cases that might have been prevented by a primary care provider. Also, evidence suggests that ED physicians are apt to overestimate the proportion of older adults treated under their care in a given day (Schumacher et al., 2006; Strange et al., 1992). These assertions are not surprising given that older adults utilize more ED resources relative to younger adults, while also having less accurate diagnoses and more admissions. Researchers have attempted to estimate the proportion of ED visits by older adults that are potentially inappropriate (Ackermann, Kemle, Vogel, Griffin, & others, 1998; Altmayer, Ardal, Woodward, & Schull, 2005; Carter et al., 2006; Gruneir et al., 2010). In Canada, the Canadian Triage and Acuity Scale (CTAS) defines acuity level in EDs (Bullard, Unger, Spence, Grafstein, & CTAS National

Working Group, 2008; Murray, Bullard, Grafstein, CTAS Natioanal Working Group, & CEDIS National Working Group, 2004) (see Appendix T). Specifically, the CTAS differentiates urgency for medical care using a 5 level scoring system (Bullard et al., 2008). Canadian studies define low-acuity visits as those that were rated as less urgent or non-urgent (CTAS score 4 or 5) (Gruneir et al., 2010; Schull et al., 2007). A large Canadian study of 110 EDs also defined 'low-complexity patients' as those who were ambulatory on arrival, low-acuity triage level, and not admitted (Schull et al., 2007). The preoccupation with rates of potentially avoidable visits as well as potentially inappropriate visits among older adults seems unjustified given the overwhelming evidence that older adults are the most appropriate users of the ED (Ettinger et al., 1987; George et al., 2006; Oates et al., 1997; Parboosingh & Larsen, 1987; Roberts et al., 2008; Singal et al., 1992; Strange et al., 1992) and are more likely to seek primary as well as have a primary care provider (Baum & Rubenstein, 1987; Ettinger et al., 1987; Lowenstein et al., 1986; Oates et al., 1997; Parboosingh & Larsen, 1987). Also, evidence suggests that so called 'low-complexity patients' are not major contributing factors to ED overcrowding (Schull et al., 2007).

3.2 RATIONALE AND OBJECTIVES

Little is known about the clinical profiles of older ED patients with respect to functional, symptomatic, and psychosocial characteristics. In particular, research to date has not compared the functional, symptom, and psychosocial needs of older ED patients to the traditional understanding of need offered by triage acuity, or to potential unmet need offered by recent ED or hospital use. In addition, knowledge of the determinants of inpatient admission represents a considerable gap in the literature. There is a need to expand the evidence base in order to gain a better understanding of the needs of older adults in EDs. A comparative examination using more comprehensive characteristics of need would suggest what, if any, needs are not captured by standard ED information systems. Also, an examination of determinants of acute admission would establish what characteristic(s) would expand the evidence base on the decision to admit older adults to acute care.

The objective of this chapter is to examine the profile of non-institutional older adults relative to ED triage and repeat ED use as well as identify determinants of acute admission from the ED. The following phases will be employed:

Phase 1: A descriptive examination of the profile of older ED patients stratified by triage acuity as well as recent ED visits or hospitalizations. This phase will determine to what extent the characteristics of older adults are related to triage acuity, and to what extent they capture unmet need. In this phase the following questions will be evaluated:

- What is the relationship between triage acuity (CTAS) and measures of functional and psychosocial status among older ED patients?
- What is relationship between recent ED visits and measures of functional and psychosocial status among older ED patients?

Phase 2: An examination of patient-level determinants of inpatient admission from the ED. Specifically, this phase will identify a multivariate model that best describes the patient-level determinants of admission among older ED patients. In addition, the participating site will be explored as an additional determinant of inpatient admission. In this phase the following questions will be evaluated:

- What person-level characteristics drive the decision to admit an older adult to acute inpatient care?
- Does the ED site influence person-level determinants of inpatient admissions among older adults?

3.3 METHODOLOGY

3.3.1 The interRAI Emergency Department Contact Assessment

The interRAI Emergency Department Contact Assessment (ED-CA) is a standardized geriatric screening-level assessment used to support decision-making in the ED (Hirdes et al., 2009) (see Appendix U). The interRAI ED-CA assesses the performance and capacity of an older ED patient across a variety of essential domains necessary at the time of initial emergency contact. Specifically, 34 items assess key domains of living arrangement, social support, function, and symptoms at admission/registration. Cognition, ADL, and key symptoms are also coded for the premorbid period in order to assess change from usual functioning. This information is used to make clinical decisions concerning immediate service provision as well as the need for further assessment or referral to specialized services. The interRAI ED-CA was designed to be used by any ED clinician, including: nurses, social workers, case managers, and physicians. The patient and an available primary informal caregiver are the primary source of information, but information sources can also include clinical observation, communication with other informal and formal caregivers, as well as a review of available medical records. The assessment items contained in the interRAI ED-CA have demonstrated reliability in acute and other settings (Gray et al., 2008; Hirdes et al., 2008; Wellens et al., 2011).

The interRAI ED-CA contains three decision-support tools, including: the Self-Reliance Indicator, Assessment Urgency Algorithm, and Service Urgency Algorithm. The Self-Reliance Indicator identifies the presence of ADL or cognitive impairment at admission to the ED. The Assessment Urgency Algorithm is the interRAI ED-CA's primary decision-support tool. It supports referral decision making related to the need for comprehensive assessment by community or inpatient specialized services. Finally, the Service Urgency Algorithm identifies the urgent need for nursing services for person discharged to the community (Hirdes et al., 2009). The interRAI ED-CA has been designed to be compatible with other interRAI assessment instruments, particularly home care and inpatient acute care. This compatibility is meant to enhance cross-sector communication as well as the sharing of assessment information between care providers.

3.3.2 The Management of Older Persons in Emergency Departments (MOPED) Study

3.3.2.1 Design and Settings

A multi-site, multi-province prospective cohort study was conducted, termed the Management of Older Persons in Emergency Departments (MOPED) Study, for this dissertation. The goal of the MOPED Study was to investigate the needs, transitions, and outcomes of older adults in Canadian EDs.

Sites were primarily recruited from delegates at the 2009 Canadian interRAI Conference in Halifax. A call for participants requested that the hospitals and health regions in attendance express their interest to participate in a non-intervention pilot of the interRAI ED-CA. Each ED site was required to secure any resources necessary for internal project management, information technology, patient assessment, and data compilation. A management and communication strategy was developed with each participating organization's local project management to ensure adherence to the MOPED Study protocol, adherence to standardized study materials, train clinical research staff, coordinate information technology, establish communication between other participating sites, and work through pilot implementation problems. Start times for each of the participating organizations was staggered so as not to exhaust resources. The MOPED study attempted to include ED sites that were broadly representative of EDs within Canada, but a lack of dedicated research funding limited broader site recruitment. The MOPED study received full ethics clearance from the University of Waterloo Office of Research Ethics (ORE #: 15524). In addition, ethics clearance was granted from all participating hospital sites and their affiliated academic institutions prior to study commencement.

3.3.2.2 Patient Recruitment

A waiver of informed consent was requested and approved from all participating hospital sites. The rationale for the request was that ED sites were employing the interRAI ED-CA as part of their own clinical non-intervention pilot and its use was a part of normal clinical practice for the duration of pilot period. The organization's regular process for obtaining consent to assessment was applied to the use of the interRAI ED-CA. Further, the process of informed consent was

deemed impractical in the ED setting given that efficient assessment is necessary, and patients and their families might have been particularly sensitive to any perceived deviation in practice. Informed consent within studies reported in the literature caused notable biases from stringent exclusion criteria and high refusal rates (see Appendix AA). The waiver for informed consent granted by each site complied with the requirements given in the Tri-Council Policy Statement on the Ethical Conduct of Research Involving Humans as well as the Health Canada Good Clinical Practice Consolidated Guidelines.

ED patients aged 75 or older were eligible for assessment using the interRAI ED-CA. This age cutoff was chosen based on existing screening practices, previous research that suggested those over the age of 75 were at highest risk for poor outcomes, and in order to have a manageable number of patients with which to collect a representative convenience sample. Patients younger than age 75 were assessed by exception, and only according to the clinical discretion of the assessor. Patients in severe acute medical crisis (highest level of triage acuity/CTAS=1-Resuscitation), or those expected to die within 24 hours were excluded. Patients who did not speak English, and without an available interpreter, were also excluded. Patients were not excluded on the basis of perceived cognitive impairment.

3.3.2.3 Baseline Measurement

The interRAI ED-CA was the information standard used for patient assessment in the MOPED Study. Participating sites also opted to include a small number of additional items to the 34-items of the interRAI ED-CA. Specifically, the time taken to conduct the interRAI ED-CA was added to the assessment itself, and assessors were also asked to judge the adequacy of the information for each assessed case (see Appendix U for pilot version of the interRAI ED-CA). All assessors were provided with a half-day interRAI ED-CA training program conducted by interRAI Canada (through the University of Waterloo). Permission to use the interRAI ED-CA for the MOPED Study was obtained through a research license from interRAI.

Research nurses or allied health professionals completed assessments during day shift hours (either 8 am to 4 pm, or 7am to 7pm). Day shift hours were chosen for assessment to reflect the

availability of staff as well as known patterns of presentation among older adults (Downing & Wilson, 2005). Assessments were completed on a consecutive basis from the time of ED registration without any pre-selection. Consecutive patients could not be assessed in some sites when there were large influxes of older patients. However, patients were not systematically selected when this constraint occurred. All interRAI ED-CA assessments were documented electronically using commercial software procured for the study, or using the interRAI ED-CA within the hospital's electronic records system.

Participating ED sites were required to assess a minimum of 100 cases in order to be included in the MOPED Study. Assessment of ED patients was halted when a pre-specified number of cases was collected, or when the predetermined collection period (defined by each site) concluded. The baseline measurement period for each site was between 2 weeks and 6 months (see Table 3-1).

3.3.2.4 Follow-up Measurement

A 90-day risk period was chosen to reflect the assumed durability of transient assessment items, as well as the presumed maximum time period that the ED could have meaningful influence. All ED cases assessed with the interRAI ED-CA had a 90-day follow-up evaluation to determine the frequency and dates of subsequent unplanned ED visits and hospitalizations using regionally representative, electronic hospital records. A hospital specific 90-day follow-up was conducted for patients admitted directly to a hospital ward from the ED to determine key hospital events and transitions, including: geriatric assessment, ward transitions, ALC designation, and discharge disposition. A home care specific 90-day follow-up was also conducted for patients who became a home care client within the 90-day follow-up period or were an existing home care client at time of ED presentation. This follow-up included: receipt of RAI-HC assessment, living arrangement, receipt of home care services, and discharge disposition. MOPED Study collection standards were used by each site to specify the information and format requirements that were to be collected for each 90-day follow-up (see Appendix V). Follow-up data collection occurred no sooner than 90 days after the last patient assessment was completed at each participating site. Each ED case was linked to regional, electronic hospital or home care medical records either manually (by a local

research nurse) or electronically by regional or hospital information management/information technology staff. All outcomes for all older ED patients were right censored after 90 days.

3.3.2.5 Data Sharing

De-identified patient records were made available for research analyses by the MOPED Study. Electronic assessment records were downloaded into usable electronic formats and transferred securely using a file transfer protocol system hosted by the University of Waterloo. Data quality assurance, formatting, and compilation occurred as data were received by each site.

3.3.2.6 Data Sample

All MOPED Study interRAI ED-CA assessments pertaining to community-dwelling ED patients were included in a sample for descriptive analyses. Each unique ED case was used as the unit of analysis in order to reflect ED case volumes. Assessments related to older adults from LTC facilities (nursing homes) were excluded in order to focus on community-dwelling ED patients. Older adults from LTC facilities accounted for close to 5% of the MOPED sample (N=105). LTC residents are regarded a special sub-population among older ED patients in both characteristics and management, and are therefore not addressed in this dissertation (Gruneir et al., 2010). Assessment records for community-dwelling older adults were merged with follow-up data in order to compare health care utilization.

3.3.3 Phase 1: The Profile of Older ED Patients in the Emergency Department

Un-stratified and stratified descriptive analyses were employed that utilized all characteristics included in the interRAI CA-ED. Characteristics examined with continuous or ordinal measures were collapsed in advance according to their distribution, and clinical usefulness. New 'dummy' variables were created to quantify changes from the premorbid period and to summarize similar clinical characteristics.

Un-stratified descriptive analyses were used to examine the entire sample of community-dwelling ED patients. Stratified analyses were used to associate differences in the prevalence of patient demographic, clinical, and resource use characteristics by triage acuity and recent ED use

or hospitalizations. The CTAS scale, as the standard scale for triage acuity in Canada, was used to stratify ED patients into two classes that were used conventionally in the Canadian literature. Low-acuity visits were defined a those that were 'Less urgent' or 'Non-urgent' on the CTAS scale, whereas high acuity visits were defined as those that were 'Resuscitation', 'Emergent', or 'Urgent' on the CTAS scale (Gruneir et al., 2010; Schull et al., 2007). Recent ED use was classified as any previous hospital use 90 days before the ED visit. Inpatient use was combined with ED visits given that the interRAI ED-CA's previous ED use item is restricted to ambulatory ED visits only. The statistical significance of stratified patient characteristics and convenience summary measures were tested using the Chi-square goodness of fit test. Confidence intervals were also calculated at the 95% level in order to evaluate effect sizes (alpha=0.01). Confidence intervals of the proportions were based on binomial estimation of the standard error of a proportion. Analyses were performed using SAS® Version 9.2 for Windows (SAS Institute, Inc., Cary, NC).

3.3.4 Phase 2: Patient-Level Determinants of Acute Inpatient Admission

Best Subset logistic regression was employed to determine the best multivariate model that represented the decision to admit older adults to inpatient acute care (*Admission Model*). Decision-tree modeling was not used for this phase given that the objective was to develop a simple explanatory model rather than a predictive clinical classification for use at the point of care. The SCORE statement in the PROC LOGISTIC procedure in SAS enacts Best Subset model selection. By default, all possible model combinations, stratified by the number of model covariates, were computed and presented in descending order using the models' Chi-square likelihood scores. The entire list of all possible model combinations can be pre-selected by restricting the logistic procedure to only consider models with *x* range in the number of covariates [7] and listing *y* number of possible model combinations[8]. The benefit of using Best Subset logistic regression, compared to traditional semi-automated methods, is that order-of-entry effects and

[7] Where *x* is any number range less than or equal to the maximum number of candidate covariates.
[8] Where *y* is any number less than or equal to the number of potential model combinations defined by *x*.

deletion effects do not influence its models, there is less potential for over-fitting the model to the data, and all alternative models can be compared with relative ease (Hosmer, 2000; King, 2003). In addition, many candidate covariates can be used with Best Subset methods, whereas manual methods require variable pre-selection. An inpatient acute care admission from the ED was the dependent measure examined. All items in the interRAI ED-CA assessment variables and acute change dummy indicators where included as candidate covariates. Ordinal and continuous independent variables were prepared for modeling by dichotomizing each to its most optimal strata using unadjusted logistic regression analyses.

Model analyses began by creating random, ED site stratified derivation and validation samples using SAS® Enterprise Miner 4.2 (SAS Institute, Inc., Cary, NC). Specifically, 70% of the sample was partitioned for model derivation, whereas 30% was partitioned for validation. The Chi-square likelihood criterion was used to examine all possible model combinations and define the range of optimal model covariate counts. This subset of optimal models was then compared across a number of criteria, including: the likelihood score (X^2), Akaike Information Criterion, AUC, and parsimony. The Clinical Panel was also employed to suggest which models had the best face validity. The best overall candidate model, referred to as the *Admission Model*, was chosen based on overall performance across the criteria. Two-way interactions among the model and candidate covariates were tested. The *Admission Model* was validated using the validation sample partition. Model diagnostics included an analysis of deviance residuals and the Hosmer and Lemeshow Goodness-of-Fit Test.

Studies have found that ED patient outcomes vary by type of ED site (Borges Da Silva et al., 2012; McCusker et al., 2012a). Therefore, it was conceivable that ED patients' likelihood of admission was correlated by ED site. The relationship between the final model covariates and acute inpatient admission was evaluated with Generalized Estimating Equation (GEE) logistic regression using the GENMOD procedure in SAS® 9.2 (multilevel modeling) and the entire MOPED sample. ED site identifiers were entered into the GEE *Admission Model* using the exchangeable correlation structure. The class-level odds ratios for the multilevel model were compared to the

ordinary logistic model to test for model generalizability across ED sites. Analyses were performed using SAS® Version 9.2 (SAS Institute, Inc., Cary, NC).

3.4 RESULTS

Eight separate ED sites across 5 Canadian provinces participated in the MOPED Study from November 2009 to April 2012, with baseline assessment occurring from November 2009 to December 2011. Of the eight ED sites that participated, three urban teaching centers, three urban general hospitals, two regional general hospitals, and one community hospital were represented. A total of 2,101 community-dwelling older ED patient cases were recruited for the MOPED Study, ranging from 91 to 807 cases between ED sites. The mean age of ED patient cases between ED sites ranged from 80.1 to 85.5. The majority of cases from all ED sites were female, accounting for between 55.6% and 70.6% of cases between ED sites. No relationship was observed between the basic demographic characteristics and the contributing province/health authority (see Table 3-1).

3.4.1 Phase 1: The Profile of Older ED Patients in the Emergency Department

3.4.1.1 MOPED Sample

The average age of the overall community-dwelling sample was 82.1 years, where 83% were age 75 or older and 36.1% were age 85 or older. Females accounted for 63.8% of the sample. Those living alone or who had caregiver distress accounted for 36.2% and 18.2% of community-dwelling ED cases, respectively. Approximately one in every five community-dwelling patients had signs of cognitive impairment, and approximately one-quarter of those with signs of cognitive impairment were acute changes from premorbid. Almost two-thirds of older ED patients had impairment in ADLs. Bathing was the most prevalent ADL impairment (57.0%), followed by dressing lower body (41.8%), locomotion (40.6%), and personal hygiene (25.6%). Declines in ADL status from premorbid were also common. Especially pronounced changes in function from premorbid were observed for locomotion (25.6%), bathing (21.6%), and dressing lower body (19.4%). Almost one-third had difficulty managing medications, and almost two-thirds had difficulty managing a full flight of stairs.

Table 3-1: **MOPED Study Samples (Ascending by Date of Collection Period)**

Hospital	Province	Baseline Collection Period (Ascending Order)	Number of Cases	Sample Profile	
				Mean Age (Std. Dev.)	Proportion Female
Royal Victoria Hospital (RVH)	Ontario	01/11/2009 – 16/05/2010	807	82.3 (6.6)	63.0%
Salvation Army Grace Hospital (SAGH)	Manitoba	15/01/2010 – 04/02/2010	92	85.5 (6.4)	70.6%
Queen Elizabeth II Health Sciences Centre (QEII)	Nova Scotia	31/05/2010 – 14/12/2010	597	80.8 (8.3)	57.4%
Royal Jubilee Hospital (RJH)	British Columbia	24/02/2011 – 10/03/2011	96	84.9 (5.9)	62.2%
Nanaimo Regional General Hospital (NRGH)		13/02/2011 – 25/02/2011	91	83.6 (6.6)	55.6%
Saskatoon City Hospital (SCH)	Saskatchewan	06/12/2011 – 29/12/2011	86	82.6 (6.9)	70.6%
Royal University Hospital (RUH)		18/10/2011 – 13/11/2011	166	80.1 (7.4)	56.4%
St. Paul's Hospital (SPH)		13/11/2011 – 14/12/2011	166	81.9 (7.8)	67.5%
		Total:	2,101		

Close to half of older ED patients had unstable cognition, ADL, mood, or behavior as a result of their condition(s). Close to one-third fell in the previous 90 days, had reduced food/fluid consumption, or experienced weight loss. Approximately one-quarter to one-fifth had dyspnea, mood symptoms, poor self-reported health, as well as daily and severe pain. Traumatic injury, hallucinations or delusions, and behaviors were relatively rare. Just over one-third of older ED patients had two or more geriatric conditions[9], and just over one-quarter had recommendations for comprehensive geriatric assessment. The majority of older ED patients were classified as resuscitation, emergent, or urgent on the CTAS scale, whereas one-fifth was classified as less-urgent, or non-urgent. Approximately half of older ED patients were admitted to inpatient acute care, over one-third was discharged back to the community, and less than 5% were discharged to other locations or were deceased (see Table 3-2 or 3-5).

Approximately 40% of community-dwelling older adults had one or more ambulatory ED visits in the previous 3 months, and close to one-fifth had two or more. Approximately one-fifth were hospitalized in the previous 3 months, and close to 1 in 10 older patients were hospitalized within the previous 30 days (see Table 3-3). ED visits in the previous 3 months were similar to the 3-month period post discharge. Among those discharged back to the community, approximately 40% revisited the ED one or more times, and close to one-fifth had two or more ED visits. Among those admitted, just over one-quarter had a hospital stay greater than three weeks. Close to one-fifth of those admitted had an ALC designation, and approximately 1 in 10 were discharged to LTC (nursing home) within 90 days of their acute admission (see Table 3-4 or 3-6).

3.4.1.2 Profile Stratified by Triage Acuity

Triage acuity, given by the CTAS score, was not associated with any demographic characteristics, living arrangement, or informal care status among older, community-dwelling ED patients. Functional characteristics showed some association with triage acuity. Older adults who were triaged as less acute or non-acute were less likely to have an acute change in cognitive status, though the difference was not significant at the 95% probability level. Overall, older adults who

[9] Including: depressive symptoms, any ADL impairment, cognitive impairment, caregiver distress, and any behaviour.

were triaged as less acute or non-acute were slightly less likely to have ADL impairment. The small difference in ADL status was the result of a decreased likelihood of new or existing impairment(s) in early loss ADLs: bathing and locomotion. No association was found for IADL status. Patients triaged as less acute or non-acute were less likely to have dyspnea, reduced food/fluid consumption or weight loss, a potential delirium, and to report poor health. Particularly, large differences between high and low triage were found in dyspnea and reduced food/fluid consumption or weight loss. Those triaged as less acute or non-acute were less likely to have any geriatric conditions[9] (though no difference was found for two or more), and were far less likely to be admitted to inpatient acute care. No associations were found between acuity levels and mood symptoms, behaviors, hallucinations or delusions, pain, traumatic injury, or unstable health. Older ED patients who were triaged as less acute or non-acute were more likely to have previous falls and a recommendation for a comprehensive geriatric assessment (see Table 3-2).

Previous ambulatory ED use was slightly influenced by triage acuity, where those with lower triage acuity were slightly more likely to have had a previous ambulatory ED visit. No difference was found for previous hospital use (see Table 3-3). Among older ED patients discharged home, those triaged as less acute or non-acute were more likely to have an unplanned ED visits within 3-months of discharge. Among patients admitted to acute care, those triaged as less acute or non-acute were more likely to have an ALC designation and, though not significant, to have been discharged to LTC within 90 days of acute admission. No association was found for hospital length of stay (see Table 3-4).

Table 3-2: **Demographic and Clinical Characteristics of Non-institutionalized Older Adults in the Emergency Department, by Canadian Triage and Acuity Scale, MOPED Study***

	All (N=2,101)		**Resuscitation, Emergent, & Urgent (CTAS 1, 2, & 3)** (N=1,655)		**Less Urgent and Non Urgent (CTAS 4 & 5)** (N=388)		
	% (CI)	**N**	**% (CI)**	**N**	**% (CI)**	**N**	**p-value**
Demographic Characteristics							
Age							
65 – 74	17.0 (±1.6)	350	17.0 (±1.8)	276	16.6 (±3.7)	63	
75 – 84	47.0 (±2.1)	971	47.2 (±2.4)	768	46.4 (±5.0)	176	
85 – 94	32.3 (±2.0)	666	31.9 (±2.2)	520	33.8 (±4.7)	128	
≥ 95	3.8 (±0.8)	78	3.9 (±0.9)	64	3.2 (±1.8)	12	0.84
Gender							
Male	39.2 (±2.1)	814	39.2 (±2.4)	641	39.0 (±4.9)	149	0.94
Lives alone	36.2 (±2.1)	752	36.2 (±2.3)	592	37.9 (±4.8)	146	0.52
Informal Care Status							
Caregiver distress[1]	18.2 (±1.6)	383	17.7 (±1.8)	293	19.1 (±3.9)	74	0.53
Functional Characteristics							
Cognition[2]							
Impairment at admission	21.1 (±1.7)	443	21.0 (±2.0)	347	21.4 (±4.1)	83	0.85
Decline from Pre-Morbid[3]	5.1 (±0.9)	106	5.7 (±1.1)	1636	3.2 (±1.7)	12	0.05
ADL Status							
Bathing		117					
Impaired at admission	57.0 (±2.1)	3	57.8 (±2.4)	938	53.0 (±5.0)	201	0.09
Decline from Pre-Morbid[3]	21.6 (±1.8)	444	23.4 (±2.0)	379	14.5 (±3.5)	55	**<0.01**
Personal Hygiene							
Impaired at admission	25.6 (±1.9)	533	24.9 (±2.1)	409	27.7 (±4.5)	107	0.25
Decline from Pre-Morbid[3]	11.1 (±1.3)	229	11.5 (±1.5)	187	10.4 (±3.0)	40	0.57
Dressing Lower Body							
Impaired at admission	41.8 (±2.1)	873	41.6 (±2.4)	685	42.5 (±4.9)	163	0.76
Decline from Pre-Morbid[3]	19.4 (±1.7)	403	20.1 (±1.9)	330	17.9 (±3.8)	68	0.32
Locomotion							
Impaired at admission	40.6 (±2.1)	842	41.7 (±2.4)	684	35.3 (±4.8)	133	**0.02**
Decline from Pre-Morbid[3]	25.6 (±1.9)	526	27.2 (±2.1)	442	20.1 (±4.0)	75	**<0.01**
Any ADL Impairment[4]	62.0 (±2.1)	1303	63.3 (±2.3)	1048	57.0 (±4.9)	221	**0.02**

Table 3-2: **Demographic and Clinical Characteristics of Non-institutionalized Older Adults in the Emergency Department, by Canadian Triage and Acuity Scale, MOPED Study* (Continued)**

	All (N=2,101)		**Resuscitation, Emergent, & Urgent (CTAS 1, 2, & 3)** (N=1,655)		**Less Urgent and Non Urgent (CTAS 4 & 5)** (N=388)		
	% (CI)	**N**	**% (CI)**	**N**	**% (CI)**	**N**	**p-value**
IADL Status							
Difficulty managing medications	29.0 (±1.9)	609	29.0 (±2.2)	479	28.4 (±4.5)	110	0.82
Difficulty with stairs[5]	58.7 (±2.1)	1228	58.2 (±2.4)	959	60.1 (±4.9)	232	0.50
Difficulty understanding others[6]	3.6 (±0.8)	75	3.6 (±0.9)	60	3.4 (±1.8)	13	0.79
Conditions and Symptoms							
Depressive Symptoms[7]	20.3 (±1.7)	426	20.2 (±1.9)	335	19.9 (±4.0)	77	0.86
Any Behaviours[8]	3.0 (±0.7)	62	2.8 (±0.8)	46	3.4 (±1.8)	13	0.55
Potential Delirium[9]	14.2 (±1.5)	296	15.3 (±1.7)	250	10.4 (±3.0)	40	**0.01**
Hallucinations & Delusions	6.0 (±1.0)	126	6.0 (±1.1)	100	5.4 (±2.3)	21	0.64
Any Falls (last 90 days)	32.2 (±2.0)	669	30.9 (±2.2)	506	39.1 (±4.9)	148	**<0.01**
Daily and Severe Pain[10]	18.7 (±1.7)	392	18.6 (±1.9)	307	17.8 (±3.8)	69	0.73
Traumatic Injury	7.3 (±1.1)	147	7.0 (±1.2)	112	8.0 (±2.7)	30	0.51
Poor Self-Reported Health[11]	20.1 (±1.7)	423	21.2 (±2.0)	350	16.0 (±3.6)	62	**0.02**
Dyspnea[12]	28.4 (±1.9)	597	30.9 (±2.2)	511	17.3 (±3.8)	67	**<0.01**
Unstable Condition[13]	47.8 (±2.1)	1000	48.4 (±2.4)	796	46.0 (±5.0)	178	0.40
Decrease Food/Fluids or Weight Loss[14]	31.3 (±2.0)	658	33.4 (±2.3)	553	23.5 (±4.2)	91	**<0.01**
Need for Comprehensive Geriatric Assessment[15]	27.6 (±1.9)	577	25.9 (±2.1)	427	37.2 (±4.8)	144	**<0.01**
Cumulative Geriatric Conditions[16] 0	28.5 (±1.9)	595	26.8 (±2.1)	441	34.9 (±4.7)	135	
1	36.0 (±2.1)	752	37.9 (±2.3)	624	29.2 (±4.5)	113	
2	21.8 (±1.8)	456	21.9 (±2.0)	360	22.0 (±4.1)	85	
3+	13.8 (±1.5)	288	13.4 (±1.6)	221	14.0 (±3.4)	54	**<0.01**
Discharge Disposition							
Private Residence	43.0 (±2.1)	875	39.5 (±2.3)	632	56.0 (±4.9)	243	
Acute Care	53.2 (±2.1)	1083	57.4 (±2.4)	919	37.8 (±4.7)	164	
Other[17]	3.8 (±0.8)	78	3.2 (±0.8)	51	6.2 (±2.3)	27	**<0.01**

*58 cases (2.77%) have missing CTAS information
[1] Primary informal helper expresses feelings of distress, anger or depression.
[2] Modified independent or any impairment in making decisions regarding tasks of daily living.
[3] At admission, a decline from the 3-day period prior to the onset of the current acute illness.
[4] Any supervision or any physical assistance in bathing, personal hygiene, dressing lower body, and locomotion.
[5] Supervision or any assistance during full flight of stairs (12 to 14 stairs)
[6] Sometimes, rarely, or never understands direct communication.
[7] Felt sad, depressed or hopeless in last 3 days.
[8] In the last 3 days, presence of any one or more of the following: verbal abuse, physical abuse, socially inappropriate or disruptive behaviour, inappropriate public sexual behaviour or public disrobing.
[9] Acute change in mental status from person's usual functioning (E.g. restlessness, lethargy, difficult to arouse, altered environmental perception).
[10] Pain that is severe or excruciating in last 3 days.
[11] When asked, "In general, how would you rate your health?", person responds "Poor".
[12] Dyspnea at rest, or present when performing normal day-to-day activities.
[13] Conditions/diseases make cognitive, ADL, mood or behaviour patterns unstable (fluctuating, precarious or deteriorating).
[14] Noticeable decrease in the amount of food usually eaten or fluids usually consumed, OR weight loss of 5% or more in last 30 days, OR 10% or more in last 180 days.
[15] Assessor feels that the person needs comprehensive geriatric assessment.
[16] Including: depressive symptoms, any ADL impairment, cognitive impairment, caregiver distress, and any behaviour.
[17] Including: Psychiatric hospital or unit, Residential care/nursing home, Deceased, or "Other".

Table 3-3: **Past Resource Use of Non-institutionalized Older Adults in the Emergency Department, by Canadian Triage and Acuity Scale, MOPED Study***

	All (N=2,101)		**Resuscitation, Emergent, & Urgent (CTAS 1, 2, & 3)** (N=1,655)		**Less Urgent and Non Urgent (CTAS 4 & 5)** (N=388)		
	% (CI)	**N**	**% (CI)**	**N**	**% (CI)**	**N**	**p-value**
Ambulatory ED visits (previous 90 Days)							
0	60.5 (±2.1)	1267	60.9 (±2.4)	1006	57.1 (±4.9)	221	
1	21.0 (±1.7)	439	19.9 (±1.9)	329	25.8 (±4.4)	100	
≥ 2	18.6 (±1.7)	389	19.2 (±1.9)	318	17.1 (±3.7)	66	**0.03**
Time Since Last Hospital Stay (In the past 90 days)							
No Hospitalization	80.6 (±1.7)	1615	79.9 (±1.9)	1255	83.9 (±3.7)	318	
0-30 days ago	8.4 (±1.2)	169	8.4 (±1.3)	132	8.2 (±2.7)	31	
31-90 days ago	11.0 (±1.3)	220	11.7 (±1.5)	183	7.9 (±2.7)	30	0.10

* 58 cases (2.77%) have missing CTAS information

Table 3-4: **Future Resource Use of Non-institutionalized Older Adults in the Emergency Department, by Canadian Triage and Acuity Scale, MOPED Study**

	All (N=2,101)		**Resuscitation, Emergent, & Urgent (CTAS 1, 2, & 3)** (N=1,655)		**Less Urgent and Non Urgent (CTAS 4 & 5)** (N=388)		
	% (CI)	**N**	**% (CI)**	**N**	**% (CI)**	**N**	**p-value**
Among those Discharged Home*							
Unplanned ED Visit within 90 days							
0	60.5 (±3.8)	529	61.6 (±4.3)	389	57.6 (±3.9)	140	
1	22.4 (±3.3)	196	22.8 (±3.7)	144	21.4 (±3.1)	52	
≥ 2	17.1 (±2.9)	150	15.7 (±3.1)	99	21.0 (±3.4)	51	**0.01**
Among those Admitted to Acute Care*							
Hospital Length of Stay							
0 – 2 days	13.2 (±2.2)	143	13.6 (±2.3)	125	11.0 (±6.0)	18	
3 – 6 days	26.6 (±2.8)	288	26.9 (±2.9)	247	25.0 (±8.0)	41	
7 – 13 days	21.4 (±2.6)	232	21.7 (±2.6)	199	20.1 (±7.6)	33	
14 – 20 days	12.7 (±2.2)	138	12.5 (±2.2)	115	14.0 (±7.2)	23	
21 + days	26.0 (±2.9)	282	25.4 (±2.9)	233	29.9 (±9.7)	49	0.66
ALC Designation	16.8 (±2.6)	182	15.6 (±2.5)	143	23.8 (±9.9)	39	**0.01**
Discharged to Nursing Home	9.6 (±2.0)	104	8.9 (±2.0)	82	13.4 (±7.7)	22	**0.07**

* 58 cases (2.77%) have missing CTAS information.

3.4.1.3 Profile Stratified by Any Previous Hospital Use

More significant associations were found between previous hospital use and patient characteristics compared to the stratification by triage acuity. Older, community-dwelling ED patients who had any ED or hospital visits in the previous 90 days were more likely to be younger, male, and have informal caregiver distress. Cognitive impairment showed no relationship to previous hospital use. Impairment in ADLs including bathing, personal hygiene, dressing lower body, and locomotion were more likely among older ED patients with previous hospital use. However, no associations were found between acute change in ADLs and previous hospital use. Impairment in managing medications and a full flight of stairs were more likely among older patients with previous hospital use. Having mood symptoms, reporting poor health, dyspnea, and reduced food/fluid consumption or weight loss was much more common among older patients with previous hospital use. Behaviours and potential delirium were slightly more likely among patients with previous hospital use, but the association did not achieve 95% probability. No association was found between previous hospital use and hallucinations or delusions, falls, pain, traumatic injury, or unstable health. Cumulative geriatric conditions[9] as well as the assessed need for comprehensive geriatric assessment were more likely among patients with previous hospital use relative to those without. Patients with previous hospital use were slightly more likely to be admitted to inpatient acute care relative to those without past hospital use. No association was found between triage acuity and previous hospital use (see Table 3-5). Among older ED patients discharged back to the community, having previous hospital use was associated with more unplanned ED use within 90-days of ED discharge. Patients who were admitted to acute care and with previous hospital use were more likely to have longer hospital stays and slightly more likely to be discharged to LTC within 90 days. There was no association with ALC designations (see Table 3-6).

Table 3-5: **Demographic and Clinical Characteristics of Non-institutionalized Older Adults in the Emergency Department, by Previous Acute Hospital Use, MOPED Study**

	All (N=2,101)		**No Previous Hospital Use (last 90 days)** (N=1,092)		**Any Previous Hospital Use (last 90 days)** (N=1,009)		
	% (CI)	**N**	**% (CI)**	**N**	**% (CI)**	**N**	**p-value**
Demographic Characteristics							
Age							
65 – 74	17.0 (±1.6)	350	17.2 (±2.2)	184	16.7 (±2.3)	166	
75 – 84	47.0 (±2.1)	971	44.2 (±2.9)	474	50.1 (±3.1)	497	
85 – 94	32.3 (±2.0)	666	34.1 (±2.8)	366	30.2 (±2.8)	300	
≥ 95	3.8 (±0.8)	78	4.6 (±1.2)	49	2.9 (±1.0)	29	**0.02**
Gender							
Male	39.2 (±2.1)	814	36.2 (±2.9)	391	42.5 (±3.0)	423	**<0.01**
Lives alone	36.2 (±2.1)	752	36.4 (±2.9)	392	36.0 (±3.0)	360	0.84
Informal Care Status							
Caregiver distress[1]	18.2 (±1.6)	383	14.1 (±2.1)	154	22.7 (±2.6)	229	**<0.01**
Functional Characteristics							
Cognition[2]							
Impairment at admission	21.1 (±1.7)	443	20.2 (±2.4)	221	22.0 (±2.6)	222	0.32
Decline from Pre-Morbid[3]	5.1 (±0.9)	106	4.6 (±1.2)	50	5.6 (±1.4)	56	0.31
ADL Status							
Bathing							
Impaired at admission	57.0 (±2.1)	1173	53.6 (±3.0)	577	60.7 (±3.0)	596	**<0.01**
Decline from Pre-Morbid[3]	21.6 (±1.8)	444	22.9 (±2.5)	246	20.2 (±2.5)	198	0.14
Personal Hygiene							
Impaired at admission	25.6 (±1.9)	533	22.3 (±2.5)	242	29.1 (±2.8)	291	**<0.01**
Decline from Pre-Morbid[3]	11.1 (±1.3)	229	9.9 (±1.8)	106	12.4 (±2.0)	123	0.07
Dressing Lower Body							
Impaired at admission	41.8 (±2.1)	873	37.4 (±2.9)	407	46.7 (±3.1)	466	**<0.01**
Decline from Pre-Morbid[3]	19.4 (±1.7)	403	19.4 (±2.3)	211	19.3 (±2.4)	192	0.94
Locomotion							
Impaired at admission	40.6 (±2.1)	842	36.5 (±2.9)	395	45.0 (±3.1)	447	**<0.01**
Decline from Pre-Morbid[3]	25.6 (±1.9)	526	25.2 (±2.6)	270	26.0 (±2.7)	256	0.67
Any ADL Impairment[4]	62.0 (±2.1)	1303	57.9 (±2.9)	632	66.5 (±2.9)	671	**<0.01**

Table 3-5: **Demographic and Clinical Characteristics of Non-institutionalized Older Adults in the Emergency Department, by Previous Acute Hospital Use, MOPED Study (Continued)**

	All (N=2,101)		**No Previous Hospital Use (last 90 days)** (N=1,092)		**Any Previous Hospital Use (last 90 days)** (N=1,009)		
	% (CI)	**N**	**% (CI)**	**N**	**% (CI)**	**N**	**p-value**
IADL Status							
Difficulty managing medications	29.0 (±1.9)	609	26.8 (±2.6)	292	31.5 (±2.9)	317	**0.02**
Difficulty with stairs[5]	58.7 (±2.1)	1228	54.1 (±3.0)	589	63.8 (±3.0)	639	**<0.00**
Difficulty understanding others[6]	3.6 (±0.8)	75	3.9 (±1.1)	42	3.3 (±1.1)	33	0.48
Conditions and Symptoms							
Depressive Symptoms[7]	20.3 (±1.7)	426	16.3 (±2.2)	178	24.6 (±2.7)	248	**<0.01**
Any Behaviours[8]	3.0 (±0.7)	62	2.3 (±0.9)	25	3.7 (±1.2)	37	0.06
Potential Delirium[9]	14.2 (±1.5)	296	12.9 (±2.0)	139	15.7 (±2.2)	157	0.07
Hallucinations & Delusions	6.0 (±1.0)	126	6.3 (±1.4)	69	5.7 (±1.4)	57	0.52
Any Falls (last 90 days)	32.2 (±2.0)	669	31.2 (±2.7)	336	33.3 (±2.9)	333	0.30
Daily and Severe Pain[10]	18.7 (±1.7)	392	17.4 (±2.2)	190	20.0 (±2.5)	202	0.12
Traumatic Injury	7.3 (±1.1)	147	7.9 (±1.6)	83	6.6 (±1.5)	64	0.26
Poor Self-Reported Health[11]	20.1 (±1.7)	423	14.4 (±2.1)	157	26.4 (±2.7)	266	**<0.01**
Dyspnea[12]	28.4 (±1.9)	597	24.5 (±2.5)	267	32.7 (±2.9)	330	**<0.01**
Unstable Condition[13]	47.8 (±2.1)	1000	46.2 (±3.0)	503	49.7 (±3.1)	497	0.11
Decrease Food/Fluids or Weight Loss[14]	31.3 (±2.0)	658	26.7 (±2.6)	291	36.4 (±3.0)	367	**<0.01**
Need for Comprehensive Geriatric Assessment[15]	27.6 (±1.9)	577	23.9 (±2.5)	259	31.7 (±2.9)	318	**<0.01**
Cumulative Geriatric Conditions[16]							
0	28.5 (±1.9)	595	33.5 (±2.8)	365	23.0 (±2.6)	230	
1	36.0 (±2.1)	752	35.9 (±2.8)	391	36.0 (±3.0)	361	
2	21.8 (±1.8)	456	19.6 (±2.4)	213	24.3 (±2.6)	243	
3+	13.8 (±1.5)	288	11.0 (±1.9)	120	16.8 (±2.3)	168	**<0.01**
CTAS							
1-3	81.0 (±1.7)	1655	81.2 (±2.3)	862	80.8 (±2.4)	793	
4-5	18.9 (±1.7)	388	18.8 (±2.3)	200	19.2 (±2.4)	188	0.85

	All (N=2,101)		No Previous Hospital Use (last 90 days) (N=1,092)		Any Previous Hospital Use (last 90 days) (N=1,009)		
	% (CI)	**N**	**% (CI)**	**N**	**% (CI)**	**N**	**p-value**
Discharge Disposition							
Private Residence	43.0 (±2.1)	875	45.4 (±2.9)	478	40.4 (±3.0)	397	
Acute Care	53.2 (±2.1)	1083	50.2 (±3.0)	529	56.4 (±3.1)	554	
Other[17]	3.8 (±0.8)	78	4.4 (±1.2)	46	3.3 (±1.1)	32	**0.02**

[1] Primary informal helper expresses feelings of distress, anger or depression.
[2] Modified independent or any impairment in making decisions regarding tasks of daily living.
[3] At admission, a decline from the 3-day period prior to the onset of the current acute illness.
[4] Any supervision or any physical assistance in bathing, personal hygiene, dressing lower body, and locomotion.
[5] Supervision or any assistance during full flight of stairs (12 to 14 stairs)
[6] Sometimes, rarely, or never understands direct communication.
[7] Felt sad, depressed or hopeless in last 3 days.
[8] In the last 3 days, presence of any one or more of the following: verbal abuse, physical abuse, socially inappropriate or disruptive behaviour, inappropriate public sexual behaviour or public disrobing.
[9] Acute change in mental status from person's usual functioning (E.g. restlessness, lethargy, difficult to arouse, altered environmental perception).
[10] Pain that is severe or excruciating in last 3 days.
[11] When asked, "In general, how would you rate your health?", person responds "Poor".
[12] Dyspnea at rest, or present when performing normal day-to-day activities.
[13] Conditions/diseases make cognitive, ADL, mood or behaviour patterns unstable (fluctuating, precarious or deteriorating).
[14] Noticeable decrease in the amount of food usually eaten or fluids usually consumed, OR weight loss of 5% or more in last 30 days, OR 10% or more in last 180 days.
[15] Assessor feels that the person needs comprehensive geriatric assessment.
[16] Including: depressive symptoms, any ADL impairment, cognitive impairment, caregiver distress, and any behaviour.
[17] Including: Psychiatric hospital or unit, Residential care/nursing home, Deceased, or "Other".

Table 3-6: **Future Resource Use of Non-institutionalized Older Adults in the Emergency Department, by Previous Acute Hospital Use, MOPED Study**

	All (N=2,101)		**No Previous Hospital Use (last 90 days)** (N=1,092)		**Any Previous Hospital Use (last 90 days)** (N=1,009)		
	% (CI)	**N**	**% (CI)**	**N**	**% (CI)**	**N**	**p-value**
Among those Discharged Home							
Unplanned ED Visit within 90 days							
0	60.5 (±3.8)	529	67.8 (±4.6)	324	51.6 (±4.6)	205	
1	22.4 (±3.3)	196	21.3 (±4.0)	102	23.7 (±8.4)	94	
≥ 2	17.1 (±2.9)	150	10.9 (±3.0)	52	24.7 (±8.2)	98	**<0.01**
Among those Admitted to Acute Care							
Hospital Length of Stay							
0 – 2 days	13.2 (±2.2)	143	13.4 (±2.9)	71	13.0 (±4.3)	72	
3 – 6 days	26.6 (±2.8)	288	29.1 (±3.8)	154	24.2 (±5.3)	134	
7 – 13 days	21.4 (±2.6)	232	24.0 (±3.5)	127	19.0 (±4.7)	105	
14 – 20 days	12.7 (±2.2)	138	10.4 (±2.5)	55	15.0 (±4.6)	83	
21 + days	26.0 (±2.9)	282	23.1 (±3.5)	122	28.9 (±5.8)	160	**0.01**
ALC Designation	16.8 (±2.6)	182	16.5 (±3.3)	87	17.2 (±4.7)	95	0.76
Discharged to Nursing Home	9.6 (±2.0)	104	11.3 (±2.8)	60	7.9 (±3.4)	44	0.06

3.4.2 Phase 2: Patient-Level Determinants of Acute Inpatient Admission

Overall, 1,471 MOPED cases were partitioned for multivariate logistic model derivation and 630 cases were partitioned for the validation of the final logistic model. A scan of all logistic model permutations showed that 7-covariate models had the most optimal combination of explanatory power and parsimony. Compared to models with 7 covariates, models with 8 or more covariates showed negligible increases in explanatory power, and included covariates with weak effect sizes that did not achieve 99% probability (see Appendix W for a summary of all subset results).

A closer examination of all 7-covariate logistic models produced a subset of 3 models that had the maximum explained variance as well as covariates that all achieved 95% probability (defined as models 'A' through 'C' in Table 3-7). All 3 best subset models had a substantial overlap of covariates. Specifically, unstable health, a reduction of food or fluids, anhedonia, and high triage acuity (CTAS 1-3) were covariates that were shared between all best subset models (see Table 3-7). Model C was ruled out given that it had less explanatory power than Model A or B, and the duplication of the locomotion ADL between two covariates was less informative. Models A and B were chosen as candidate logistic models on the basis of maximum explanatory power as well as the diversity of the model covariates. Model A was ruled out given the rarity of declines in cognition (less than 5%) and lack of precision of its adjusted odds ratio. A validation of Model A using the validation partition confirmed the inconsistency of changes in cognition within the multivariate model (see Table 3-8). Accordingly, Model B was chosen as the *Admission Model*. Testing of two-way interactions in the *Admission Model*, particularly with living arrangement and caregiver support, yielded insignificant interactions.

Table 3-7: **Most Optimal Multivariate Logistic Models, Admission to Acute Care among Non-institutionalized Older Adults in the Emergency Department, MOPED Study, Derivation Sample Partition (N=1,471) ~**

Model ID	Covariates	OR	95% CI	AUC	AIC	Chi-Sq Score
A	Impaired locomotion (at admission)	2.16	(1.70 - 2.77)			
	Unstable cog., mood, ADL, or beh.	2.00	(1.59 - 2.52)			
	Recent decrease in food or fluids	1.86	(1.43 - 2.42)			
	Decline in cognition from pre-morbid	2.67	(1.33 - 5.37)			
	Decline in bathing from pre-morbid	1.76	(1.29 - 2.40)			
	Anhedonia	1.54	(1.21 - 1.97)			
	CTAS 1,2, or 3	2.22	(1.67 - 2.97)	0.73	1727.1	195.2
B	Impaired cognition (at admission)	1.69	(1.25 - 2.28)			
	Unstable cog., mood, ADL, or beh.	1.91	(1.51 - 2.42)			
	Recent decrease in food or fluids	1.87	(1.44 - 2.42)			
	Decline in bathing from pre-morbid	1.59	(1.14 - 2.22)			
	Decline in locomotion from pre-morbid	2.41	(1.76 - 3.29)			
	Anhedonia	1.60	(1.26 - 2.04)			
	CTAS 1,2, or 3	2.16	(1.63 - 2.88)	0.73	1730.8	193.4
C	Impaired locomotion (at admission)	1.71	(1.24 - 2.37)			
	Unstable cog., mood, ADL, or beh.	2.04	(1.62 - 2.57)			
	Recent decrease in food or fluids	1.86	(1.43 - 2.42)			
	Decline in cognition from pre-morbid	2.82	(1.40 - 5.67)			
	Decline in locomotion from pre-morbid	1.85	(1.27 - 2.70)			
	Anhedonia	1.58	(1.24 - 2.01)			
	CTAS 1,2, or 3	2.18	(1.64 - 2.90)	0.73	1737.4	192.4

~ Having maximum explained variance.
OR = Odds Ratio
AUC = receiver operating characteristic (ROC) area under the curve (AUC)
AIC = Akaike Information Criterion
* Not significant (p>0.05

Table 3-8: **Candidate Multivariate Logistic Model, Admission to Acute Care among Non-institutionalized Older Adults in the Emergency Department, MOPED Study, Derivation Sample Partition and Validation Sample Partition**

Covariates	Derivation (N= 1471)		Validation (N= 630)	
	OR	95% CI	OR	95% CI
Impaired locomotion (at admission)	2.16	(1.70 - 2.77)	3.05	(2.02 - 4.61)
Unstable cog., mood, ADL, or beh.	2.00	(1.59 - 2.52)	3.39	(2.32 - 4.95)
Recent decrease in food or fluids	1.86	(1.43 - 2.42)	1.73	(1.14 - 2.63)
Decline in cognition from pre-morbid	2.67	(1.33 - 5.37)	*2.42	(0.86 - 6.79)
Decline in bathing from pre-morbid	1.76	(1.29 - 2.40)	1.88	(1.14 - 3.10)
Anhedonia	1.54	(1.21 - 1.97)	1.56	(1.06 - 2.31)
CTAS 1,2, or 3	2.22	(1.67 - 2.97)	1.66	(1.05 - 2.62)
AUC (95%CI)	**0.73 (0.70 – 0.75)**		**0.78 (0.75 – 0.82)**	
Goodness-of-Fit Test`	**Chi-sq=4.42, p=0.73**		**Chi-sq=3.76, p=0.87**	

OR = Odds Ratio
AUC = receiver operating characteristic (ROC) area under the curve (AUC)
* Not significant (p>0.05)
`Hosmer and Lemeshow Goodness-of-Fit Test

The final *Admission Model* included impaired locomotion at admission, unstable cognition, mood, ADL, and behaviour, recent decrease in food or fluids, acute change in cognition, acute decline in bathing performance, anhedonia, and high triage acuity (CTAS 1-3). The adjusted odds of admission were high for each of the *Admission Model* covariates, achieving odds ratios of 1.60 or greater. In addition, the *Admission Model* covariates had fairly good overall predictive accuracy (AUC) in the derivation partition (see Table 3-9). An analysis of deviance residuals using the derivation and partitions showed even distributions (see Appendix X), and the Hosmer and Lemeshow Goodness-of-Fit Test did not achieve significance – both indicating that the *Admission Model* was well calibrated to the derivation sample. The effect size of covariates and overall predictive accuracy (AUC) in the validation partition was greater than in the derivation partition,

but differences were not significant (see Table 3-9). The increase in overall model accuracy in the validation partition compared to the derivation partition almost achieved 95% probability. Good overall accuracy (AUC) was found in the validation partition. The Hosmer and Lemeshow Goodness-of-Fit Test did not achieve significance in the validation partition, indicating a stable model (see Table 3-9). Also, the *Admission Model*'s deviance residuals plot showed even distributions in the validation sample (see Appendix Y).

Table 3-9**: Final *Admission Model*, Best Multivariate Logistic Model for Admission to Acute Care among Non-institutionalized Older Adults in the Emergency Department, MOPED Study, Derivation Sample Partition and Validation Sample Partition**

Covariates	Derivation (N= 1471)		Validation (N= 630)	
	OR	**95% CI**	**OR**	**95% CI**
Impaired cognition (at admission)	1.69	(1.25 - 2.28)	3.27	(1.93 - 5.55)
Unstable cog., mood, ADL, or beh.	1.91	(1.51 - 2.42)	3.05	(2.06 - 4.52)
Recent decrease in food or fluids	1.87	(1.44 - 2.42)	1.92	(1.27 - 2.91)
Decline in bathing from pre-morbid	1.59	(1.14 - 2.22)	2.14	(1.23 - 3.71)
Decline in locomotion from pre-morbid	2.41	(1.76 - 3.29)	2.10	(1.24 - 3.56)
Anhedonia	1.60	(1.26 - 2.04)	1.62	(1.10 - 2.38)
CTAS 1,2, or 3	2.16	(1.63 - 2.88)	1.74	(1.11 - 2.75)
AUC (95%CI)	**0.73 (0.70 – 0.75)**		**0.78 (0.74 – 0.82)**	
Goodness-of-Fit Test`	**Chi-sq=4.42, p=0.73**		**Chi-sq=3.77, p=0.88**	

OR = Odds Ratio
AUC = receiver operating characteristic (ROC) area under the curve (AUC)
`Hosmer and Lemeshow Goodness-of-Fit Test

Odds ratios between the normal logistic and multilevel *Admission Model*s were not significantly different. The effect of anhedonia in the *Admission Model* showed the greatest change between ED sites, but the difference was not significant. The overall consistency of the multilevel *Admission Model* suggested that it was generalizable across ED sites, and that there were no indications of site-level effects (see Table 3-10).

Table 3-10: **Multilevel Generalized *Admission Model* (by Hospital Site), Admission to Acute Care among Non-institutionalized Older Adults in the Emergency Department, MOPED Study (N=2,101)**

Covariates	Logistic			Multilevel		
	OR	95% CI	p	OR	95% CI	p
Impaired cognition (at admission)	1.69	(1.25 - 2.28)	<0.01	1.97	(1.65 - 2.34)	<0.01
Unstable cog., mood, ADL, or beh.	1.91	(1.51 - 2.42)	<0.01	2.05	(1.49 - 2.83)	<0.01
Recent decrease in food and fluids	1.87	(1.44 - 2.42)	<0.01	2.10	(1.72 - 2.53)	<0.01
Decline in bathing from pre-morbid	1.59	(1.14 - 2.22)	<0.01	1.80	(1.19 - 2.77)	<0.01
Decline in locomotion from pre-morbid	2.41	(1.76 - 3.29)	<0.01	2.39	(1.86 - 3.10)	<0.01
Anhedonia	1.60	(1.26 - 2.04)	<0.01	1.26	(1.13 - 1.40)	<0.01
CTAS 1,2, or 3	2.16	(1.63 - 2.88)	<0.01	2.08	(1.12 - 2.68)	<0.01

OR = Odds Ratio

3.5 DISCUSSION

The MOPED Study addressed a large gap in the literature by comprehensively examining the functional, symptom, and psychosocial profile of older ED patients. The use of a multi-site, multi-jurisdiction sample with more clinically representative recruitment methods is unique to the MOPED Study, and enhances the generalizability of its convenience sample. Data from the MOPED Study represent one of the most comprehensive prospective information sources available to examine older adults in the ED. The implications of the descriptive analyses and determinants for acute admission are discussed separately.

3.5.1 The Profile of Older ED Patients in the Emergency Department

The un-stratified profile of older, community-dwelling ED patients suggests that they frequently arrive at the ED with complex presentations and are likely to have very different characteristics than younger ED patients. The majority of older ED patients were dependent on others for basic tasks of daily living. Many also had fragile informal care support due to distressed caregivers, or had a solitary living arrangement. The prevalence of some conditions and symptoms in this study were similar to what has been reported in the disease or condition specific literature. The prevalence of cognitive impairment and acute change of mental status in this study (21.1%) was similar to previous estimates (Gerson et al., 1994; Hustey & Meldon, 2002). Two studies also found that the majority of older ED patients had functional impairments, though without reference to premorbid status (Gerson et al., 2001; Wilber et al., 2006). The prevalence of self-reported mood symptoms (20.3%) was similar to the prevalence of self-reported depression reported in one study (Kumar et al., 2004). Falls and nutritional issues were also identified in many older patients. These, and the prevalence of mood symptoms, appear to corroborate a study's finding that 1 in 5 of the presenting diagnoses among older adults were related to poor nutrition, falls, and psychosocial issues (Lowenstein et al., 1986). The prevalence of caregiver distress, difficulty managing medications, frequent and severe pain, and dyspnea are not reported in the literature, but were common in the study sample. Multiple geriatric conditions were also

common, and had a similar prevalence to the perceived need for comprehensive geriatric assessment.

The profile of older ED patients stratified by triage acuity showed that triage acuity was sensitive to acute changes in health, including: changes in function, mental status, breathing, food and fluid consumption, and weight loss. This result was not surprising given that the expressed goal of current ED triage systems is to prioritize patients in according to their risk of death and rapid decline (Bullard et al., 2008; Murray et al., 2004). However, triage acuity was found to be insensitive to caregiver distress, premorbid functional status, functional instability, as well as mood symptoms, and was inversely associated with falls and the perceived need for further geriatric assessment. Inconsistent with previous studies, triage acuity was not associated with advanced age (Ettinger et al., 1987; Singal et al., 1992; Strange et al., 1992). Though highly appropriate for prioritizing the medical acuity of presenting complaints, triage-based paradigms in the ED appear unsuited for the identification and prioritization of disability and complex conditions - particularly having multiple or preexisting geriatric conditions. The lack of problem resolution among older adults in EDs may be related to the absence of a parallel geriatric paradigm for decision-making (Denman et al., 1989; Hedges et al., 1992; Watson et al., 1999). Also, a lack of resolution to geriatric syndromes may partly explain why patients with low triage had a higher prevalence of past ambulatory ED use. Higher unplanned ED use post-ED discharge among low triaged patients who were discharged home may be the result of unidentified geriatric syndromes. The lack of attention to multiple and preexisting geriatric conditions may also explain the higher rate of ALC designation and slightly higher rate discharge to institutional care for those admitted to the hospital.

The profile of older ED patients was strongly associated with previous hospital use, and showed that frequent users of ED had more acute and complex ailments. That previous hospital use was associated with older ED patients with dyspnea, reduced consumption of food/fluid or weight loss, acute care admissions, as well as being younger and male suggests that unmet acute needs may partly drive repeated ED use. The association between previous hospital use and geriatric syndromes, such as pre-existing functional impairment, mood symptoms, and informal care

breakdown, suggests that unmet chronic needs might drive repeat ED use. The strong positive association between past hospital use and future unplanned ED use is consistent with other studies that report low rates of problem resolution among older ED patients (Denman et al., 1989; Hedges et al., 1992; Watson et al., 1999). It also suggests that care mechanisms to identify and intervene for older patients with multiple visits are lacking in many EDs. The lack of response to the needs of older ED patients with previous visits, and particularly geriatric conditions, may explain the longer acute lengths of stay and the slightly higher likelihood of being discharged to LTC amongst those admitted. The inverse relationship between previous ambulatory ED use and triage acuity suggests that the dominant acuity-based decision support frameworks in EDs are not sensitive to unmet needs. Patients who were younger and male were more likely to have had previous ED use. Chapter 2 also found that, among home care clients who were likely to visit the ED, those who were younger and male were especially predisposed to unplanned ED visits. The exact mechanism(s) underlying these relationships are not fully understood, and are an important area for further research.

The un-stratified and stratified profiles of older, community-dwelling ED patients are useful for developing better principles and approaches to geriatric emergency care. Consistent with the literature (Ettinger et al., 1987; Oates et al., 1997), the triage acuity profile of older ED patients provided little evidence for ED misuse. This suggests that, although older ED patients present with complex chronic conditions, their urgent need for treatment of acute conditions should not be discounted. Nonetheless, the high prevalence of undifferentiated conditions and symptoms are likely to confound standard approaches to diagnosis, and many older ED patients will likely require more careful evaluation relative to younger patient cohorts. Particularly, patients with cognitive deficits were common and are likely to have atypical disease presentations that complicate timely testing, diagnosis, and treatment (Han et al., 2011). An appreciation of premorbid functioning and informal support is clearly useful for evaluating current health status and new approaches to care. Likewise, a reduced ability to manage medications was common and should be anticipated when considering new therapeutic approaches.

The profile of older adults stratified by previous hospital use indicates that strategies should be aimed at breaking the cycle of repeat ED visits. Specifically, enhanced identification and intercession is needed to maintain and restore functional capacity, augmenting informal support, maintain or improve medication adherence, maintain adequate dietary consumption, prevent falls, as well as alleviate cardio-vascular and mood symptoms. Triage stratified findings suggest that older adults with multiple or pre-existing geriatric conditions are especially vulnerable given that they are likely to be triaged low and, thus, face longer wait times in the ED. These frail, long-wait cases are likely to require continuous observation, re-triage, and diligent ADL support (i.e., food, hydration, ambulation, and toileting) in order to prevent further declines while in the ED. Stratified results also suggest that history taking should always include a focus on previous ED use in order to establish a useful context for the current ED presentation. History taking should capture informal support status, pre-existing functional status, medication management, mood, nutrition, and the management of disease symptoms. Evidence presented here demonstrates that use of a standardized geriatric assessment in the ED, and particularly the interRAI ED-CA, is an essential strategy for identifying premorbid status and complex chronic conditions in order to evaluate unmet needs and fully consider the most appropriate approaches to investigation and treatment.

Approximately one in four patients were thought to require referral to specialized geriatric services for comprehensive assessment, and one in three had two or more geriatric conditions. This suggests that standardized protocols for referral to specialized geriatric services and community-based services should be established or improved in order to provide timely access to care in the inpatient and community settings. Given the prevalence of geriatric syndromes among older ED patients, efforts are also necessary to increase the level of specialized geriatric training among ED staff, as well as encourage the development of specialized geriatric care teams. The use of advance practice nurse-led geriatric assessment and referral teams has already been shown to improve patient outcomes (Caplan et al., 2004; Mion et al., 2003). Therefore, the use of specialized geriatric care teams in conjunction with standardized geriatric assessment should be considered a standard practice in all EDs. This is especially crucial given evidence that suggests ED

nurses generally perceive themselves to have good knowledge of geriatric care, but generally do not upon objective evaluation (Roethler, Adelman, & Parsons, 2011). Studies also find that many ED physicians report being unprepared to provide emergency care to older adults (Kihlgren et al., 2005; McNamara et al., 1992; Peterson et al., 2009; Robinson & Mercer, 2007; Schumacher et al., 2006). Ministries of education and health, with the advocacy of geriatric societies and regional programs, should mandate a geriatric training requirement for health professionals in the ED. The prevalence of geriatric conditions among older ED patients in the MOPED Study suggests that ED physicians should receive standard geriatric training. Currently, ED physicians receive no standard geriatric training, despite that they are required to have standard training in pediatrics. Evaluations of pilot geriatric emergency management training for residents have shown improved documentation and a reduction in inappropriate treatment (i.e., urinary catheters) (Biese et al., 2011; Wadman, Lyons, Hoffman, & Muelleman, 2011). All ED-based family physicians should undergo formal training in geriatric emergency management during their emergency medicine fellowship. Also, a subspecialty in geriatric emergency management should be available to emergency medicine specialists to compliment existing subspecialties in toxicology, critical care, pediatrics, and sports medicine.

3.5.2 Patient-Level Determinants of Acute Inpatient Admission

Findings from the multivariate logistic regression analyses provide a multidimensional model that represents, with moderate accuracy, the patient-level factors associated with admission decision-making by clinicians for older, community-dwelling ED patients. Above all, the *Admission Model* indicates that multiple factors are associated with the decision to admit an older ED patient rather than discharge them back to the community. Predictably, higher triage acuity was a relatively strong predictor in the model. Older patients with elevated severity and life threatening illness are more likely to also require acute medical observation and intervention in the hospital. Instability in cognition, mood, ADLs, and behaviour also independently predicted admission to acute care. The predisposing effect of functional instability likely reflects the need for more advanced investigation and treatment of illness(s) in order to stabilize patient function, mood, and behaviour. Such instability negates the possibility of a safe discharge to the community.

Acute changes in ADL status were also predictive of the decision to admit older patients. Relatively early loss ADLs – bathing and locomotion – independently predicted admission, suggesting that both the inability to perform self-care and to ambulate in their usual living environment limited the likelihood of safe discharge back to the community. Changes in ADL status might be the result of underlying injuries from traumatic events such as falls. Also, the onset of acute ADL changes may be caused by the presence of general weakness from new illness, and is probably more common in older patients with frailty. Impaired cognition (either acute or pre-existing) predisposed older patients to admission. Similar to changes in ADL, the effect of cognition suggests that a discharge back to the community is often precarious and improbable. New ADL dependencies and deficits in cognition may also cause emotional distress for informal caregivers, which can also necessitate short-term institutionalization.

A recent decrease in food or fluid consumption independently predicted the decision to admit older patients and may be consequence of mechanical difficulties with chewing or swallowing, depression, social isolation, or the treatment of disease (Furman, 2006; Vesnaver & Keller, 2011). Whatever the cause, the predisposition to admission suggests that older patients with decreased consumption of foods or fluids frequently require supervised rehydration and other therapies to treat potential malnutrition. The presence of anhedonia was predictive in the *Admission Model*, and suggests that mental illness is associated with the decision to admit older patients. Anhedonia is a prominent symptom of major depressive disorders in older adults, and mood conditions have been known to prompt physical complaints that lead to inpatient medical testing (Tune, 2001). In this case, the increase in likelihood of admission suggests the perceived need for further medical evaluation, potentially at the encouragement of the patient or family. Additional analyses are required to test this hypothesis. Anhedonia was the only *Admission Model* covariate to have less generalizability across ED sites, indicating that the admission of older ED patients with anhedonia is not a wholly universal phenomenon. None of the hypothesized risk pathways in the *Admission Model* could have been specifically tested, and require more investigation.

Studies find that older adults admitted to inpatient acute care commonly deteriorate and acquire new geriatric syndromes (Creditor, 1993; Lakhan et al., 2011). Evidence also suggests that

malnutrition is often unrecognized in hospital settings (Bocock & Keller, 2009). The increased likelihood of admission among older ED patients with cognitive impairment, new ADL impairment, unstable function, potential malnutrition, and mood symptoms suggests that discrete identification and care strategies are necessary in inpatient acute care to enhance their management. Acute care comprehensive geriatric assessment systems already exist to identify and improve the quality of care available to older patients (Gray et al., 2009, 2008). Also, successful strategies already exist to prevent further ADL and cognitive decline of older patients during hospitalization (Inouye, Bogardus, Baker, Leo-Summers, & Cooney, 2000; Rubin, Neal, Fenlon, Hassan, & Inouye, 2011).

Some of the covariates in the *Admission Model*, particularly impaired cognition and anhedonia, do not necessarily represent sufficient causes for acute medical intervention in their own right. Scenarios of potentially avoidable acute admissions are a source of frustration for hospital staff and administrators who are concerned about acute bed shortages and its effect on ED overcrowding (Hammond, Pinnington, & Phillips, 2009; Schull et al., 2002). Beyond administrative outcomes, excessive waits for inpatient beds also results in poor patient outcomes (Guttmann et al., 2011). ED observation units have been described alternatives to acute care admission for older, non-acute patients with undifferentiated presentations or for whom a discharge back to the community is deemed unsafe (Moseley, Hawley, & Caterino, 2013). They have been used to allow time for assessment, targeted therapeutic intervention, and to arrange enhanced post-discharge care plans. In addition, diverting non-acute, complex cases directly into geriatric assessment and rehabilitation units from the ED has been shown to be a sensible strategy to avoid acute admission (Somme et al., 2011). This might be particularly appropriate for non-acute older ED patients with cognitive or mental illnesses that require psychogeriatric consultation.

Discrete strategies are also necessary to increase the transitional care capacity from the ED and into the community, with particular emphasis on non-acute older ED patients with impaired function and mood symptoms. Poor coordination between EDs, primary care, and supportive care (home care and community support services), especially after regular business hours, are barriers that will need to be overcome in order to divert non-acute, complex cases from acute admissions.

Sharing clinical data between the ED and community-based care (particularly home care and primary care) is also a necessary strategy to ensure the seamless transition and timely care planning in the community. Evidence-based ED care guidelines are necessary as the basis for clinical education and protocols in the ED. It is suggested that the depth and comprehensiveness of existing research is not adequate to inform geriatric advanced practice nursing in the ED (Shapiro et al., 2012). For example, existing dementia guidelines in ED are based on research from nursing homes given the lack of ED-based research (Clevenger et al., 2012).

3.5.3 Limitations

Consistent with previous ED studies, the main limitation of the MOPED study relates to sample generalizability. ED site samples collected in the MOPED Study were clinically oriented convenience samples and may not fully reflect the entire population of older ED patients in Canada. Given the lack of external funding, EDs were unable to recruit patients outside of normal day shift hours. Known patterns of presentation among older adults suggest that this may not have had a great effect on generalizability (Downing & Wilson, 2005). ED sites without substantial resources were also unable to recruit all consecutive patients during times of excessive case volumes. Despite limitations, a comparison to the literature suggests that the MOPED study was one of the largest prospective cohort studies of older adults in the ED. Particularly, the lack of participation bias, exclusion criteria (i.e., cognitive deficits), as well as the breadth of sites included (i.e., multi-province, mix of hospital types) suggests that the MOPED study is the most representative primary study sample collected to date in Canada.

The MOPED Study employed a comprehensive set of independent variables relative to previous research. However, the profiles of older ED patients as well as the *Admission Model* were limited to a source of independent variables that focused on socio-demographics, function, and symptoms. It is conceivable that the profiles of older ED patients as well as the *Admission Model* would have been improved by an inclusion of diagnostic and treatment information. In addition, site-level factors such as bed supply, staffing, and case volumes could have allowed for a more informative, multi-level *Admission Model*. It should also be noted that the *Admission Model* reflects the entire MOPED sample, and more accurate site-specific models are conceivable.

3.5.4 Future Research

Future descriptive research using the MOPED Study data should focus on the comparative profiles of clinically relevant subgroups of older ED patients, including: patients with previous falls, cognitive impairment, nutritional issues, mood disorders, as well as sex-based analyses. Such analyses can inform the development and improvement of specialized protocols for ED care and the planning of patient transitions. The finding that male patients were more likely to have had previous ED use should be the focus for more descriptive, sex-based analyses. The combination of extensive subgroup analyses, a review of literature and best practice guidelines, as well as stakeholder engagement may also allow for the creation of a geriatric emergency management resource guide. This guide would represent an evidence-informed service-level framework on how to structure and employ ED-based geriatric resources to manage the care and transitions of important patient subgroups. Additional descriptive analyses should also be employed to understand the profile and transitions of ED patient sub-groups identified in the *Admission Model*. More detailed analyses may clarify the risk pathway underlying the relationship between each model covariate and the decision to admit. For instance, a focus on the variation in the admission of ED patients with anhedonia across ED sites might shed light on management strategies that do not employ admission to acute inpatient care. There is a clear opportunity to conduct intervention-based research targeted toward reducing unnecessary acute care admissions. This research would help define and evaluate alternate management strategies for non-acute ED patients whose discharge safety is in question.

Chapter 4

PERSON-LEVEL DETERMINANTS OF ADVERSE OUTCOMES AFTER DISCHARGE FROM THE EMERGENCY DEPARTMENT: ALTERNATE LEVEL OF CARE/LONG-TERM CARE AND REPEAT ED PRESENTATIONS

" … there is ample evidence that older persons who visit hospital EDs are at high risk of functional decline and other adverse outcomes. Moreover, there are many deficiencies in the care of this high-risk population, including failure to recognize problems that could benefit from more careful assessment (either in the ED or another setting), failure to refer to appropriate community services, and failure to communicate to the primary physician in a timely fashion the problems identified and interventions implemented at the ED visit."
McCusker, Verdon, Caplan, Meldon, & Jacobs, 2002.

4.1 INTRODUCTION

4.1.1 Patterns and Determinants of Adverse Outcomes Post ED Discharge

Older ED patients are more likely to experience adverse outcomes post discharge relative to younger ED patients despite the fact that they are also more likely to be referred to community or inpatient follow-up programs (Caplan et al., 1998; Denman et al., 1989; Hedges et al., 1992; Lowenstein et al., 1986; Sanders, 1992). Beyond the enormous personal costs associated with adverse outcomes, post discharge adverse outcomes often have negative financial implications on the health system (Hoogerduijn, Schuurmans, Duijnstee, de Rooij, & Grypdonck, 2007).

Prospective cohort studies have found that older ED patients are at high risk for many adverse outcomes post-discharge, including: death, functional decline, long-term care (LTC; nursing home) placement, repeat ED visits, hospitalization, and alternate level of care (ALC; delayed hospital discharge) (Aminzadeh & Dalziel, 2002; CIHI, 2007; Caplan et al., 1998; Chin et al., 1999; Hastings & Heflin, 2005; McCusker, Bellavance, Cardin, & Trépanier, 1998; McCusker, Bellavance, Cardin, Belzile, & Verdon, 2000; McCusker et al., 1999; McCusker et al., 2000; Richardson, 1992; Rosenfeld et al., 1990; Rowland et al., 1990; Sayers, 1997). The few studies that explored the risk of death have found that just over 10% of older adults die within 90 days of their ED discharge (Chin et al., 1999; Richardson, 1992; Rosenfeld et al., 1990). Few studies also investigated post discharge functional decline. Both Hustey et al. (2007) and Rowland et al. (1990) found that functional decline occurred in close to half of older adults post ED discharge. Functional capacity, cognitive capacity, age, recent hospitalizations or ED visits, informal care capacity, comorbidity, and polypharmacy were the most prevalent predictors of adverse outcomes, mostly composite measures of multiple adverse outcomes, among prospective ED cohort studies (Caplan et al., 1998; Chin et al., 1999; Lowenstein et al., 1986; McCusker et al., 1998; McCusker et al., 2000; McCusker et al., 1999; McCusker et al., 2000; McCusker et al., 1997; Richardson, 1992). The common use of composite outcome measures that included multiple adverse outcomes diminishes the ability to differentiate the specific determinants of particular adverse outcomes.

The most well studied post discharge adverse outcome has been repeat ED visits. Repeat ED visits are thought to be the most valid and reliable proxy indicator for persistent decline and unmet need, particularity when they occur more proximate to the index ED visit. In addition, concerns of ED overcrowding and poor quality of care have contributed to the use of repeat ED visits as the primary dependent variable in prospective studies. Older ED patients have the highest repeat ED visit rate of any age group (Hustey et al., 2007; McCusker et al., 2003). Studies suggest that the proportion of older adults that re-visit is approximately 5.6% within 14 days, 15.8% to 25% within 30 days, 19.3% to 38% within 90 days, and 43.9-49% within 6 months of an index ED visit (Fan et al., 2006; Graf et al., 2012; Hustey et al., 2007; McCusker et al., 2000; McCusker et al., 1997; Moons et al., 2007; Rosenfeld et al., 1990; Rowland et al., 1990). A Canadian study suggested that 7.5% of older adults have three or more repeat ED visits within 6 months of their index ED visit (McCusker et al., 2000). Consistent with the rates of repeat ED visits reported in the literature, a study found that 24% of older ED patients had a hospital admission (not counting any admissions from the index ED visit) within 90 days of ED discharge (Rosenfeld et al., 1990). McCusker et al. (2000) provided the only study which specifically investigated the determinants of repeat ED visits among older ED patients. They found that heart disease, previous inpatient hospital use, depression, and alcohol use provided the best multivariate model. More studies are needed to increase the evidence base regarding the determinants of repeat ED visits among older ED patients.

Prospective cohort studies that examined the patterns and determinants of adverse outcomes among older ED patients differed greatly with respect to sample, data source, measurement method, and length of observation period. Also, many studies suffered from weaknesses with respect to external validity. For example, many investigations recruited small single facility samples (Fan et al., 2006; Moons et al., 2007; Rosenfeld et al., 1990; Runciman, Currie, Nicol, Green, & McKay, 1996; Salvi et al., 2009; Sayers, 1997). Though the reporting of response rates was unreliable, many studies also report a response rate of under 70% (Fan et al., 2006; Hustey et al., 2007; Lee et al., 2008; Meldon et al., 2003). Numerous studies also deliberately excluded persons with any cognitive impairment, which may have had the effect of eliminating one-quarter

of all potential subjects (Dendukuri, McCusker, & Belzile, 2004; Fan et al., 2006; Hustey et al., 2007; Lee et al., 2008; McCusker et al., 2000; McCusker et al., 2000; McCusker et al., 2003; Meldon et al., 2003; Moons et al., 2007). Future research regarding the determinants of adverse outcomes among older ED patients should utilize more representative, multi-site samples.

No ED literature was found that explored the determinants of adverse outcomes for older ED patients admitted to inpatient acute care despite the fact that between one-third and two-thirds of ED visits by older adults result in an acute admission (Baum & Rubenstein, 1987; Downing & Wilson, 2005; Ettinger et al., 1987; George et al., 2006; Gillick & Steel, 1983; Lowenstein et al., 1986; Richardson, 1992; Singal et al., 1992; Strange et al., 1992). Older ED patients admitted to inpatient acute care were more likely to be subsequently placed in LTC (i.e., nursing homes, residential care) relative to younger ED patients (CIHI, 2007a). The perceived necessity for placement into LTC often reflects the loss of independence in basic ADLs, as well as caregiver distress – termed the 'cascade to dependency' (Covinsky et al., 2003; Creditor, 1993; Fortinsky, Covinsky, Palmer, & Landefeld, 1999). An Australian study found that 33%, 9%, and 8% of older patients in a general medical ward experienced clinically relevant ADL, cognitive, and bladder function declines during their inpatient stay, respectively (Lakhan et al., 2011). Opportunities to avoid unnecessary LTC placement from hospitals by preventing functional decline and enhancing community-based supportive services are being explored in Canada. For example, the Ontario Aging at Home strategy endeavors to expand community-based supports in order to avoid or delay admission to LTC (MOHLTC, 2009). An Ontario study found that a sizable proportion of LTC admissions could be avoided with more targeted community-based supports and greater transitional capacity in hospitals (Costa & Hirdes, 2010). Research conducted in inpatient acute care or geriatric wards has often used the receipt of placement to a LTC facility to validate geriatric risk indices that predict functional decline or new disability at discharge, or to identify the requirement of early discharge planning (Blaylock & Cason, 1992; Inouye et al., 1993; Mehta et al., 2011; Noro et al., 2011).

Of particular concern is the large number of hospital beds being occupied by older patients who no longer need acute hospital services, but have not been discharged because of ongoing post-

acute care needs or inadequate supports in the community. Patients who experience a delayed discharge are at further risk of functional decline, social isolation, as well as the loss of independence (Graf, 2006; Hitcho et al., 2004; Kydd, 2008). These delayed discharges represent a minority of hospital cases, yet their influence extends to ED crowding, cancelations of day procedures, and poor coordination of sub-acute and community care resources (ALC Expert Panel, 2006; Rock et al., 1995). In Canada, delayed discharges are designated as alternate level of care or 'ALC'. The ALC construct is also used to identify delayed discharges in some U.S. jurisdictions (Burgin & Schuetz, 1992; Rock et al., 1995; Tellis-Nayak & Tellis-Nayak, 1986). In Canadian hospitals, an authorized physician or physician delegate designates ALC when acute care is no longer medically necessary for the patient (Alternate Level of Care in Canada, 2009). Hospital patients admitted through the ED accounted for 65% of acute patient bed days in Canada, 11% of which were ALC days (excluding Quebec) (Dawson, Weerasooriya, & Webster, 2006). Approximately 83% of all acute ALC patients are admitted through the ED, accounting for over a million ALC bed days in Canada (excluding Quebec) (CIHI, 2007; Dawson et al., 2006). The proportion of ALC days in Ontario's acute hospitals has almost doubled since 1995 — comprising 19% of all current acute care beds in Ontario (ALC Expert Panel, 2006; Ontario Hospital Association ALC Survey 2010). ALC patients have been described using administrative and clinical data (Costa & Hirdes, 2010; Costa, Poss, Peirce, & Hirdes, 2012; Walker, Morris, & Frood, 2009). One such study showed that patients waiting for LTC placement account for a large portion of ALC bed days (Costa et al., 2012). The literature suggests LTC placements drive the majority of ALC days throughout Canada and elsewhere (Gallagher, Henry, & O'Callaghan, 2008; Mayo, Wood-Dauphinee, Gayton, & Scott, 1997; Rock et al., 1995; Victor, Healy, Thomas, & Seargeant, 2000; Walker et al., 2009).

Studies are needed to investigate the adverse outcomes among older ED patients admitted to inpatient acute care from the ED. Two studies explored acute hospital utilization by older ED patients post ED discharge (Dendukuri et al., 2004; McCusker et al., 2000). However, these studies investigated high hospital utilization as a function of the hospital bed days after the index ED visit, regardless of whether the hospital days were a part of the index acute episode. Therefore,

whether the hospital days were related to the index ED visit could not have been discerned. Also, ALC status or discharge to LTC was not identified. Studies investigating the determinants of adverse inpatient outcomes among older ED patients, particularly LTC placements and ALC designations, would be useful additions to the research literature and would contribute to early identification in the ED.

4.1.2 Existing Risk Assessment Methods

Research concerning risk of adverse outcomes post discharge frequently used vital signs as indicators of acuity/complexity of older adults (e.g., temperature, blood pressure, pulse rate) (Gillick & Steel, 1983; Rutschmann et al., 2005). Researchers and practitioners also suggest the use of triage acuity to risk assess older ED patients presenting to the ED. In Canada, the Canadian Triage and Acuity Scale (CTAS) defines triage acuity (Bullard et al., 2008; Murray et al., 2004). Studies have used the CTAS to differentiate patients with respect to resources use, medical complexity, need for referral, and risk of admission (Brooks, Warshaw, Hasse, & Kues, 1994; Rowe et al., 2006).

Geriatric conditions and syndromes among older adults - despite their relationship to adverse outcomes - often remain undiagnosed or unattended to in the ED (Denman et al., 1989; Elie et al., 2000; Hustey & Meldon, 2002; Meldon, Emerman, Schubert, Moffa, & Etheart, 1997; Singal et al., 1992). Hustey et al. (2002) found that only 28% of older ED patients with cognitive impairment had any related documentation in their ED chart. Of those with documentation of cognitive impairment, only 18% had a follow-up arrangements or a referral noted upon discharge to the community (Hustey et al., 2002). A recent study found that less that 25% of ED physicians and 30% of nurses regularly screened for common geriatric syndromes (Carpenter, Griffey, Stark, Coopersmith, & Gage, 2011). A Canadian study by Elie et al. (2000) found that the detection of delirium by emergency physicians achieved 35% sensitivity. Older research by Lewis et al. (1995) broadly supports their finding. Depression among older patients is also poorly recognized in the ED. One study found that depressive symptoms, mental health referral, or related diagnoses were not noted for any of 70 older patients that presented with self-reported depression (Meldon et al., 1997). Only two of the 70 patients' attending physicians noted the use of psychoactive

medication (Meldon et al., 1997). Studies also find that the vast majority of older ED patients are not asked about their ability to care for themselves prior to ED discharge (Denman et al., 1989; Singal et al., 1992). A 10-year U.S. study that explored prescribing practices found a 44% increase in the number of visits where three or more medications were prescribed. This escalation was primarily attributed to a 90% increase among older patients who had a diagnosis of "other and undefined" (Roberts et al., 2008).

The literature suggests that traditional models of ED screening and assessment are not entirely suited to older ED patients (Kihlgren et al., 2005; McNamara et al., 1992; Peterson et al., 2009; Schumacher et al., 2006). Awareness of the complexity of care needs and relative risks among older ED patients has led to the development of geriatric screening tools. Only four such screening tools have been validated in the ED: the Identification of Seniors At Risk (ISAR), the Triage Risk Screening Tool (TRST), the Runciman Screener, and the Rowland Screener (see Appendix Z). All four tools address common domains of polypharmacy, impaired memory, impaired IADLs/ADLs, as well as informal care support. Other screening tools have also been used to identify older ED patients: the Mini-Mental State Exam (MMSE) (Chiovenda, Vincentelli, & Alegiani, 2002), the Barthel Index (Caplan et al., 2004; Wong, Wong, & Caplan, 2007), the Orientation-Memory-Concentration (OMC) Test for cognitive impairment (Gerson et al., 1994), and the Self-Rated Depression Scale (SRDS) (Meldon et al., 1997). However, these screening tools are not ideal for ED use given that they were not developed for, or validated within, an ED setting.

Both the Runciman Screener and the Rowland Screener represent older questionnaires that have had limited use since their development. The Runciman Screener was designed to predict re-injury post discharge among older adults age 75 or older (Runciman et al., 1996). This tool was developed based on expert consensus. If 3 or more of the eight items are scored positive, then the patient is deemed at risk. Runciman et al. (1996) show fair sensitivity (50%) and specificity (77%) with their development sample, but do not report measures of overall predictive accuracy. The Rowland Screener was developed to determine the risk of a repeat ED visit from an index ED visit (Rowland et al., 1990). In their brief article, the authors do not describe the particular methods used to develop the tool. If four of the seven items are scored positively then the patient

is deemed to be vulnerable. Rowland et al. (1990) report poor sensitivity (28%) but good specificity (85%) using a single sample.

The Triage Risk Screening Tool (TRST) represents a more recent six-item, assessor driven instrument designed to predict resource utilization, including risk of hospitalization, nursing home admission, and readmission to the ED among older patients (>64) (Meldon et al., 2003). The TRST was developed using a two-step process of literature review and expert panel consensus. The TRST includes six dichotomous items, including a subjective professional recommendation by the assessor. A patient is considered 'at risk' if two or more of the dichotomous items are scored positively (Meldon et al., 2003). A study that tested TRST's ability to predict a composite outcome of subsequent ED visit, hospital admission, and nursing home admission found fair sensitivity (64%) and specificity (63%) at 30 days post ED visit (AUC=0.64) (Meldon et al., 2003). When compared to an independent high or low risk classification, the TRST showed 70% agreement (k=0.38; 95% CI: 0.28-0.49) (Meldon et al., 2003). In their 2006 study, Fan et al. (2006) sought to validate the predictive utility of the TRST in an elderly Canadian ED sample. They concluded that the TRST was a poor diagnostic test to predict a composite outcome (ED readmission, hospital admission, or nursing home placement) at both 30 and 120 days given the failure of the likelihood ratios to achieve levels of significance (Fan et al., 2006). In Lee et al.'s (2008) study of a Canadian ED sample, they found that the ability of the TRST to predict the composite outcome (ED readmission or hospital admission) at 30 days was clinically 'sub-optimal' with a sensitivity of 62% (95% CI: 54-70%) and specificity of 57% (CI: 53-61%) (AUC=0.61). Hustey et al. (2007) found the TRST to be moderately predictive of ADL functional decline at 30 days (AUC=0.64; 95% CI: 0.56-0.72) and 120 days (AUC=0.66; 95% CI: 0.58-0.74).

The Identification of Seniors At Risk (ISAR) was developed for older patients (>64) in the ED to identify those at risk of mortality, functional decline, readmission, and institutionalization. Similar to the TRST, the ISAR consists of six dichotomous patient-directed questions. The tool was developed and tested as a patient driven tool - completed by a patient or an available informant. A patient is considered at risk if 2 or more questions are answered in the affirmative (McCusker et al., 1999). The items used in the tool were selected from a set of 27 self-report screening

questions identified from the literature, an existing instrument, and an expert panel. Item selection was based on face validity and predictive value. Validation of the ISAR determined that sensitivity (71%) and specificity (57%) were fair (AUC=0.71; 95% CI: 0.68-0.74) for the prediction of a composite outcome (functional decline, mortality, and long-term care admission) 6 months post ED index visit (McCusker et al., 1999). For the prediction of high acute hospital utilization (more than 11 days) 6 months post ED visit, the ISAR also demonstrated fair sensitivity (73%) and specificity (51%) (AUC=0.68; 95% CI: 0.59-0.75) (McCusker et al., 2000). Using much of the original study sample, Dendukuri et al. (2004) found that the ISAR was also relatively successful in predicting frequent ED visits (>1) 6 months post index ED visit (AUC=0.68; 95% CI: 0.61-0.75). Concurrent validity for functional impairment (partial or complete dependence in 3 or more ADLs) (AUC=0.86; 95% CI: 0.75-0.92) and depression (AUC=0.78; 95% CI: 0.70-0.84) at baseline was favorable (Dendukuri et al., 2004).

A summary table was created to determine the relative predictive performance of all four tools across all studies reported in the literature (see Appendix AA). To date, two studies directly compared the predictive validity of all four screening tools in head-to-head studies. Moons et al. (2007) found that the Rowland Screener and had the best overall predictive performance and that the TRST performed least favorably in predicting repeat ED visits relative to the other tools (Moons et al., 2007). They also found that the ISAR had better predictive value relative to the TRST, but did not perform as well as the Runciman Screener (Moons et al., 2007). Buurman et al. (2011) found that the Runciman Screener and ISAR predicting a composite measure composed of death, repeat ED visit or hospitalization better than the TRST and Rowland Screener. These results are surprising given the relatively rudimentary development work that generated the Rowland Screener and the Runciman Screener, as well as perceptions of their face validity. A Swiss Study that compared the ability of the ISAR and TRST to predict repeat ED visits of inpatient hospital use found that the ISAR had marginally better performance (Graf et al., 2012). Differences in study design and dependent variables between the four tools limit a direct comparison of predictive performance. Overall, validation studies suggest that the performance of existing tools in predicting composite outcomes is weak to moderate.

The development and validation studies of geriatric screening tools have key methodological drawbacks. Firstly, all of the development studies had limitations related to sampling. With exception to the ISAR, the development of geriatric screening tools were based on small single site samples. In particular, the TRST development sample was a very urban sample with a distinct ethnic and socioeconomic profile. The use of small single site samples reduces external validity. Also, the ISAR and TRST were developed in samples that were biased against patients with cognitive deficits or no willing informal caregiver given that these patients were excluded in their development studies. Poor sampling combined with moderate to poor response rates also suggests that population samples may be biased toward the relatively well-functioning older ED patient. Second, the systematic lack of an independent validation sample for all four tools' development studies created the possibility for 'over fit' models and influential observations. This had the potential to exaggerate the predictive performance of each tool. In the case of the TRST, sample limitations as well as the lack of a validation sample may have caused noticeably poorer validations relative to the studies based on the development sample. Another methodological limitation is the use of composite outcomes within both the development and validation studies. Particularly, composite outcomes used in TRST and ISAR studies contained a broad spectrum of adverse outcomes that were related to separate discharge pathways from the ED. Crude comparisons of studies that have examined determinants of long-term care admission and those that have examined determinants of hospital utilization suggest that different determinants drive these discrete outcomes (see Hirdes et al., 2008 and Appendix Z and AA). Without high correlation or a common risk pathways there is little justification to combine dependent variables into composite outcomes, particularly if discrete outcomes are not first explored in isolation. The use of composite outcomes to design predictive models likely minimizes the ability of such models to achieve a level of predictive validity that is clinically useful, while also overestimating their ability to function as multi-outcome decision-support tools. Lastly, testing of reliability was not found, however, it could be argued that reliability is less irrelevant wherever predictive validity is demonstrated given that reliability is necessary for validity.

Limitations of the four geriatric screening tools also relate to their utility in point-of-care clinical practice. None of the development studies overtly describe a screener development approach that incorporates enhancements to clinical deployment. For example, the ISAR was developed as a self-report tool, which limits its use among patients who cannot speak official languages, those with poor reading comprehension, as well as those with cognitive impairment (orientation to time and place) or no available informant (McCusker et al., 1999; McCusker et al., 2000). In their study, McCusker et al. (2000) reported that, of the 2,733 patients aged 65 and older who were screened for study eligibility, 14.6% (N=400) were not eligible because of disorientation and no informant, and 2.4% (N=66) because of language comprehension. Similarly, the prevalence of cognitive impairment among older ED patients has been found to be between 10 – 25% in the literature and 21.1% in the MOPED Study (Chiovenda et al., 2002; Hustey et al., 2003; Lewis et al., 1995). Cognitive changes are thought to be pivotal to the understanding of clinical presentations and potential discharge (Gerson et al., 1994; Han et al., 2011; Hare, Wynaden, McGowan, & Speed, 2008). Therefore, it is essential to design and validated screening tools using samples that closely resemble the cognitive profile of the population. Also, the nature of an ED limits the use of a patient directed, self-assessment tool. This is reflected in the observation that studies using the ISAR tool always employ an assessor driven approach (Buurman et al., 2011; Graf et al., 2012; Moons et al., 2007; Salvi et al., 2009).

The use of screening questions that are generally capacity-based as well as some items that are 'double-barreled' may limit the psychometric properties of some of the items used in the four screening tools. Question based on capacity (for example, 'do you need help with …') may be unreliable as they are likely to interact with aspects of locus of control. So-called 'double-barred' items are those that include "or" in the line of inquiry and, therefore, confuse the attribution of the independent variable. In addition, both the ISAR and TRST ask about the number of prescription medications used. However, it is unclear to what extent the number of medications is related to that of polypharmacy or medication management. Related to the potentially poor psychometric properties of some of the items included in the four screening tools is the use of rudimentary risk scoring methods. Specifically, all four screening tools use a simple un-weighted

linear addition of items despite the fact that each item has a different effect size. The result of these risk-scoring methods is illustrated in figure 3 of Meldon et al.'s (2003) TRST development paper (see Appendix BB). This figure shows that three of the six items in TRST do not reach significance. Therefore, a simple addition of the TRST items can identify many 'at risk' cases that are in fact less likely to have an adverse event. For example, given that previous ED visits is the strongest predictor in TRST and ISAR (Lee et al., 2008; McCusker et al., 2000), this item should be weighted to reflect its strong influence. Also, the poor precision achieved from the simple addition of various effect sizes severely threatens internal validity, which may lead to poor buy-in from clinicians at the point of care. Perhaps the most crucial clinical limitation relates to the ability of all four tools to sufficiently differentiate older ED patients, regardless of predictive validity. Though validations show fair to moderate specificity, all of the geriatric screening tools distribute risk across one level only. This feature makes for a tool that is too sensitive for EDs that do not have the resources to respond to a near 50% trigger rate. Future geriatric screening tools should be designed to differentiate older ED patients into meaningful and manageable risk clusters.

4.2 RATIONALE AND OBJECTIVES

Prospective cohort studies have found that older ED patients are at high risk for many adverse outcomes post-discharge, and broad determinants have been delineated. Multicenter prospective studies recruiting more representative samples of older ED patients are required to refine our knowledge of the specific determinants of particular adverse health outcomes post discharge. There is some evidence in the literature that geriatric assessment in the ED coupled with multidisciplinary intervention reduces adverse post discharge outcomes (Caplan et al., 2004; Foo, Siu, Tan, Ding, & Seow, 2012; Graf, Zekry, Giannelli, Michel, & Chevalley, 2011; McCusker et al., 2001; Sinha, Bessman, Flomenbaum, & Leff, 2011), is acceptable to ED clinicians (Carpenter et al., 2011), and has cost-benefit (Warburton, 2005). However, there is a clear need for further research and development related to geriatric screeners in the ED given the limitations of the available geriatric screeners. Geriatric screening tools should be designed to predict specific subsets of adverse outcomes that are relevant to discrete clinical and decision-making pathways. Particularly, models are needed to predict adverse outcomes for older ED patients admitted to inpatient acute care and those discharged back to the community, respectively. Also, the use of best available statistical modeling methods are needed to better differentiate older ED patients into coherent risk clusters at the point of care.

The objective of this chapter is to examine the prevalence of key post discharge adverse outcomes among older ED patients and develop risk assessment methods to aid decision-making at the point of care. An ALC designation or placement in LTC will represent post discharge adverse outcomes among those admitted to inpatient acute care, whereas unplanned repeat ED visits represent post discharge adverse outcomes among those discharged back to the community. The following phases will be employed:

Phase 1: An examination of the prevalence as well as the development of a decision-support tool to determine the risk of ALC designation or LTC placement among older ED patients admitted to inpatient acute care. The resulting risk models will shed light on person-level determinants of ALC designation and LTC placement as well as expand the evidence base on adverse outcomes among older ED patients admitted to inpatient

acute care. The development of a risk assessment method will contribute to the prevention of inpatient adverse outcomes in the ED and inpatient care. The following questions will be evaluated:

- What is the prevalence of ALC designation and LTC placement among older ED patients admitted to inpatient acute care?
- To what extent are ALC designations and LTC placements correlated among older ED patients admitted to inpatient acute care?
- What person-level factors best reflect the risk of ALC designation or LTC placement among older ED patients admitted to inpatient acute care?
- Do the determinants of ALC designation or LTC placement among patients admitted to inpatient acute care vary by ED site?

Phase 2: An examination of the prevalence as well as the development of a decision-support tool to determine the risk of unplanned repeat ED visits among older ED patients discharged back to the community. The resulting risk models will shed light on person-level determinants of unplanned repeat ED visits as well as add to the existing evidence base on adverse outcomes among ED patients discharged home. The development of a risk assessment method will contribute to the prevention of adverse outcomes in the community following an ambulatory ED visit. The following questions will be evaluated:

- What is the prevalence of unplanned repeat ED visits among older ED patients discharged back to the community?
- What person-level factors best reflect the risk of unplanned repeat ED visits among older ED patients discharged back to the community?
- Do the determinants of unplanned repeat ED visits among older ED patients discharged to the community vary by ED site?

4.3 METHODOLOGY

4.3.1 MOPED Study Patient Sample and Variables

All MOPED Study records belonging to community-dwelling ED patients were included in the modeling sample. Records related to older patients from LTC facilities were excluded in order to focus on community-dwelling ED patients. Each unique ED case was used as the unit of analysis in order to reflect ED case volumes and to maximize the explanatory power of the MOPED sample. Assessment records for community-dwelling older adults were merged with follow-up data in order to examine adverse outcomes. All interRAI ED-CA assessment items, acute change 'dummy' indicators, and derivative scales where included as independent variables for modeling. There was no pre-selection of independent variables given that most of the interRAI ED-CA's 34 items represented distinct health domains and that the number of independent variables was not excessive. This conservative approach was employed to include all potentially important independent variables.

Dependent outcome variables among patients admitted to inpatient acute care included ALC designation as well as LTC placement within 90 days of ED discharge. The primary dependent variable was any ALC designation or LTC placement among ED patients admitted to inpatient acute care. Secondary dependent variables were ALC designation as well as LTC placement within 90 days of ED discharge, separately. Amongst ED patients discharged to a community setting, any unplanned repeat ED visits within 90 days and 30 days were used as dependent variables, separately. Any unplanned repeat ED visits within 90 days was chosen as the primary dependent variable in order to reflect the maximum risk period. Any unplanned repeat ED visits within 30 days was used as a secondary dependent variable in order to capture more proximate ED visits that were more likely to be influenced by an index ED visit. The dependent variables employed were similar to those used in previous research (Blaylock & Cason, 1992; Buurman et al., 2011; Graf et al., 2012; Hustey et al., 2007; Inouye et al., 1993; Lee et al., 2008; McCusker et al., 2000; McCusker et al., 1999; McCusker et al., 2000; Mehta et al., 2011; Meldon et al., 2003; Moons et al., 2007; Salvi et al., 2009).

4.3.2 Analytic Strategy

Consistent with Chapter 2, the main analytic technique was decision-tree modeling, and specifically Chi-squared Automatic Interaction Detection (CHAID). Decision-tree modeling was chosen given that the goal of the multivariate analyses was to also to generate decision-support classification for use in clinical practice. The visual nature of decision-tree models was expected to provide a clearer conceptual representation for educational purposes of the clinical decisions support applications in the ED compared with those generated by traditional modeling methods. Decision-tree analyses also allowed for the use of all independent variables collected in the MOPED Study without variable preparation or pre-selection. Consistent with chapter 2, the Chi-square statistic was selected to inform each CHAID split. SAS® Enterprise Miner Client 6.2 was used to perform CHAID analyses (SAS Institute, Inc., Cary, NC). Contrasting with chapter 2 methods, candidate variables for each node were listed for all independent variables that achieved 90% significance. A less stringent probability level was used given the smaller sample sizes. The sensitivity, specificity, and positive predictive values for each candidate variable split were also used to select split criteria for each node. A given decision-tree branch was considered complete when candidate variables did not reach 95% probability.

Analyses began with the creation of two separate data sets for each analytic phase. A data set containing MOPED records for ED patients admitted to inpatient acute care was created for phase 1; whereas the data set for phase 2 contained MOPED records for ED patients discharged back to the community. The overall and site-specific prevalence of the primary and secondary dependent variables were plotted in each phase. An un-weighted Cohen's Kappa matrix was tabulated to determine the level of agreement between an ALC designation, LTC placement, and 90-day censored discharges. Guidelines established by Landis and Koch (1977) were used to evaluate the magnitude of agreement. Also, a Kaplan-Maier survival curve for days to first unplanned repeat ED visit was plotted in phase 2. Decision-tree analyses began for phase 1 and phase 2 by creating random, ED site stratified test and validation samples using SAS® Enterprise Miner Client 6.2 (SAS Institute, Inc., Cary, NC). Specifically, 60% of the sample in each phase was allotted for model derivation and 40% for model validation in order to preferentially enhance the explanatory power

of the derivation sample partitions. Full derivation sample partitions were imported into SAS® Enterprise Miner Client 6.2 interactive decision-tree, rather than samples, in order to maximize explanatory power. Consistent with chapter 2 methods, candidate root nodes were evaluated based on discriminatory power (sensitivity, specificity, positive predictive values) and conceptual organization. Conceptual organization was judged based on the ability of the candidate variable to simplify the tree without reducing overall discriminatory power. Also, input from the clinical panel was used to aid decision-making. Decisions on subsequent nodes and branches were selected based on discriminatory power (sensitivity, specificity, PPV) and clinical coherence. Independent variables were grouped when there were variables with similar powers to discriminate and representing similar risk pathways. Sensitivity analyses were performed to establish the most parsimonious and discriminatory variable groupings using an iterative process. Input from the clinical panel was used to ensure clinical coherence of node selections. The *ALC/LTC Model* and *Repeat ED Model* decision-trees were then coded in SAS® 9.2, and the LOGISTIC procedure was used to determine the class-level odds ratios within each model's derivation sample partition. Each model's nodes were collapsed if their class-level odds ratio splits did not achieve 95% significance in the derivation sample. The class-level odds ratios for the final *ALC/LTC Model* and *Repeat ED Model* were graphed, and model scores were established by combining leaves with similar odds ratios. A sensitivity analysis was completed on the *ALC/LTC* and *Repeat ED Model* to establish the most discriminatory and coherent model scoring based on the precision of the class-level odds ratios and overall discriminatory power.

The class-level odds ratios of the final *ALC/LTC* and *Repeat ED Models* were graphed using their respective primary and secondary dependent variables in the derivation sample partitions. The class-level odds ratios, AUC, and Hosmer and Lemeshow Goodness-of-Fit Test for the primary dependent variables were also calculated using the derivation and validation partitions in order to establish the models' fit and performance. Deviance residual plots were also plotted to establish each model's goodness of fit in the derivation and validation partitions. Kaplan-Meier survival curves were plotted for the time to unplanned repeat ED visit in phase 2 in order to test and validate the time to event performance of the Repeat *ED Model*.

Outcomes among older ED patients vary by type of ED site (Borges Da Silva et al., 2012; McCusker et al., 2012a). Therefore, the effect of the *ALC/LTC* and *Repeat ED Models'* covariates may have been correlated by ED site. The relationship between each models' covariates and primary outcomes were evaluated with Generalized Estimating Equation (GEE) logistic regression using the GENMOD procedure as well as the entire phase 1 and 2 MOPED samples, respectively. ED site identifiers were entered into the GEE *ALC/LTC* and *Repeat ED Model* using the exchangeable correlation structure. The class-level odds ratios for the *ALC/LTC* and *Repeat ED Models* were compared to their standard logistic model to test for their generalizability across ED sites. Analyses were performed using SAS® Version 9.2 (SAS Institute, Inc., Cary, NC).

4.4 RESULTS

4.4.1 Phase1: The Risk of ALC Designation or a Placement among Older ED Patients admitted to Inpatient Acute Care

A total of 1,083 (53.2 ±2.1%) community-dwelling patient cases were admitted to inpatient acute care following their ED visit. Overall, 16.8% (±2.1%) were designated ALC and 9.6% (±2.1%) were placed into a LTC facility within 90 days of admission. In total, 20.7% (±2.1%) were either designated ALC or admitted to a LTC facility (see Figure 4-1). The prevalence of ALC designation and LTC placement varied markedly across hospital sites. The prevalence of ALC designation amongst those admitted ranged from 0% (SPH) to 31% (±15.4%; SAGH); whereas the prevalence of LTC placement ranged from 0% (SCH) to 26% (±14.5%; SAGH). Despite observed variability in estimated prevalence, the width of each confidence interval suggests that there are few significant differences in outcomes across sites. The relative proportions between ALC designation and LTC placement were fairly consistent across sites, where ALC designations were generally more common than LTC placements (see Figure 4-2). The Kappa matrix between ALC designation, LTC placement, and LTC placement or 90-day censored discharge showed that ALC designation and LTC placement had fair to moderate agreement. The Kappa between ALC designation and LTC placement or 90-day censor showed modest agreement, suggesting that many patients designated ALC are also discharged to a LTC facility or remain in acute care 90 days post admission (see Table 4-1).

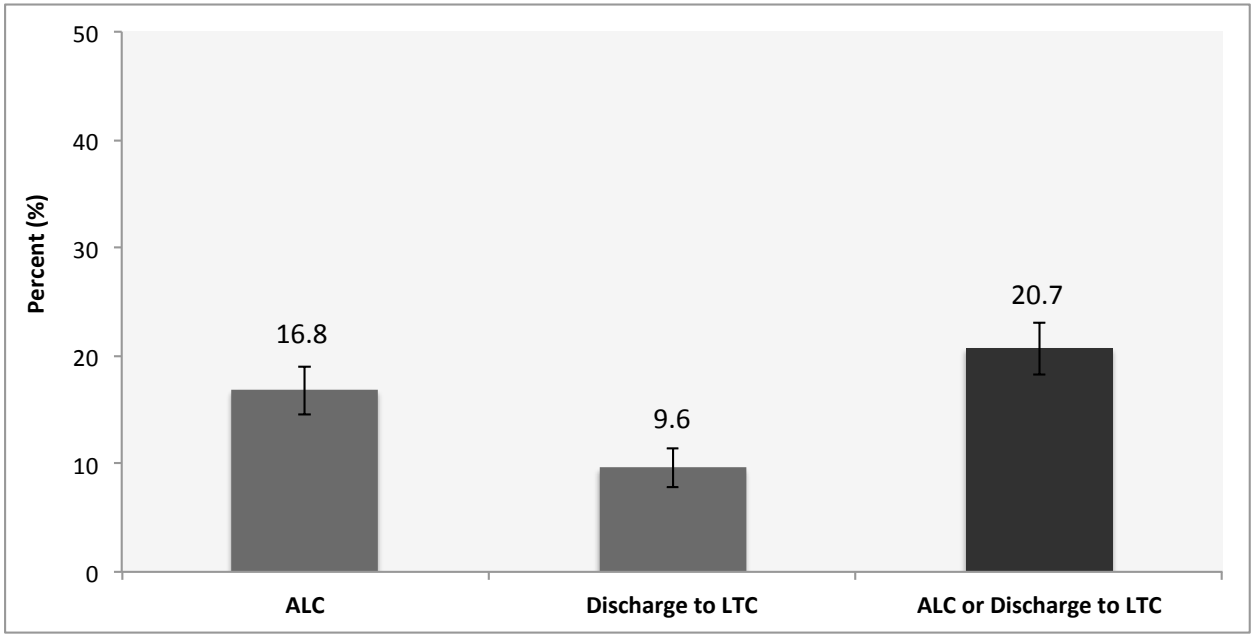


Figure 4-1: **Prevalence of Selected Adverse Outcomes among ED Patients Admitted to Acute Care, MOPED Study (N=1,083)**

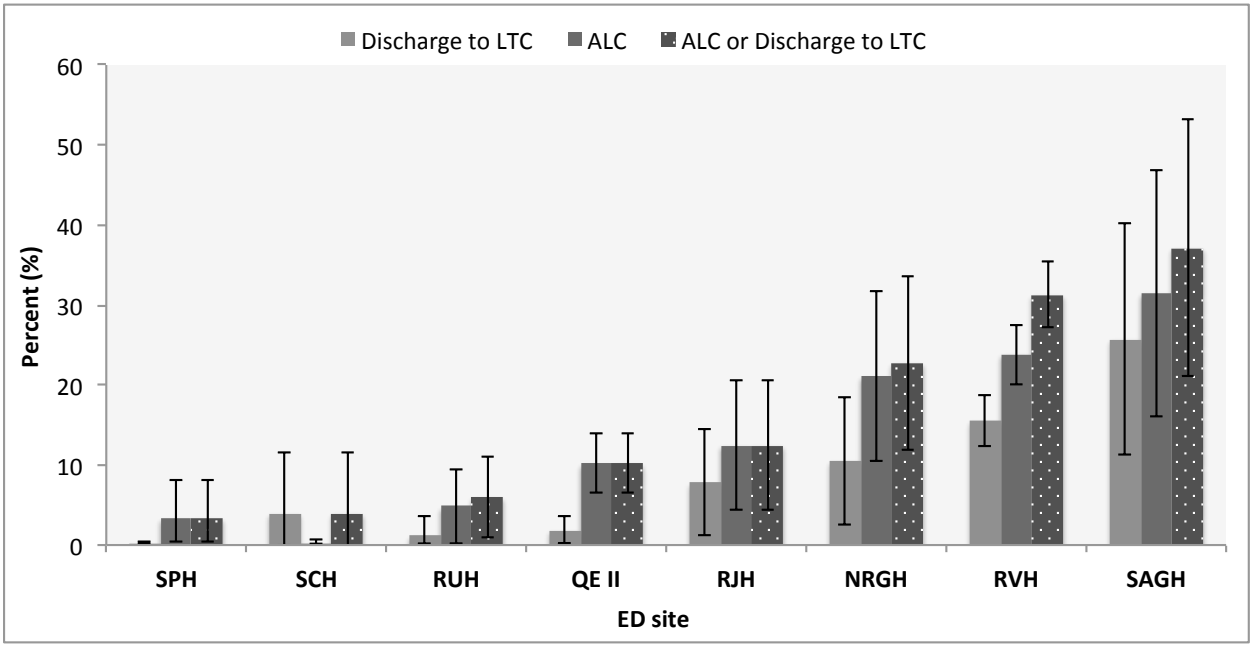


Figure 4-2: **Prevalence of Selected Adverse Outcomes among ED Patients Admitted to Acute Care by Hospital Site, MOPED Study (N=1,083)**

Table 4-1: **Kappa Matrix, Selected Adverse Outcomes among ED Patients Admitted to Acute Care, MOPED Study (N=1,083)**

	ALC	**LTC Placement**	**LTC Discharge or 90 Day Censor**
ALC	-	**0.35** (95% C.I.= 0.28-0.43) (p=<.00)	**0.50** (95% C.I.= 0.43-0.57) (p=<.00)
LTC Placement	**0.35** (95% C.I.= 0.28-0.43) (p=<.00)	-	**0.83** (95% C.I.= 0.77-0.88) (p=<.00)
LTC Placement or 90 Day Censor	**0.50** (95% C.I.= 0.43-0.57) (p=<.00)	**0.83** (95% C.I.= 0.77-0.88) (p=<.00)	-

Overall, 647 and 436 admitted MOPED cases were partitioned for decision-tree derivation and validation, respectively. The final decision-tree *ALC/LTC Model* contained 17 leaves, where the proportion of admitted cases with an ALC designation or LTC placement within 90 days of admission ranged from 3.8% (leaf #1) to 84.6% (leaf #17) (see Figure 4-3).

The combination of existing and new cognitive and ADL impairments showed the highest discriminatory power, as well as the best ability to organize the proceeding tree branches relative to other candidate variables (e.g., Self-Reliance Indicator, ADL only, and cognition only). Older ED patients who had new or existing cognitive impairment or signs of delirium were approximately 2 and 6 times more likely to be ALC/LTC relative to patients with existing and new ADL impairment, respectively. Patients who had existing ADL impairment were approximately 2.5 times more likely to be ALC/LTC relative to patients with new ADL impairment. Higher relative age (≥ 85) further differentiated those without new or existing cognitive or ADL impairment. ED patients age 85 years or older shared a very similar risk profile to those with new ADL impairment (see Figure 4-3).

Older ED patients with new or existing cognitive impairment or signs of delirium were further differentiated by informal care status. Low triage acuity (CTAS 4 or 5) was also a good candidate node to differentiate ED patients with cognitive impairment, but it was less discriminant and clinically meaningful than informal care status. Patients with no informal support were at higher risk of ALC/LTC compared to patients with informal caregivers. Impaired locomotion, an early loss ADL, differentiated patients with cognitive impairment and no informal support. Informal caregiver distress was the best node to differentiate older ED patients with cognitive impairment and informal caregivers. Impairment in personal hygiene, a later loss ADL, differentiated older patients with cognitive impairment and distressed informal care. Among those with impairment in personal hygiene, living alone further differentiated risk of ALC/LTC. Older ED patients with cognitive impairment and no signs of caregiver distress were further differentiated by self-reported health and needing assistance to manage medications, sequentially (see Figure 4-3).

Traumatic injury, falls, and symptoms of depression further differentiated older ED patients with any existing ADL impairment. Older ED patients with new impairment in any ADLs as well as those age 85 or older were further differentiated by informal caregiver status. Specifically, ED patients with no informal care or whose informal caregivers are distressed were at higher risk of ALC/LTC in both model branches (see Figure 4-3). Traumatic injury was a candidate node to differentiate ED patients with existing ADL impairment and durable informal support, but it was not significant. Falls was also a candidate node to further differentiate older ED patients younger than age 85, but it too did not reach the 95% significance level.

The proportion of ED patients triggered in each leaf of the *ALC/LTC Model* was inconsistent; the majority of the derivation sample was clustered at the lower levels of the raw decision-tree model as well as the lower levels of each route node branch. The plotted class-level odds ratios for *ALC/LTC Model* leaves had a rapid, stepped progression throughout the hierarchical *ALC/LTC Model*, achieving an odds ratio point estimate of over 128 in its peak risk level. However, each class-level odds ratio estimate had a wide 95% confidence interval (see Figure 4-4). Leaf numbers were collapsed into 5 levels of differentiation, and scored hierarchically from the lowest level (see Table 4-2).

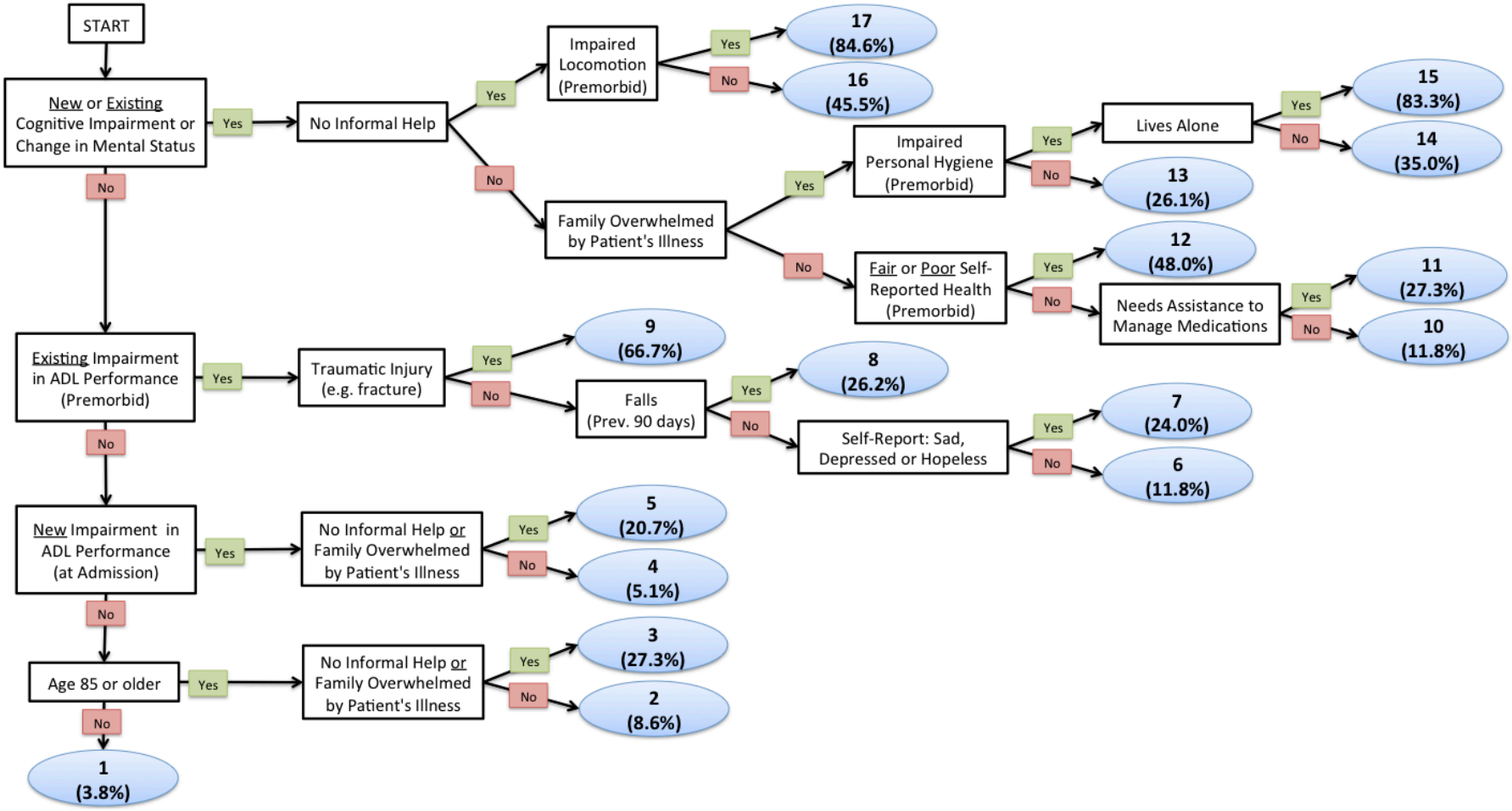


Figure 4-3: **Raw *ALC/LTC Model*, ALC Designation or Discharge to a LTC facility, among admitted ED patients, MOPED Study, Derivation Sample Partition (N=647)**

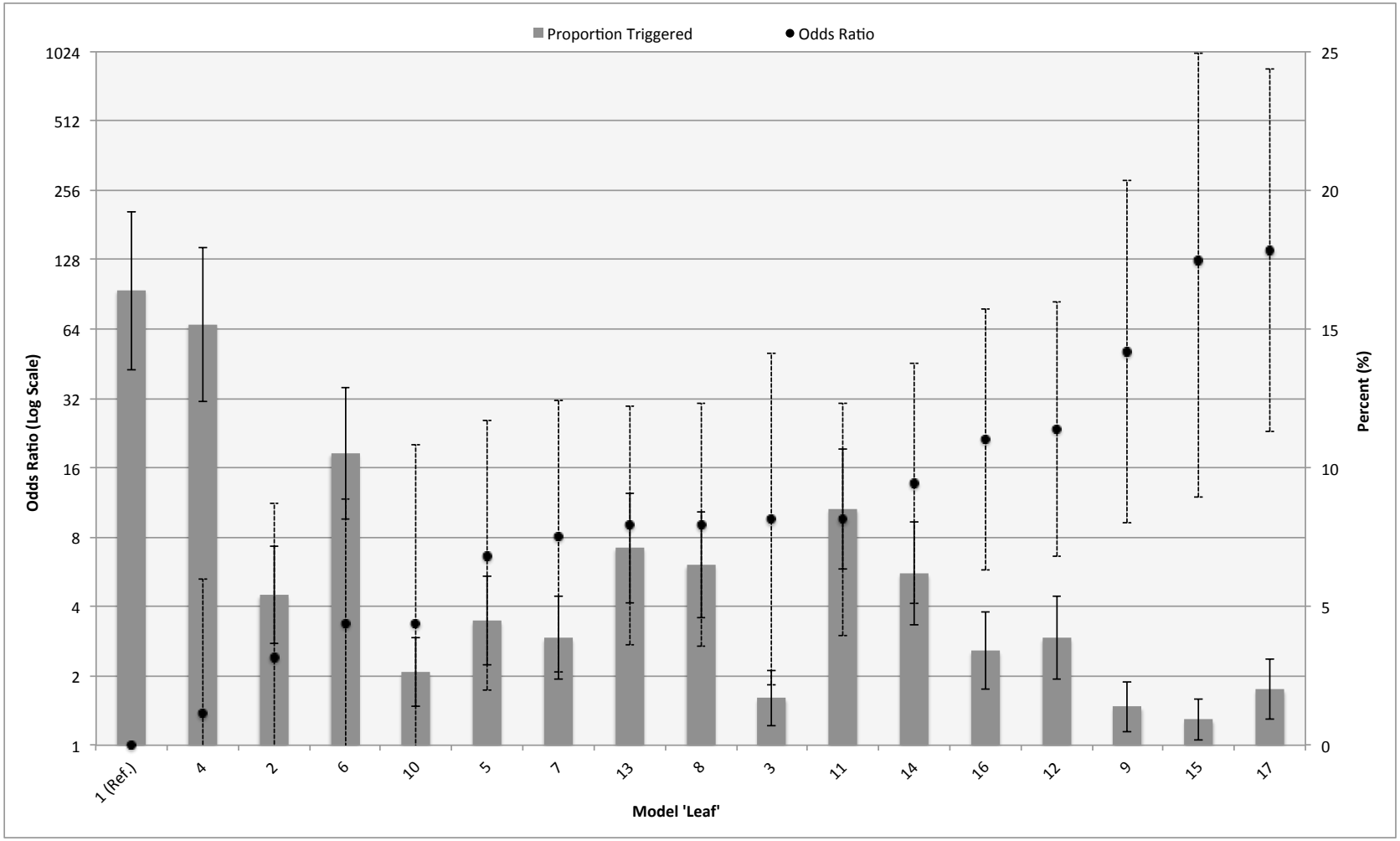


Figure 4-4: **Odds Ratios and Proportion Triggered for each Raw *ALC/LTC Model* Leaf, ALC Designation or Discharge to LTC, among admitted ED patients, MOPED Study, Derivation Sample Partition (N=647)**

Table 4-2: **Scoring of *ALC/LTC Model* Leaves, ALC Designation or Discharge to a LTC facility, among admitted ED patients, MOPED Study, Derivation Sample Partition (N=647)**

Model Score	Model 'Leaf' Numbers
5	9,15,17
4	16,12
3	14
2	5, 7, 13, 8, 3, 11
1	1, 4, 2, 6, 10

The *ALC/LTC Model* had fairly consistent hierarchical structures across the decision-tree branches as well as leaves within each branch. Each route node branch contained the lowest hierarchical strata of the model (see Figure 4-5). The class-level odds ratios for each score in the *ALC/LTC Model* generally increased rapidly through the model score hierarchy for both the primary composite and secondary discrete dependent variables. However, the increases in odds ratio estimates between model scores were not significant. Also, there was little observed risk separation between scores 2 and 3 with respect to LTC placement. The slopes of the odds ratio plot for the secondary discrete dependent variables were similar overall, except that the middle of the *ALC/LTC Model* hierarchy performed better with ALC designations and the top of the hierarchy performed better with LTC placements. The distribution of clients across the *ALC/LTC Model* was positively skewed (see Figures 4-6 and 4-7).

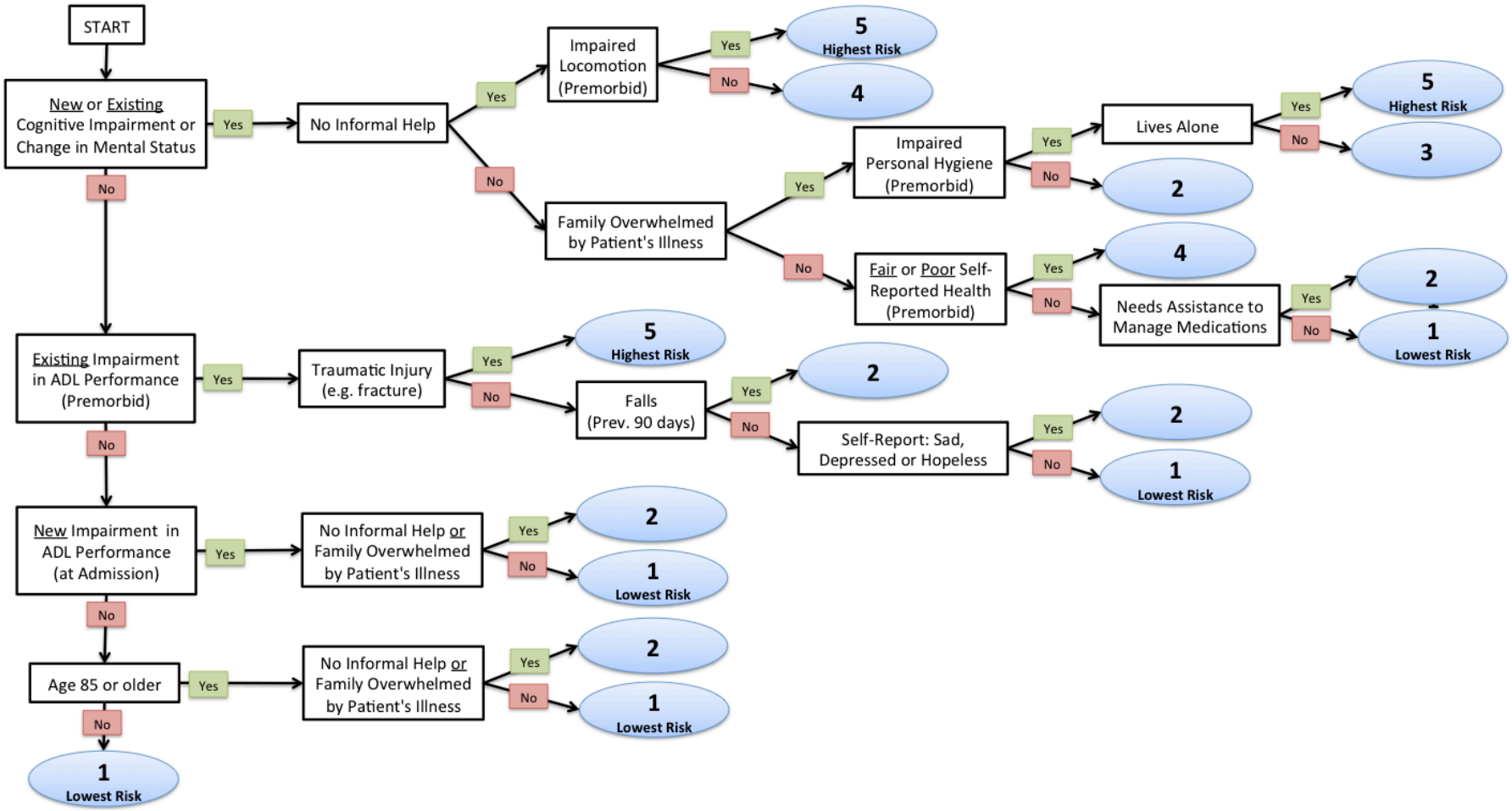


Figure 4-5: ***ALC/LTC Model*, ALC Designation or Discharge to LTC, among admitted ED patients, MOPED Study, Derivation Sample Partition (N=647)**

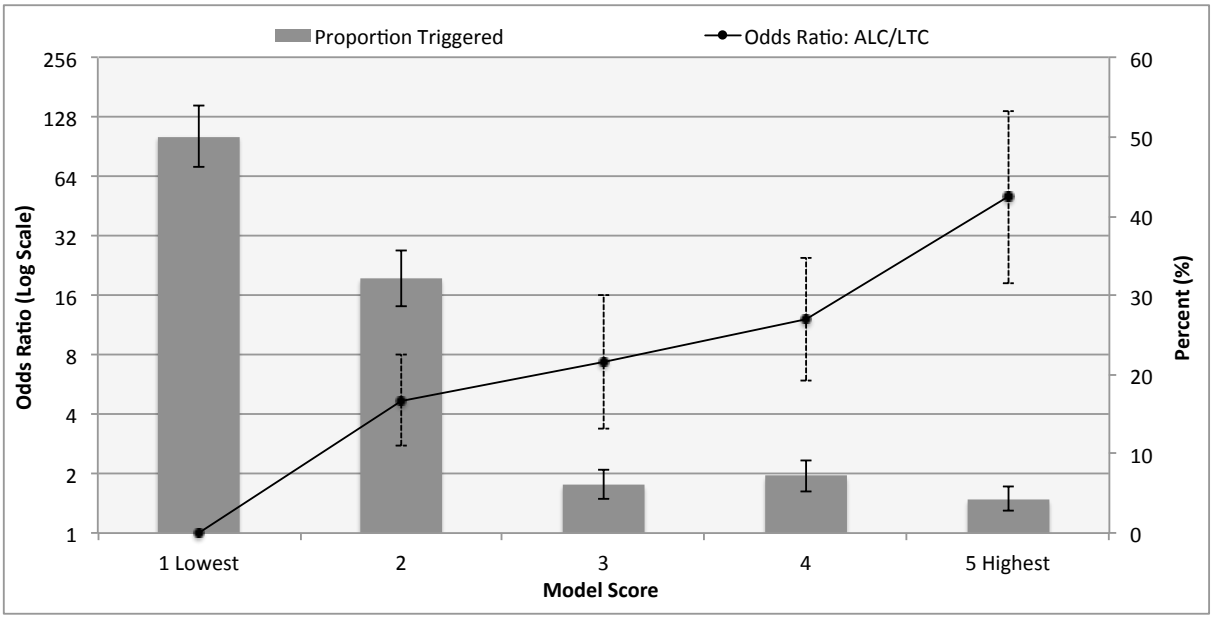


Figure 4-6: **Odds Ratios and Proportion Triggered, Scored *ALC/LTC Model*, ALC Designation or Discharge to a LTC facility, among admitted ED patients, MOPED Study, Derivation Sample Partition (N=647)**

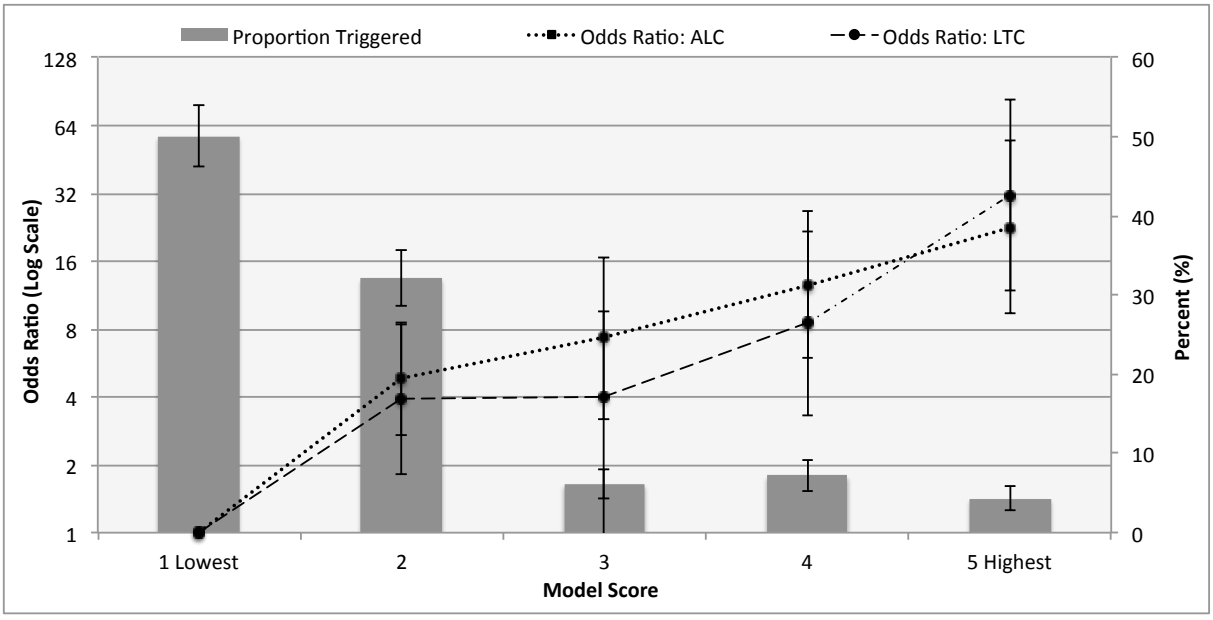


Figure 4-7: **Odds Ratios and Proportion Triggered, Scored Model, ALC Designation and Discharge to a LTC facility, among admitted ED patients, MOPED Study, Derivation Sample Partition (N=647)**

The class-level odds ratios and AUCs between the derivation and validation sample were not significantly different, but had a good level of consistency. The only notable divergence in the performance between derivation and validation occurred for risk level 4, where it had a weaker odds ratio in the validation partition. The overall accuracy of the *ALC/LTC Model* in both partitions was good. Also, the odds ratios were highly significant in both the derivation and validation partitions ($p<0.01$). The Hosmer and Lemeshow Goodness-of-Fit Test did not achieve significance in either sample partition, indicating a well-calibrated model (see Table 4-3). The deviance residual plots within the derivation and validation partitions showed even distributions (see Appendices CC and DD). The plot showing the proportion triggered and proportion with an ALC designation or LTC placement within each model risk level corroborated the ALC/LTC Model's consistency and accuracy in both sample partitions. The positively skewed distribution of the *ALC/LTC Model* showed good overall negative prediction and clinical utility (see Figure 4-8).

Table 4-3: ***ALC/LTC Model*** **Validation, ALC Designation or Discharge to a LTC facility, among admitted ED patients, Derivation and Validation Sample Partition, MOPED Study**

	Derivation (N=647)		**Validation (N=436)**	
Model Score	**OR**	**95% CI**	**OR**	**95% CI**
5	50.32	(18.49 - 136.92)	43.90	(13.10 - 147.02)
4	12.10	(5.90 - 24.77)	6.83	(3.00 - 15.57)
3	7.39	(3.39 - 16.14)	5.12	(1.85 - 14.16)
2	4.70	(2.75 - 8.00)	4.36	(2.35 - 8.10)
1 (reference)	1.00		1.00	
AUC (95%CI)	**0.76 (0.72 - 0.81)**		**0.74 (0.69 - 0.79)**	
Goodness-of-Fit Test`	**Chi-sq=0.00, p=0.99**		**Chi-sq=0.00, p=0.99**	

OR = Odds Ratio
AUC = receiver operating characteristic (ROC) area under the curve (AUC)
`Hosmer and Lemeshow Goodness-of-Fit Test

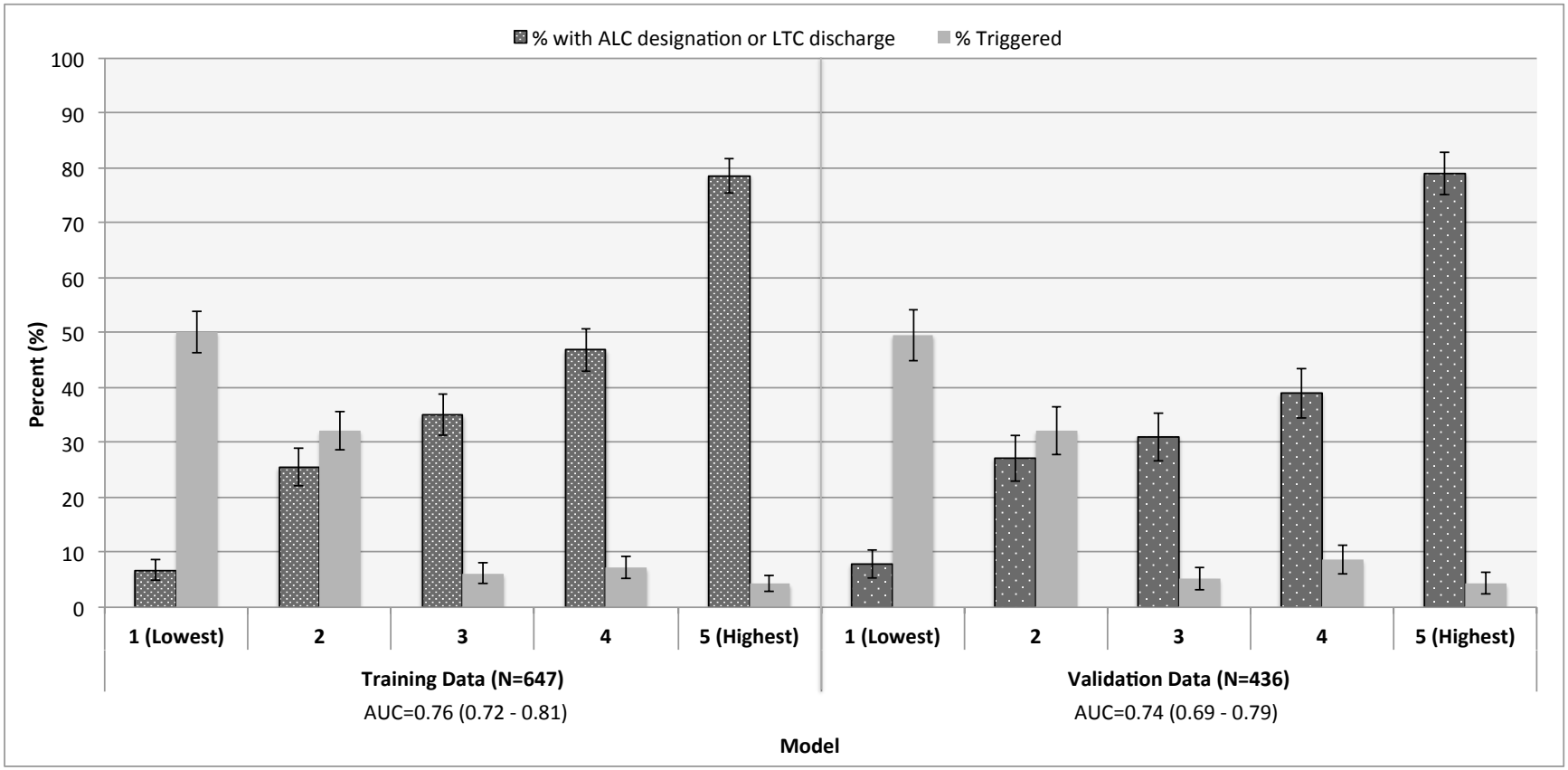


Figure 4-8: **Comparing the Performance of the *ALC/LTC Model* in Derivation and Validation Samples, ALC Designation or Discharge to a LTC facility, among admitted ED patients, MOPED Study**

Overall, the class-level odds ratios between the standard logistic and multilevel *ALC/LTC Models* were very similar. There was some moderation in the discriminatory power of risk levels 3 to 5, and particularly risk level 3. However, these differences did not achieve significance despite that some hospital sites contributed small samples. The overall consistency between the standard and multilevel models suggested that the *ALC/LTC Model* was generalizable across hospital sites with different outcome rates (see Table 4-4).

Table 4-4: **Multilevel Generalized *ALC/LTC Model* (by Hospital Site), MOPED Study (N=1,083)**

	Conventional Logistic			Multilevel Logistic		
Model Score	**OR**	**95% CI**	**p**	**OR**	**95% CI**	**p**
5	47.52	(22.00 - 102.71)	<0.01	44.87	(24.07 - 83.64)	<0.01
4	9.44	(5.50 - 16.19)	<0.01	9.73	(6.88 - 13.74)	<0.01
3	6.42	(3.47 - 11.90)	<0.01	5.20	(3.86 - 7.01)	<0.01
2	4.55	(3.04 - 6.81)	<0.01	4.29	(2.84 - 6.50)	<0.01
1 (reference)	1.00			1.00		

OR = Odds Ratio

4.4.2 Phase 2: The Risk of Unplanned Repeat ED Visits among Older ED Patients Discharged back to the Community

A total of 875 (43.0 ±2.1%) community-dwelling patient cases were discharged back to the community following their ED visit. Overall, 39.5% (±3.2%) had one or more unplanned repeat ED visits within 90 days, and 17.1% (±2.9%) had one or more unplanned repeat ED visits within 30 days (see Figure 4-9). The prevalence of one or more unplanned repeat ED visits within 90 days and 30 days varied somewhat across hospital sites - varying from 30% (±10.0%; RUH) to 51% (±13.7%; SAGH) within 90 days, and from 19% (±15.1%; RJH) to 39% (±13.4%; SAGH) within 30 days. Despite moderate variability in estimated prevalence, the confidence intervals suggested that there was little true variability in unplanned repeat ED visits across sites. The relative difference between repeat ED visits within 90 days and 30 days within each hospital site was consistent across sites (see Figure 4-10).

The number of repeat ED visits within 90 days varied from 0 to 13. Approximately one-quarter of older ED patients discharged back home had one repeat ED visit, close to 1 in 10 had 2 repeat visits, and close to 1 in 20 had repeat 3 visits within 90 days of initial discharge. Having greater than 4 or more unplanned repeat ED visits with 90 days was rare (see Figure 4-11). The absolute risk of unplanned repeat ED visits from initial ED discharge was higher in the first 30 days, and particularly in the 7-day period after ED discharge. Approximately 13%, 25%, and 30% of older ED patients had an unplanned repeat ED visit within 7 days, 30 days, and 60 days, respectively (see Figure 4-12).

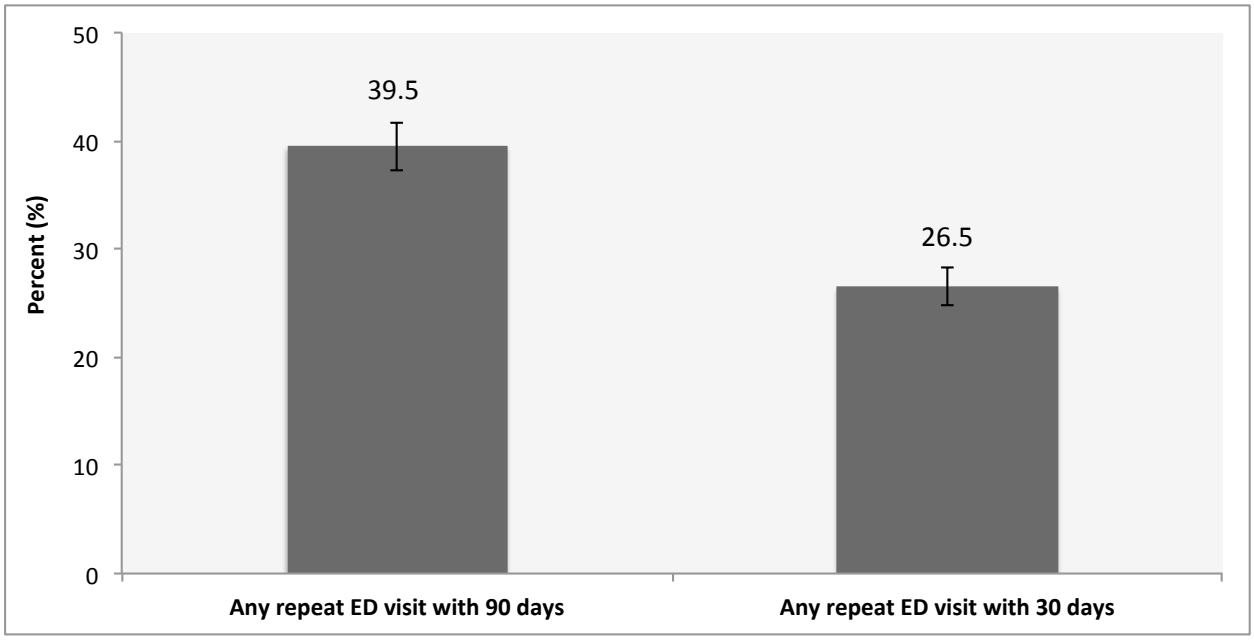


Figure 4-9: **Selected Adverse Outcomes among ED Patients Discharged to a Private Dwelling, MOPED Study (N=875)**

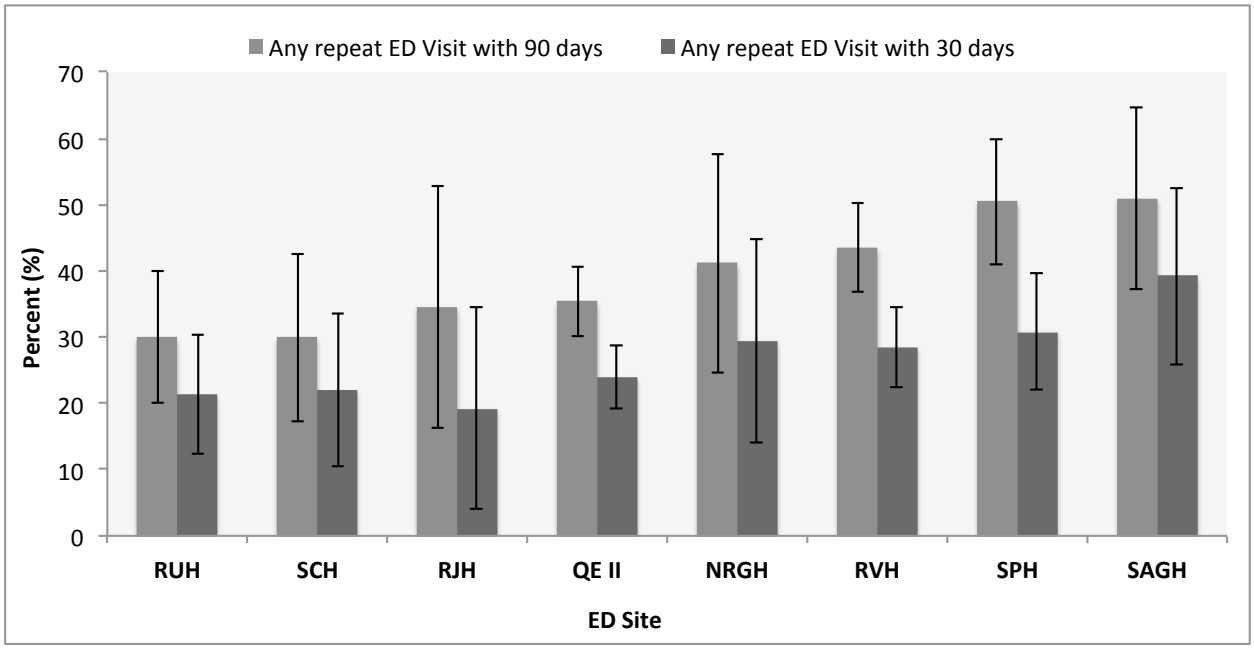


Figure 4-10: **Selected Adverse Outcomes among ED Patients Discharged to a Private Dwelling by Hospital Site, MOPED Study (N=875)**

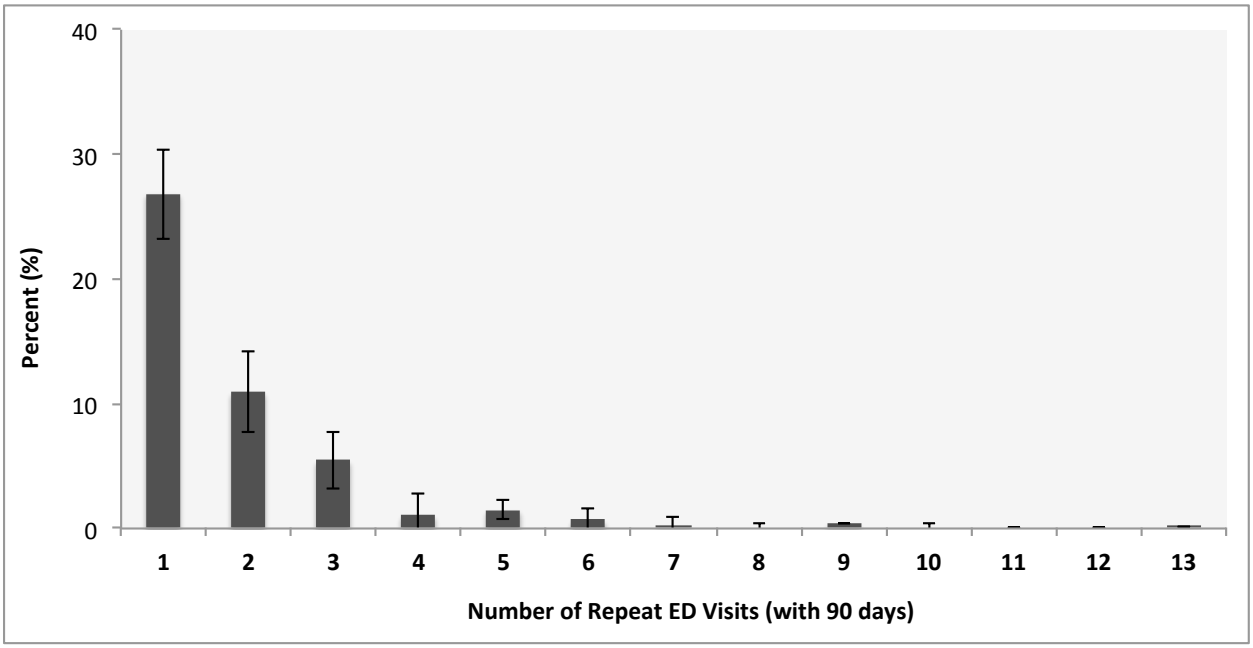


Figure 4-11: **Distribution of Revisits to the ED within 90 days of Discharge, Among ED Patients Discharged to a Private Dwelling, MOPED Study (N=875)**

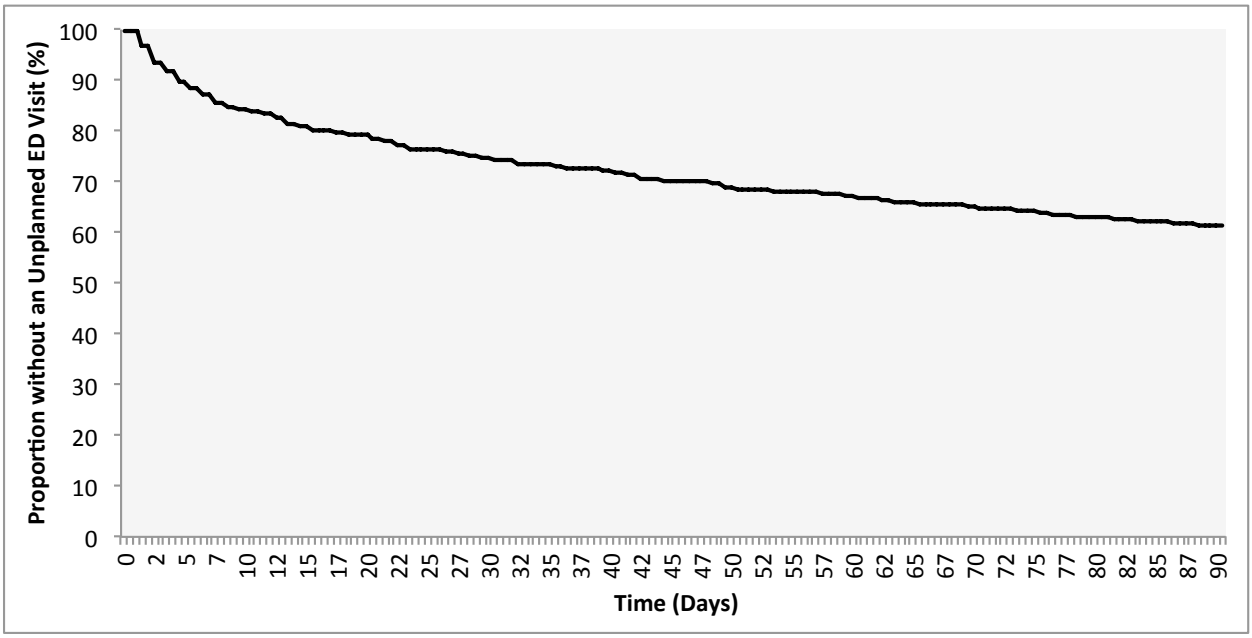


Figure 4-12: **Kaplan-Meier Survival Curve for First Revisit to the ED within 90 days of Discharge, Among ED Patients Discharged to a Private Dwelling, MOPED Study (N=875)**

Overall, 523 and 352 MOPED cases discharged back to the community were partitioned for decision-tree derivation and validation, respectively. The final decision-tree *ED Revisit Model* contained 10 leaves, where the proportion of community discharge cases with an unplanned repeat ED visit within 90 days of initial ED discharge varied from 29.0% (leaf #1) to 66.7% (leaf #10) (see Figure 4-13).

Consistent with chapter 2, the amount of previous ED or hospital utilization in the previous 90 days showed the highest discriminatory power, as well as the best ability to organize the decision-tree relative to other candidate root nodes (e.g., functional status, symptoms). Older ED patients who had one or more previous ED visits or hospitalizations were approximately 1.5 times more likely to have an unplanned repeat ED visit within 90 days. Existing ADL impairment further differentiated ED patients with one or more previous ED visits or hospitalizations. Neither new ADL impairment nor cognitive impairment showed any significant effect on repeat ED use. ED patients with previous ED visits or hospitalizations and with existing ADL impairment were further differentiated by anhedonia. Those without anhedonia were differentiated by dyspnea. Premorbid poor self-reported health and previous falls sequentially differentiated patients with previous ED visits or hospitalizations, but without existing ADL impairment (see Figure 4-13).

Existing ADL impairment also provided the best node to further differentiation of older ED patients with no previous ED visits or hospitalizations. ED patients without previous ED visits or hospitalizations, but with existing ADL impairment, were further differentiated by previous falls. Those with neither previous ED visits or hospitalizations nor existing ADL impairment were differentiated by unstable cognition, ADL, mood, or behavior (see Figure 4-13). Premorbid fair or poor self-reported health was a candidate node to further differentiate ED patients without previous ED visits, hospitalizations, and ADL impairment, but it did not achieve 95% probability.

The majority of the derivation sample was clustered at the lower levels of the *ED Revisit Model* as well as the lower levels of each route node branch. The plotted class-level odds ratios of the *ED Revisit Model* leaves had a rapid, stepped progression throughout the hierarchical *ED Revisit Model*, achieving a maximum odds ratio of over 16. However, the progressions between each class-level odds ratio estimate did not achieve 95% probability (see Figure 4-14). Leaf numbers were collapsed into 5 levels of differentiation and scored hierarchically from the lowest level (see Table 4-5).

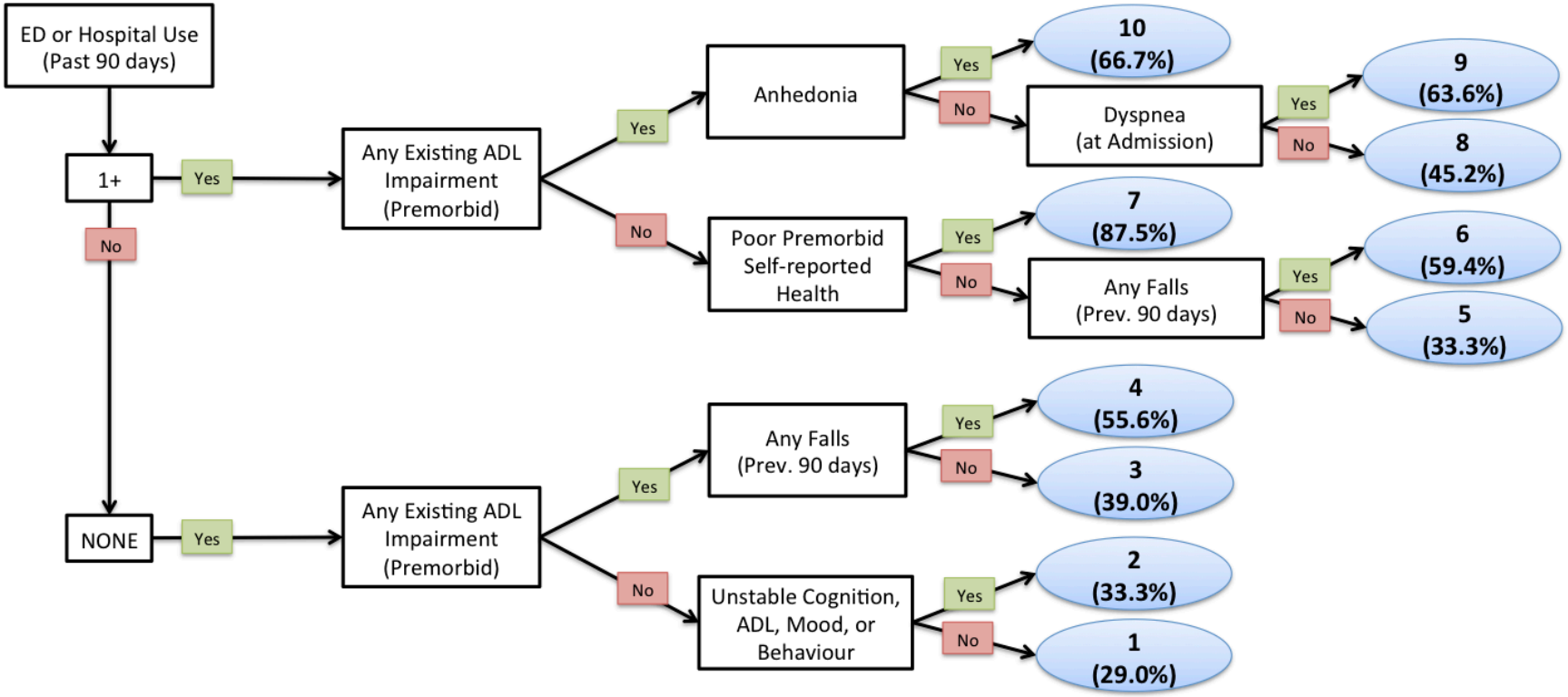


Figure 4-13: **Raw *ED Revisit Model*, Any Revisit to the ED within 90 days of Discharge, among ED Patients Discharged to a Private Dwelling, MOPED Study, Derivation Sample Partition (N=523)**

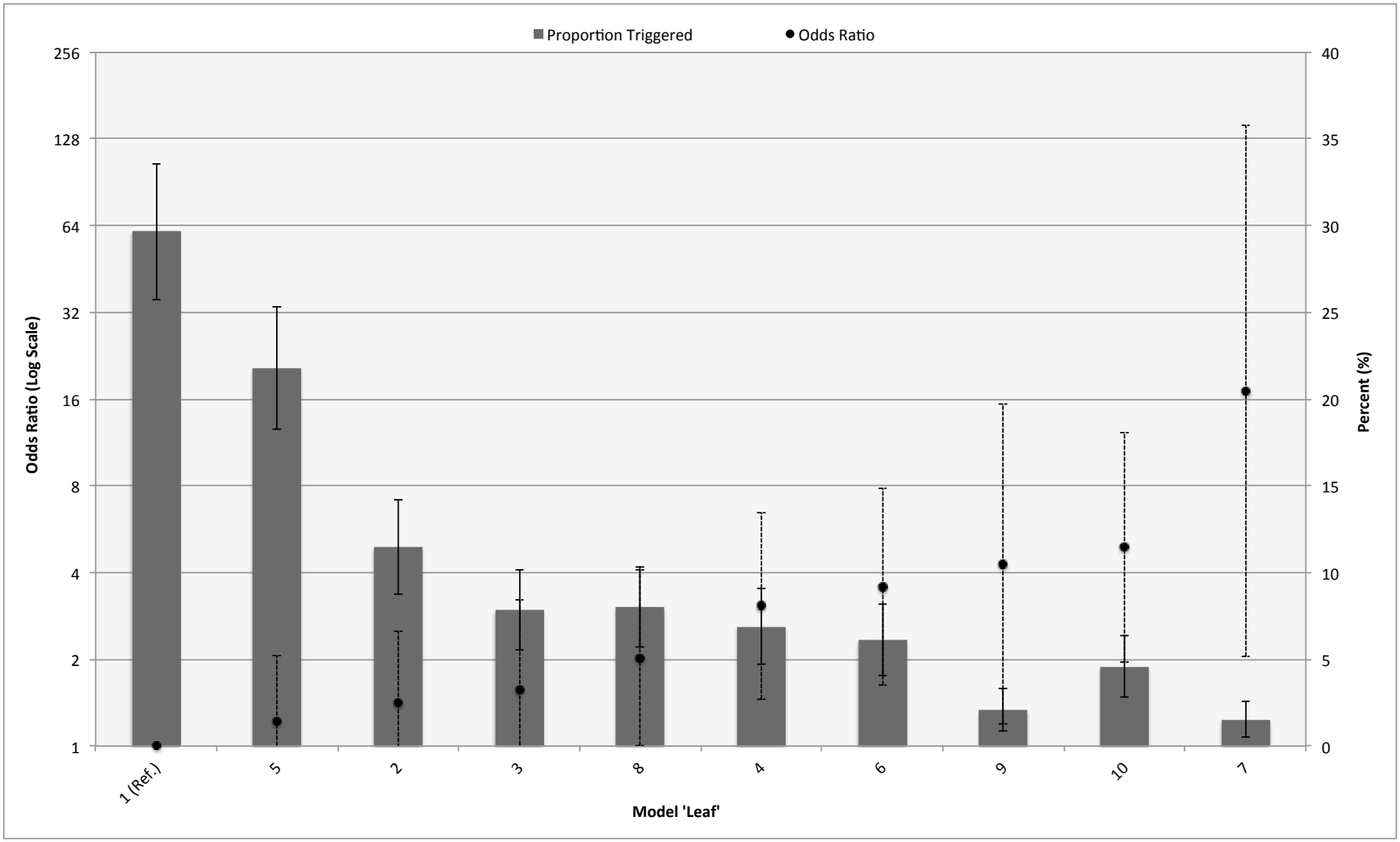


Figure 4-14: **Odds Ratios and Proportion Triggered for each Raw *ED Revisit Model* Leaf, Any Revisit to the ED within 90 days of Discharge, among ED Patients Discharged to a Private Dwelling, MOPED Study, Derivation Sample Partition (N=523)**

Table 4-5: **Scoring of *ED Revisit Model* Leaves, Any Revisit to the ED within 90 days of Discharge, among ED Patients Discharged to a Private Dwelling, MOPED Study, Derivation Sample Partition (N=523)**

Model Score	Model 'Leaf' Numbers
5	10,7
4	6,9
3	8,4
2	5,2,3
1	1

The *ED Revisit Model* had consistent hierarchical organization between the decision-tree branches and leaves in each branch. Each route node branch contained the lowest hierarchical level of the scored model (see Figure 4-15). The class-level odds ratios in the scored *ED Revisit Model* increased consistently throughout the model score hierarchy for repeat ED visits within 90 days and somewhat consistently within 30 days. However, the increases in odds ratio estimates between adjacent model risk levels were not significant. Particularly, there was relatively little risk differentiation between risk levels 1 and 2 for repeat ED visits with 90 day, and also between risk levels 2 and 3 for repeat ED visits with 30 day. The slopes of the odds ratio plot for repeat ED visits within 90 days and 30 days were similar overall, but slightly higher for repeat ED visits within 90 days. The distribution of clients across the *ED Revisit Model* was positively skewed; over 60% of ED patients were in the lowest two risk levels (see Figures 4-16 and 4-17). The Kaplan-Meier survival curve for days to first unplanned repeat ED visit exhibited clear differentiation between the highest and lowest *ED Revisit Model* scores within 30 days, whereas the middle risk levels did not differentiate risk. All *ED Revisit Model* risk levels clearly differentiated risk beyond 30 days post discharge. Clients who scored '1' had a 28% risk of repeat ED visits at 90 days compared to 71% for clients with a score of '5'. ED patients who scored 5 on the *ED Revisit Model* had an almost 40% chance of repeat ED visit within 7 days of ED discharge (see Figure 4-18).

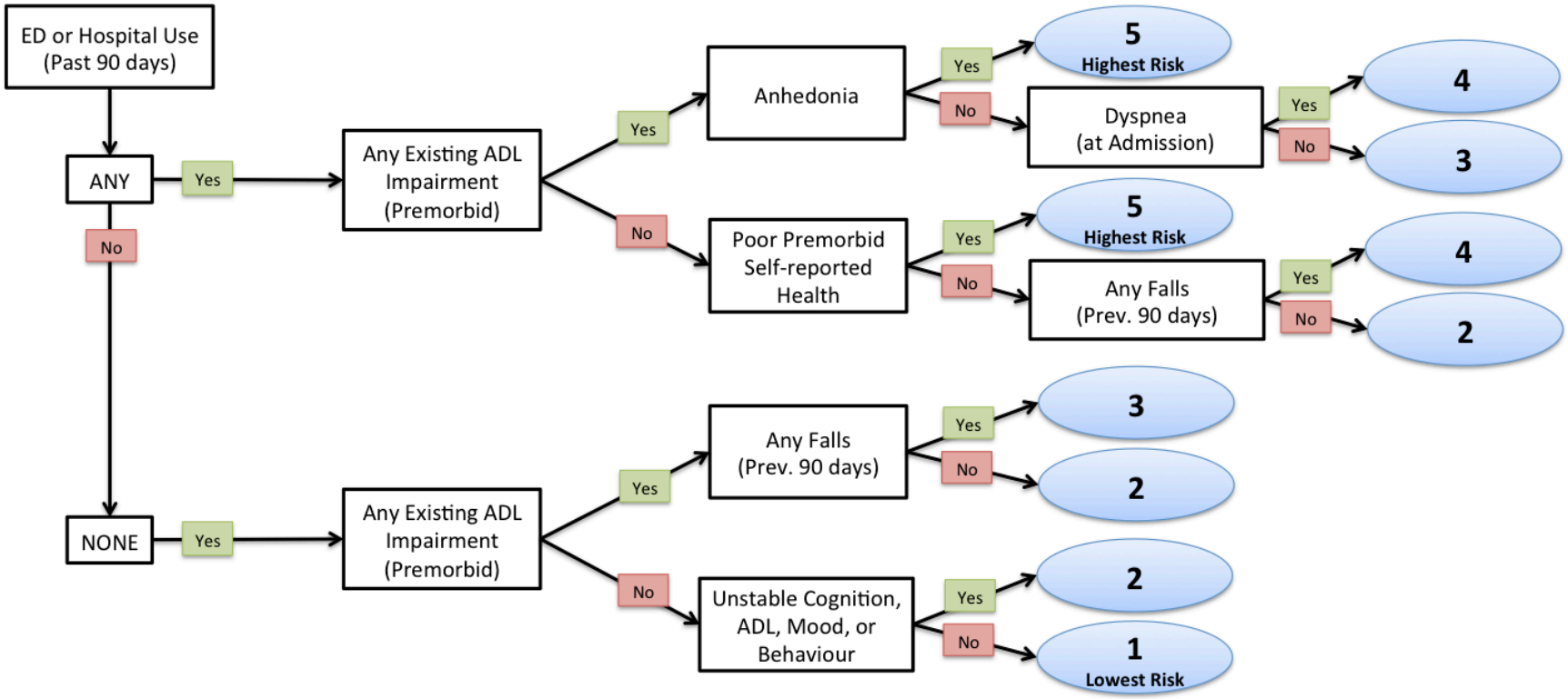


Figure 4-15: ***ED Revisit Model*, Any Revisit to the ED within 90 days of Discharge, among ED Patients Discharged to a Private Dwelling, MOPED Study, Derivation Sample Partition (N=523)**

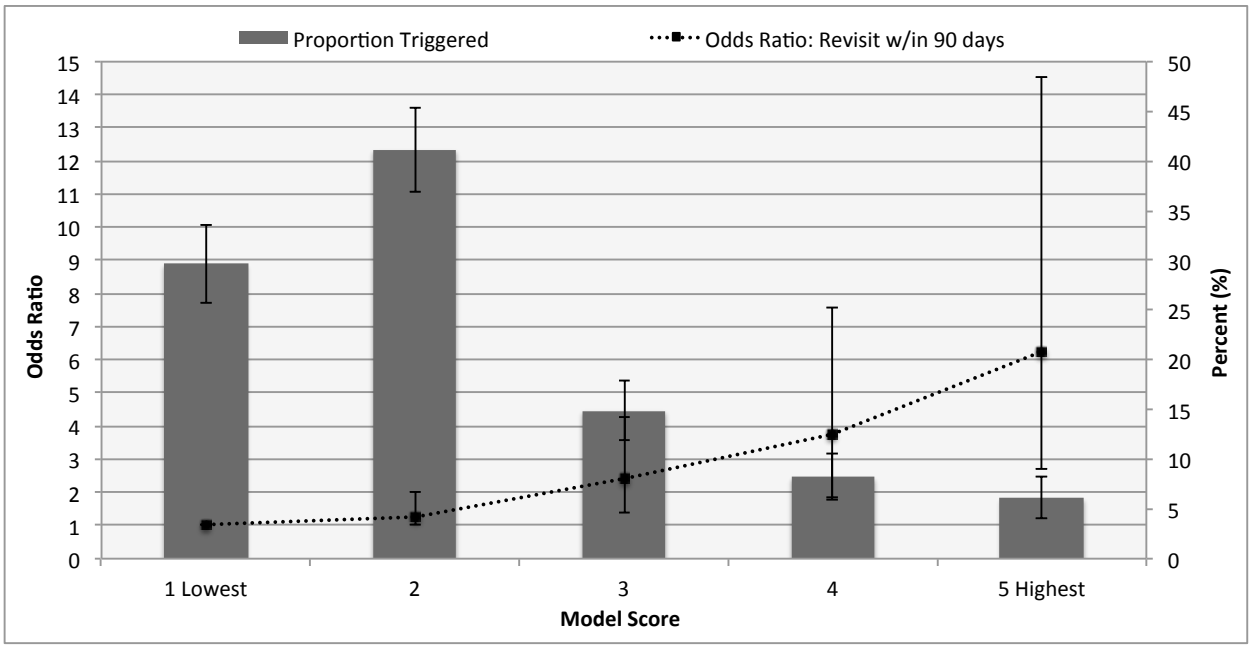


Figure 4-16: **Odds Ratios and Proportion Triggered, Scored *ED Revisit Model*, Any Revisit to the ED within 90 days of Discharge, among ED Patients Discharged to a Private Dwelling, MOPED Study, Derivation Sample Partition (N=523)**

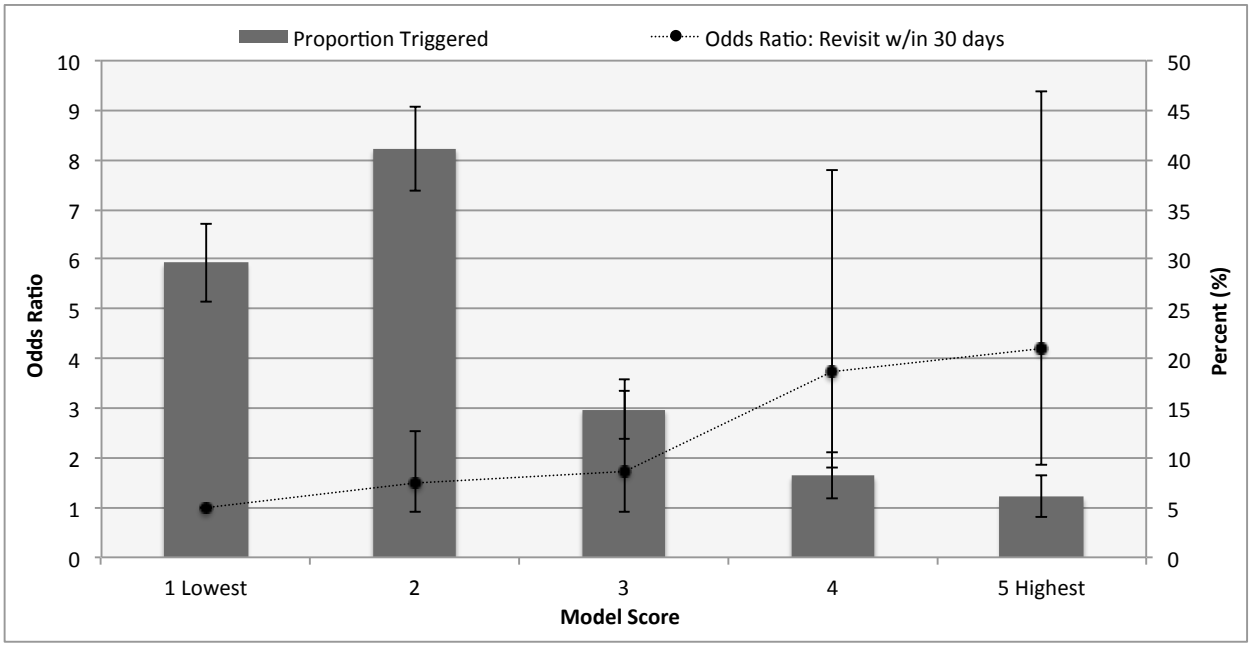


Figure 4-17: **Odds Ratios and Proportion Triggered, Scored Model, Any Revisit to the ED within 30 days of Discharge, among ED Patients Discharged to a Private Dwelling, MOPED Study, Derivation Sample Partition (N=352)**

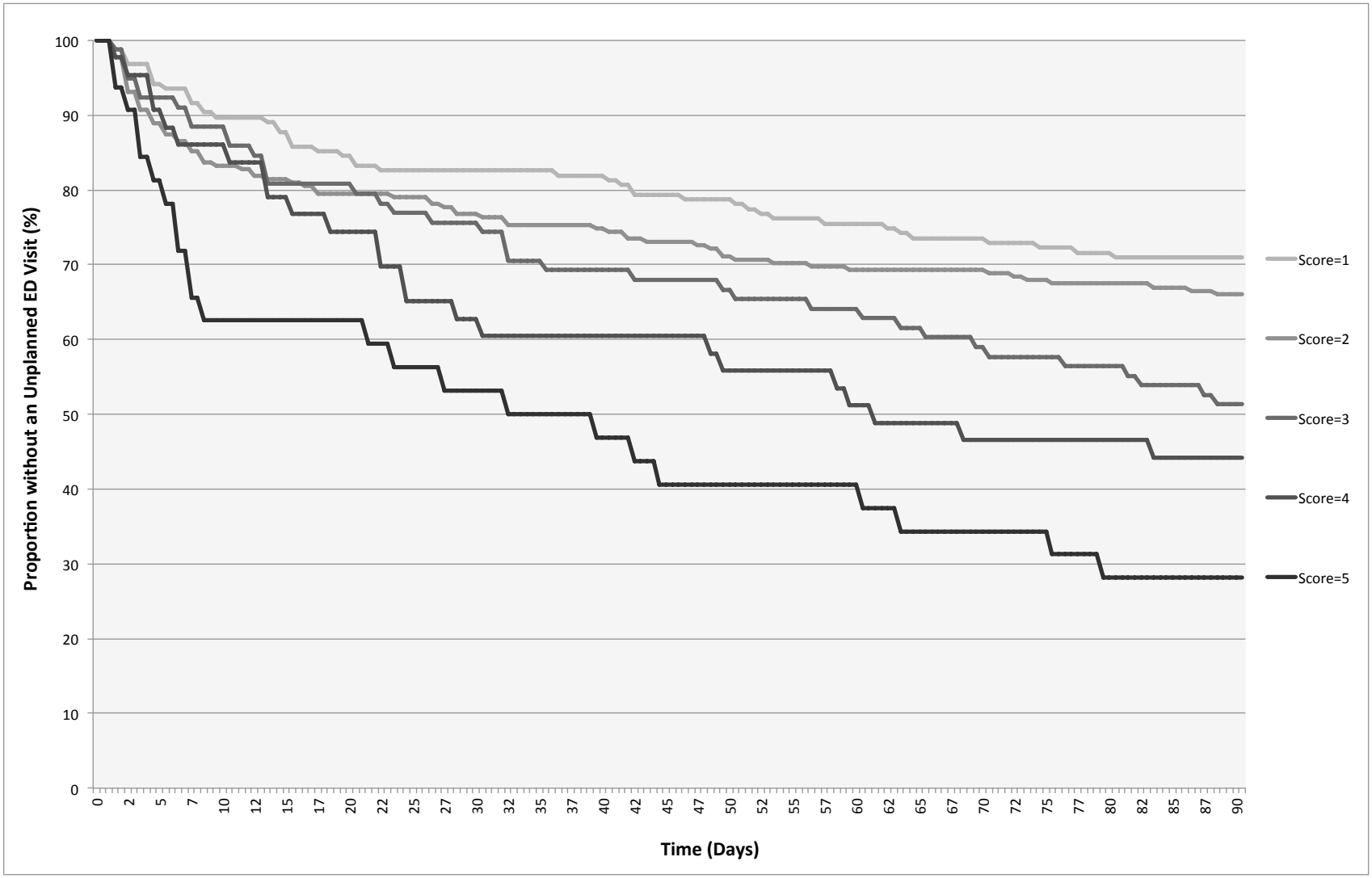


Figure 4-18: **Kaplan-Meier Survival Curve for Any Revisit to the ED within 90 days of Discharge among ED Patients Discharged to a Private Dwelling, by *ED Revisit Model*, MOPED Study, Derivation Sample Partition (N=523)**

The class-level odds ratios and AUCs between the derivation and validation samples were not significantly different, but did increase in the validation partition. The most notable differences in the performance between derivation and validation occurred for risk levels 4 and 5. The accuracy of the *ED Revisit Model* in the derivation partition was fair; whereas the accuracy in the validation partition was fair to good. With exception to score 2 in the derivation partition, the odds ratios were highly significant ($p<0.01$). However, the *ED Revisit Model* score 2 did was highly significant in the 30-day secondary dependent variable. The Hosmer and Lemeshow Goodness-of-Fit Test did not achieve significance in either sample partition, indicating that the *ED Revisit Model* was well calibrated (see Table 4-6). The deviance residual plots within the derivation and validation partitions showed even distributions (see Appendices FF and GG). The Kaplan-Meier survival curve for days to first unplanned repeat ED visit using the validation sample partition showed good proportional differentiation except for scores 4 and 5 after 7 days post discharge (see Figure 4-19).

Table 4-6: ***ED Revisit Model*** **Validation, Any Revisit to the ED within 90 days of Discharge, among ED Patients Discharged to a Private Dwelling, Derivation and Validation Sample Partition, MOPED Study**

	Derivation (N=523)		**Validation (N=352)**	
Model Score	**OR**	**95% CI**	**OR**	**95% CI**
5	6.25	(2.68 - 14.54)	12.04	(4.82 - 30.09)
4	3.74	(1.85 - 7.55)	7.64	(3.20 - 18.26)
3	2.44	(1.39 - 4.29)	2.93	(1.34 - 6.40)
2	*1.28	(0.92 - 2.01)	2.50	(1.35 - 4.63)
1 (reference)	1.00		1.00	
AUC (95%CI)	**0.63 (0.59 - 0.68)**		**0.69 (0.63 - 0.74)**	
Goodness-of-Fit Test`	**Chi-sq=0.00, p=1.00**		**Chi-sq=0.00, p=1.00**	

OR = Odds Ratio
AUC = receiver operating characteristic (ROC) area under the curve (AUC)
`Hosmer and Lemeshow Goodness-of-Fit Test
* Did not achieve 95% significance

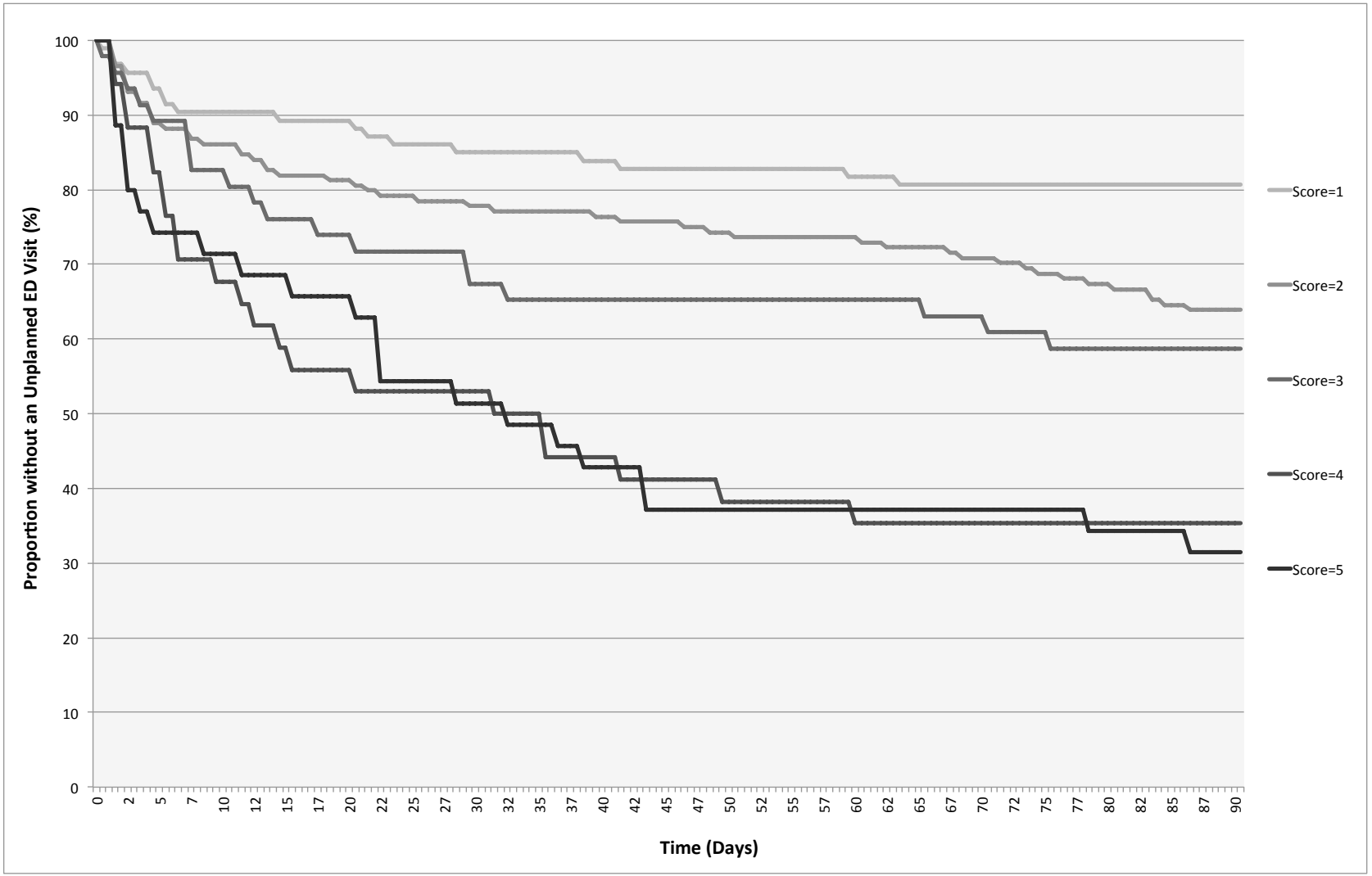


Figure 4-19: **Kaplan-Meier Survival Curve for Any Revisit to the ED within 90 days of Discharge among ED Patients Discharged to a Private Dwelling, by *ED Revisit Model*, MOPED Study, Validation Sample Partition (N=352)**

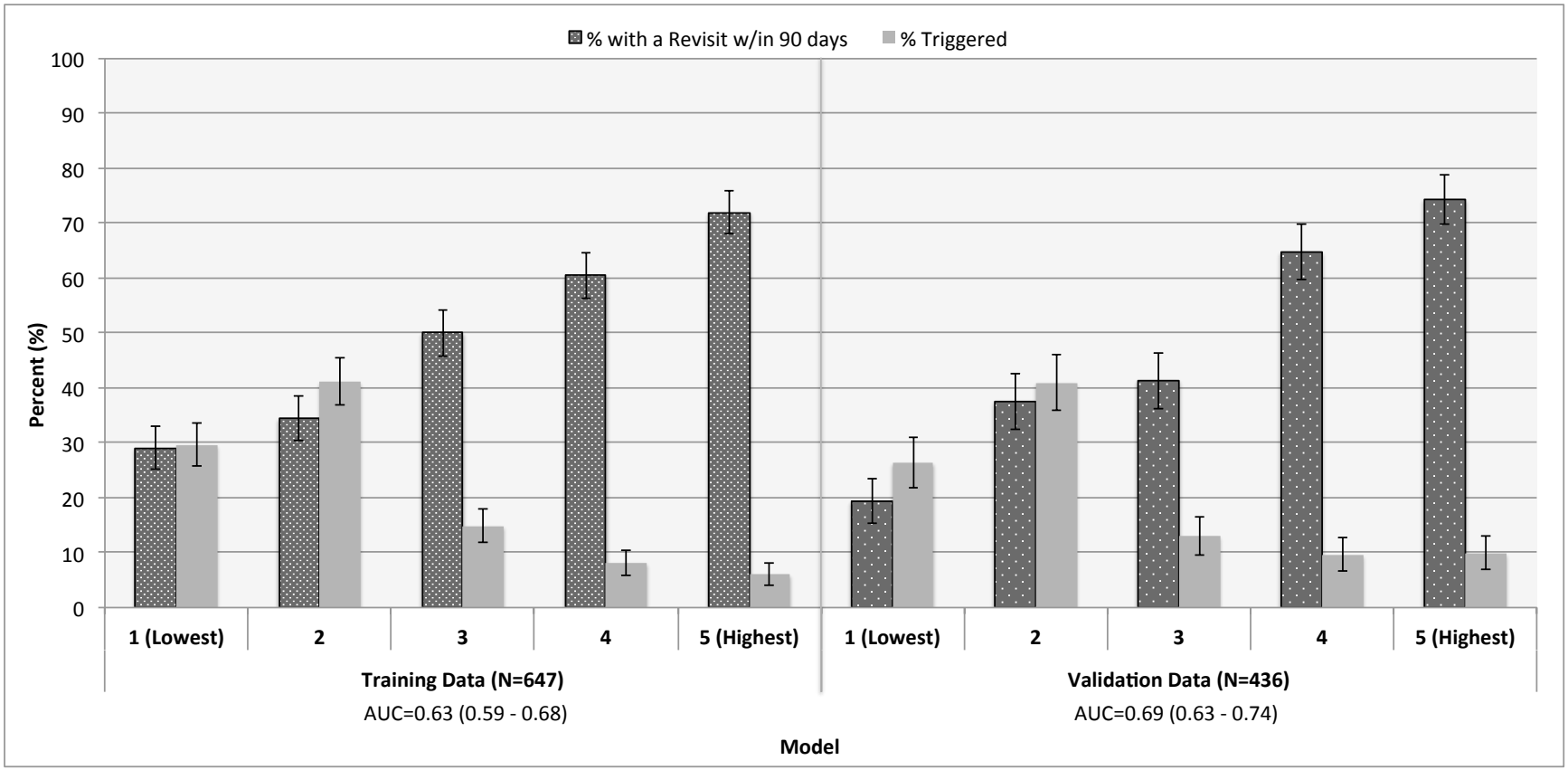


Figure 4-20: **Comparing the Performance of the *ED Revisit Model* in Derivation and Validation Samples, Any Revisit to the ED within 90 days of Discharge, among ED Patients Discharged to a Private Dwelling, MOPED Study**

The plot showing the distribution of the *ED Revisit Model* and proportion with a repeat ED visits within each risk strata corroborated the Model's general consistency and accuracy in both sample partitions. The *ED Revisit Model* had similar negative and positive prediction to the *ED Model* in chapter 1 (see Figure 4-20). The class-level odds ratios between the standard logistic and multilevel *ED Revisit Model*s were almost identical. The consistency between the standard and multilevel models suggested that the *ED Revisit Model* was generalizable across the hospital sites included in the MOPED Study (see Table 4-7).

Table 4-7: **Multilevel Generalized *ED Revisit Model* (by Hospital Site), MOPED Study (N=875)**

	Conventional Logistic			Multilevel Logistic		
Model Score	**OR**	**95% CI**	**p**	**OR**	**95% CI**	**p**
5	8.00	(4.34 - 14.73)	<0.01	7.75	(5.57 - 10.79)	<0.01
4	4.86	(2.83 - 8.36)	<0.01	4.90	(3.91 - 6.14)	<0.01
3	2.58	(1.64 - 4.06)	<0.01	2.55	(2.03 - 3.21)	<0.01
2	1.63	(1.14 - 2.33)	<0.01	1.60	(1.15 - 2.24)	<0.01
1 (reference)	1.00			1.00		

OR = Odds Ratio

4.5 DISCUSSION

The MOPED Study addressed a large gap in the literature by comprehensively and discretely examining the determinants of post discharge adverse outcomes for older ED patients who were admitted to acute care and discharged home. Again, the use of a large multi-site, multi-jurisdiction sample with more clinically representative recruitment methods was a unique element to the MOPED Study. Particularly, the large sample size allowed for analyses by discharge pathway as well as a true validation of each model's performance. The conceptual and practical implications of the *ALC/LTC Model* and the *ED Revisits Model* are discussed separately.

4.5.1 Conceptual Implications

4.5.1.1 *ALC/LTC Model*

Notwithstanding some variance across ED sites, one in five ED patients admitted to acute care had either an ALC designation or LTC placement. This suggests that ALC designation or LTC placement are not rare outcomes in most hospitals. Findings from the ALC/LTC decision-tree analyses provide a fairly precise, visual representation of the person-level determinants of ALC/LTC among older ED patients admitted to acute care. Overall, it indicates that cognitive and ADL functions, and particularly premorbid function, as well as informal care status are the predominant determinants of ALC/LTC among admitted ED patients.

That potential delirium or cognitive impairment was the first model root node indicates that cognitive impairment, either new or preexisting, is the major predictor of both ALC designation and LTC placement. The *Admission Model* also established that ED patients with cognitive impairment were more likely to be admitted. Consistent with the need for admission, cognitive impairment can severely limit independence and often necessitates discharge to supported or institutional settings given that many community living options require some ability to direct care. The time needed to arrange adequate community-based supportive care or LTC placement contributes to ALC. The reduced likelihood of a safe discharge back to the community as well as greater informal care distress likely underlies the strong relationship between cognition and ALC/LTC. The predictive validity of cognitive impairment is consistent with the high prevalence of cognitive impairment among ALC patients waiting for LTC placement in Ontario (Costa & Hirdes, 2010).

The *ALC/LTC Model* indicates that a large number of indicators of disability and frailty influence on ALC/LTC risk among admitted patients with cognitive impairment. Informal care status substantially moderated the risk of ALC/LTC among ED patients admitted with cognitive impairment. Specifically, ED patients with no informal care and those with informal caregiver distress were at a higher risk compared to those without caregiver distress. Older ED patients who had cognitive impairment and no informal care were further differentiated by premorbid impairment in locomotion. The inability to ambulate in their home indicates a more precarious living arrangement that, regardless of recovery, is unlikely to resume after admission to acute care. The inability to ambulate may also reflect more advanced stages of dementia. Those who could ambulate in their home were at considerably less risk given their comparatively good ADL capacity and, perhaps, milder cognitive illness. Similar to impairment in locomotion, older ED patients with distressed informal care were differentiated by premorbid impairment in personal hygiene. The inability to perform personal hygiene – a later loss ADL – implies that the patient has advanced functional impairment and, therefore, much greater informal care requirements. Premorbid impairment in personal hygiene likely reflects the severity of informal care distress in those already providing high levels of informal care. A patient living alone in addition to having cognitive impairment, caregiver distress, and a higher informal care requirement is in an even more precarious living arrangement that is unlikely to persist after an acute admission. The inability of informal caregivers to accommodate them in a community-based environment likely accounts these older ED patients' particularly high risk for LTC placement. Persistently fair or poor self-reported health differentiated those without informal care distress, and likely reflects precarious or declining health or mood. The inability to manage medications independently further differentiated cognitively impaired patients who had intact informal care and good self-reported health. The inability to manage medications suggests a lower capacity for self-care, and perhaps more advanced cognitive impairment relative to those who are independent in medication management. The relatively few admitted ED patients who were negative for all modifiers were at the lowest risk level in the *ALC/LTC Model*.

Preexisting ADL impairment was the second most predictive root node in the *ALC/LTC Model.* Consistent with the effects of preexisting ADL impairments and other modifiers in the cognition branch, preexisting ADL impairment for admitted ED patients was more discriminant than new

ADL impairment or the combination of new and preexisting ADL impairments. This result is not surprising given that patients with persistent ADL impairment are less likely to recuperate relative to those with new ADL impairments. Also, evidence suggests that older inpatients with premorbid ADL impairment are more likely to acquire new ADL impairments during their acute episode (Lakhan et al., 2011). Traumatic injury differentiated admitted ED patients with preexisting ADL impairment. Falls are a common cause of injury among older adults (Carter & Gupta, 2008; Dove & Dave, 1986; Singal et al., 1992). Fractures, and particularly hip fractures, likely underlie the relationship between traumatic injury and ALC/LTC among those with preexisting ADL impairment. Older adults with chronic conditions and gait disturbances are at higher risk of hip fractures. Also, patients presenting with a hip fracture and comorbidities are at higher risk of surgical and non-surgical complications (Collins, Mallett, & Altman, 2011). The combination of preexisting ADL impairment, surgery, stress, infection, and prolonged immobility likely causes greater institutionalization or the need to wait for rehabilitation. Non-traumatic falls also differentiated admitted ED patients with preexisting ADL impairment. Falls are well-known indicators of frailty (Tinetti et al., 1994), and their influence in the A*LC/LTC Model* likely reflects the severity of premorbid conditions and impairments, as well as the greater potential for distress among informal caregivers. Admitted ED patients with symptoms of depression had a very similar risk profile as those with falls. Consistent with the *ED Model* in chapter 2, mood was shown to substantially moderate the effect of functional impairment. Many more patients in the premorbid ADL impairment branch were at the lowest level of ALC/LTC risk compared to ED patients captured in the cognitive impairment branch.

New ADL impairment was the third root node to differentiate admitted ED patients' likelihood of ALC/LTC. New ADL impairment implies a serious change in patient status that might reflect the severity of acute illness and a declining functional trajectory. A lack of informal support or informal care distress substantially modified the risk of ALC/LTC among patients admitted with new ADL impairment. The severity of new impairments as well as the preexisting fragility of informal care may account for the observed relationship. Admitted patients age 85 or older had a similar risk profile to those with new ADL impairment. The undifferentiated effect of age likely reflects early-stage frailty not accounted for in the previous root nodes. Such frailty may predispose a patient to complications during acute treatment, or may interact with acute

illnesses. The effect of age without documented functional impairment may also represent ageism, and specifically a preconceived notion that patients of advanced age are expected to require higher levels of care upon discharge. Again, informal care status substantially modified ALC/LTC risk. The effect of informal care status likely reflects the severity of preexisting illnesses that did not affect function, non-traumatic events (e.g., falls, syncope, cardiovascular incident), or an extreme fragility in informal care. The combination of acute illness, early-stage frailty, ageism, and brittle informal support is a scenario that could explain a predisposition to ALC/LTC. None of the hypotheses regarding the underlying risk pathways in the *ALC/LTC Model* could be tested, and require additional investigation.

The multilevel *ALC/LTC Model* showed no site-level effect despite markedly different prevalence of ALC/LTC between ED sites. This suggests that the influence of the person-level determinants in the *ALC/LTC Model* is consistent, but the prevalence of determinants varies widely across hospitals. The generalizability of the *ALC/LTC Model* across hospitals with different resources, policies, and locations is somewhat surprising. A very large academic center, small community hospitals, and regional hospitals are represented in the MOPED Study. The stability of the *ALC/LTC Model* suggests that existing hospital practices and resources do not modify the risk pathways identified in the *ALC/LTC Model*.

4.5.1.2 *ED Revisit Model*

The prevalence of the unplanned repeat ED use within 30 days and 90 days of discharge from the ED was fairly consistent between ED sites, and slightly higher than the prevalence estimates reported in the literature (Fan et al., 2006; Graf et al., 2012; Hustey et al., 2007; McCusker et al., 2000; McCusker et al., 1997; Moons et al., 2007; Rosenfeld et al., 1990; Rowland et al., 1990). Also, the higher absolute risk of unplanned repeat ED visits within seven and 30 days, respectively, suggests that many repeat ED visits likely reflect similar complaints or underlying conditions that initiated the index ED visit.

The *ED Revisit Model* provides a visual representation of the determinants and pathways that drive unplanned repeat ED use among older adults discharged to the community. Overall, the model indicates that previous ED or hospital use, preexisting ADL impairment, mood, falls, and chronic disease symptoms drive repeat ED use. The *ED Revisit Model* articulates similar risk

pathways that were suggested in the profile of older adults stratified by previous ED or hospital use. Namely, preexisting ADL impairment, negative mood symptoms, poor self-reported health, and dyspnea are *ED Revisit Model* nodes that were also significantly more likely among ED patients with previous ED or hospital use. In addition, the *ED Revisit Model* resembles a stepwise regression model reported by McCusker et al. (2000) that included heart disease, previous use, depression, and alcohol use.

Consistent with chapter 2's *ED Model*, previous ED or hospital use provided the most discriminant root node in the decision-tree analyses. Previous ED or hospital use was also found to be a powerful predictor in the ED geriatric screening literature (Dendukuri et al., 2004; Fan et al., 2006; McCusker et al., 1999; Meldon et al., 2003; Moons et al., 2007). Previous use may reflect unresolved complaints, unmeasured conditions and symptoms, as well as predisposing and enabling factors (e.g., access, preferences). Preexisting ADL impairment differentiated ED patients regardless of previous ED or hospital visits. This was consistent with the profile of older ED patients stratified by previous ED or hospital use in chapter 3. Preexisting ADL impairment may reflect a combination of risk pathways. First, it might reflect persistent declines, unmet need, and frailty. Secondly, the predictive power of preexisting ADL impairments, rather than cognitive impairment or new ADL impairment, may represent a sample bias. Given that ED patients with cognitive impairment or new ADL impairment are more likely to be admitted, it is plausible that those who are instead discharged home are unique cases that have a high likelihood of problem resolution.

Anhedonia differentiated the risk for unplanned repeat ED visits among older ED patients with previous ED and hospital visits and preexisting ADL impairment. The moderating effect of mood on ADL impairment is also seen in the *ED Model* and the *ALC/LTC Model*. However, anhendonia is a prominent symptom of more advanced mental illness, including major depressive disorders (Tune, 2001). Evidence suggests that mental illness is the most common diagnosis among older adults with frequent ED visits (Brokaw & Zaraa, 1991). ED patients without anhendonia were differentiated by dyspnea. Dyspnea combined with preexisting ADL impairment is likely to be a distressing event. Consistent with the *ED Model* in chapter 2, dyspnea often reflects underlying cardio-respiratory conditions that are difficult to manage, and have been found to be major drivers of ED use among older adults (Carter & Gupta, 2008; Dove & Dave, 1986; Downing &

Wilson, 2005; Ettinger et al., 1987; Lishner et al., 2000; Singal et al., 1992). Patients who had previous ED or hospital use but no existing ADL impairment were differentiated by preexisting poor self-reported health. Self-reported health is a crucial component of care seeking behavior, evidenced by the high likelihood of repeat ED use in the *ED Revisit Model*. Its use in the model is plausible given that ED use is largely elective, and that personal need factors are strong predictors for unplanned use. Preexisting poor self-reported health may be a reflection of the low rates of problem resolution reported in the literature (Denman et al., 1989; Hedges et al., 1992; Watson et al., 1999).

Falls in the previous 90 days differentiated older ED patients' risk of unplanned repeat ED visits in both of the root node branches. Previous falls likely represents underlying frailty and the instability of conditions. Older ED patients presenting to the ED with falls are more likely than non-fallers to have a history of cardiac conditions, osteoarthritis, osteoporosis, macular degeneration, and cataracts (Davies, Steen, & Kenny, 2001; Miller et al., 2009; Murray, Hill, Phillips, & Waterston, 2005; Salter et al., 2006). Older adults with previous ED or hospital use and falls, but with preexisting ADL impairment of poor self-report, are likely to be more unstable that non-fallers. Older ED patients with preexisting ADL impairment and previous falls, but without previous ED or hospital use, are likely to be more frail relative to those without previous falls. Unstable cognition, ADL, mood, or behavior slightly differentiated older ED patients who were discharged home but who had neither previous ED or hospital use nor preexisting ADL impairment. This relatively undifferentiated node suggests low-level instability that, without adequate management, would predispose an older ED patient to a proximate repeat ED visits. None of these hypotheses could have been addressed in this study and require more investigation.

Consistent with the *ED Model* and the *ALC/LTC Model*, the *ED Revisit Model* performed consistently across ED sites. Also, the accuracy of the *ED Revisit Model* was similar to the *ED Model* in chapter 2. Consistent with results in chapter 2, the stochastic nature of unplanned ED visits influences the accuracy of any prediction model. Also, the ability to modify the risk pathways identified in the *ED Revisit Model* is uncertain given that ED site level factors, such as existing protocols and resources, do not seem to influence the *ED Revisit Model* across sites.

4.5.2 Practical Implications

Chapter 3 showed that triage-based paradigms in the ED, though highly appropriate for prioritizing the acuity of presenting complaints, appear less suited to the identification and prioritization of disability and complex conditions. This investigation on the predictive pathways that drive ALC/LTC and repeat ED use suggests that recognizable characteristics among older ED patients can be used to prioritize the likelihood of post-discharge adverse outcomes, with moderate to good accuracy, across different hospitals and in different Canadian jurisdictions. The pathways identified in the *ALC/LTC Model* and the *ED Revisit Model* also identify unmet care needs that may partly explain the poor resolution rates reported in the literature (Denman et al., 1989; Hedges et al., 1992; Watson et al., 1999). The results also provide additional evidence for the use of geriatric screening and assessment in the ED. Particularly, the *ALC/LTC Model* and the *ED Revisit Model* demonstrate the predictive validity of items in the interRAI ED-CA. The predominance of premorbid indicators in the interRAI ED-CA is unique, and has been shown in the *ALC/LTC* and *ED Revisit Models* to be highly relevant for risk determination, and therefore, the initiation of a care plan. The utility of pre-morbid information to predict outcomes among older patients is consistent with the acute inpatient geriatrics literature (Jónsson et al., 2008).

Timely discharge is complicated for vulnerable older ED patients given the unstable dynamics between the ED and inpatient acute care as well as primary and community-based care. The use of the *ALC/LTC Model* and the *ED Revisit Model* within the interRAI ED-CA can help prioritize ED patients whose care ED clinicians are working to integrate with one of more sectors of the health care system. The use of separate risk tools for separate discharge pathways provides more precise risk measurement and profiling. This may help ED clinicians target specific resources for patients who will be admitted or discharged back to the community. Beyond the identification of risk, older ED patients are vulnerable to poor transitional care from errors or gaps in communication between the ED and adjacent health care sectors (Cwinn et al., 2009; Stiell, Forster, Stiell, & van Walraven, 2003). Utilizing detailed results from the *ALC/LTC Model* and the *ED Revisit Model,* a summary of the interRAI ED-CA can be shared with clinicians in inpatient acute care, community-based supportive care, or primary care to communicate risk profile and outcome relevant patient information. The visual nature of the models can be leveraged to produce care guidelines for patients defined within each model leaf. The use of the *ALC/LTC* and

ED Revisit Models for communication can prevent adverse events associated with poorly executed transitions. The use of the *ALC/LTC* and *ED Revisit Models* for communication during care transitions can be particularly useful in situations where there isn't a compatible interRAI assessment in the sector accepting the referral.

The accuracy of the *ALC/LTC Model* and the *ED Revisit Model* suggests they are useful for case identification at the point of care. The *ALC/LTC Model* has very good negative prediction given that close to 50% of admitted ED patients trigger at the lowest risk level where less than 10% become ALC/LTC. The model also has fairly good positive prediction given that the two highest levels identify less than 10% subsets where close to 80% and 40% become ALC/LTC, respectively. Similarly, the *ED Revisit Model* has fairly good negative prediction given that close to 30% of patients trigger at the lowest risk level where between 20 and 30% have repeat visit within 90 days. The *ED Revisit Model* also has very good positive prediction given that the two highest risk levels trigger at the rate of approximately 10% where just over 70% and 80% have repeat visits within 90 days. That both models trigger small patient subsets at higher levels allows each ED to prioritize their fluctuating resources on manageable numbers of cases.

Case identification is only useful to the extent that the causes of adverse outcomes can be resolved by intervention. Studies broadly suggest that effective ED-initiated interventions already exist and can be employed to reduce the risk of adverse post-discharge outcomes among older ED patients (Caplan et al., 2004; Ellis, Whitehead, O'Neill, Langhorne, & Robinson, 2011; McCusker et al., 2003, 2001; Mion, Palmer, Anetzberger, & Meldon, 2001; Runciman et al., 1996; Tan et al., 2012). These approaches typically combine advanced-practice nurse discharge planning as well as follow-up by inpatient specialized geriatric services or community-based primary care and supportive care. Beyond risk stratification, the use of a visual grouping methodology for the *ALC/LTC* and *ED Revisit Models* optimizes their use for staff education on the risk pathways that drive adverse post discharge outcomes across common ED dispositions. Given that atypical presentations, multi-morbidity, and polypharmacy often confound medical diagnosis (Singal et al., 1992; Wofford et al., 1993), the recognition of influential geriatric features included in the *ALC/LTC* and *ED Revisit Model*s may also prove useful for therapeutic decisions in the ED.

The prevention of ALC/LTC is in the best interest of ED clinicians given that inpatient bed shortages are the greatest contributing factor to ED overcrowding (Canadian Association of

Emergency Physicians, 2003; Estey et al., 2003; Kollek, 2002; Schull et al., 2003; Schull et al., 2003; Upfold, 2002; Vermeulen et al., 2009). The *ALC/LTC Model* can be used within the interRAI ED-CA to target inpatient interventions aimed at preventing the determinants identified in the model. Improved coordination between the ED and acute inpatient care is needed in order to identify and address older patients who are at high risk for ALC/LTC. As mentioned in chapter 3, older ED patients who are at elevated risk of ALC/LTC, but medically stable, could detour inpatient acute care and be admitted directly into post-acute geriatric assessment and rehabilitation units (Somme et al., 2011). However, the onset of new geriatric syndromes, deterioration in independence, and decreased discharge potential in acute care also should be addressed for the benefit of older patients who require acute admission (Creditor, 1993; Lakhan et al., 2011). Acute inpatient comprehensive geriatric assessment systems already exist to improve the quality of care provided to older patients (Gray et al., 2009, 2008). The *ALC/LTC Model* can be used to help target the use of comprehensive geriatric assessment, and particularly to initiate such assessment early in the inpatient stay. The interRAI ED-CA assessment information can also be used to trigger specialized geriatric services as well as shared with geriatric assessment teams to reduce the burden of subsequent assessment. The use of targeted comprehensive geriatric assessment is essential given that it has been shown to reduce the risk of institutionalization as well as other adverse outcomes (Ellis et al., 2011). In addition, the *ALC/LTC Model* could help target admission to elder friendly acute care units that have been shown to prevent additional ADL and cognitive decline among older patients (Inouye et al., 2000; Rubin et al., 2011). Such units employ structural, team, and protocol modifications that are designed to increase socialization, improve orientation, and decrease barriers to ambulation. Similar post-acute ALC units have been described in the literature (Burgin & Schuetz, 1992; Ostry et al., 2004, 2003). The prevalence of cognitive and functional impairment in the *ALC/LTC Model* suggests that elder friendly units can influence the prevalence of ALC/LTC.

The *ALC/LTC Model* also suggests the need for improvement in the management and rehabilitation of older adults that present with traumatic injuries, and particularly fractures. The use of rehabilitation has been shown to reduce delayed discharge rates (Glasby, Littlechild, & Pryce, 2006). Referrals to specialized geriatric services has also been shown to reduce the rate of subsequent falls and fractures among older adults presenting to the ED with falls (Close et al.,

2012). Lastly, co-management of hip fracture patients by orthopedic surgeons and geriatricians has been shown to reduce complications and reduce hospital length of stay (Friedman, Mendelson, Bingham, & Kates, 2009; Kates, Mendelson, & Friedman, 2011; Mazzola et al., 2011). That informal care capacity, and particularly informal care distress, substantially modified many risk pathways in the *ALC/LTC Model* indicates that social work is a crucial element in the prevention of unnecessary ALC/LTC. Early and continuous discharge planning with social work has been shown to reduce ALC length of stay (Rock et al., 1995). Similarly, older patients who are no longer able to live independently can be considered for transitional care programs that will allow them to live in a community-based congregate living arrangement. The *ALC/LTC Model* also identified the need for targeted psychogeriatric services or psychiatric consult services within inpatient acute care, particularly for cognitively intact patients who are experiencing persistent ADL impairment or decline. It is plausible that the investments required to respond to the risk pathways identified in the *ALC/LTC Model* will be offset by the resources that would otherwise be consumed to react to inpatient bed supply crises and opportunity costs from day procedure cancellations (Black & Pearson, 2002).

The *ED Revisit Model* can be used within the interRAI ED-CA to initiate community-based interventions aimed at modifying the risk pathways that drive unplanned, repeat ED use. Overall, the risk pathways identified in the *ED Revisit Model* suggest that mechanisms to identify and intervene for older patients with multiple previous visits are lacking in many EDs. Similarly, preexisting ADL impairment was found to be a significant determinant of repeat ED use. Randomized control trials that evaluated ED-initiated interventions in community-based supportive care, primary care, and geriatric clinic by advanced practice nurses have shown mixed success in reducing repeat ED use, functional decline, and institutionalization (Caplan et al., 2004; Guttman et al., 2004; McCusker et al., 2003, 2001; Mion et al., 2003). Notwithstanding the variability in study designs, the variability of ED-initiated interventions and their deployment does not provide definitive evidence on the best approaches. However, targeted interventions have greater likelihood of producing better outcomes (McCusker & Verdon, 2006; McCusker et al., 2003; Mion et al., 2003). Also, a qualitative review of intervention trials suggests that referral and coordination with community-based supportive care is successful at reducing functional decline and subsequent institutionalization, whereas interventions in primary care (beyond simple

notifications) or through hospital-based outreach teams are best suited to reducing repeat ED and hospital use (Caplan et al., 2004; Guttman et al., 2004; McCusker et al., 2003, 2001; Mion et al., 2003). McCuker et al.'s review (2006) of interventions to reduce repeat ED visits also found that interventions based in primary care were most effective.

The prevalence of past ED or hospital use, ADL impairment, falls, as well as mood and cardio-respiratory symptoms in the *ED Revisit Model* suggests that interventions in both community-based supportive care and primary care are needed. Also, the greater likelihood of repeat ED visits within the first 7 and 30 days post discharge indicates that rapid intervention is often required. interRAI ED-CA information collected in the ED can be shared with home care and community-support providers to integrate into their compatible interRAI assessment systems in order to respond more quickly with service provision. As mentioned in chapter 2, a large Canadian study found that 40% of persons with one or more severe chronic conditions did not have a treatment plan with their primary care provider in over a year (CIHI*,* 2009a). The interRAI ED-CA assessment information can be shared with primary care providers or hospital-based outreach teams to specify the history needed for chronic disease management.

Beyond their use as point of care decision-support tools, the *ALC/LTC Model* and the *ED Revisit Model* may also be used for evaluating and monitoring at the organizational and regional levels. Hospitals, health regions, and quality measurement agencies can use both models to stratify and adjust quality indicators that focus on ALC designations, LTC placements, and repeat ED visits. This method can establish regional benchmarks for performance. High and low model-adjusted performance can be examined to determine how variations in practice and resources between the relevant care partners influence post-discharge adverse outcomes.

4.5.3 Limitations

A few key limitations not already discussed in chapter 3 bear reflection. Namely, the choice of adverse post-discharge outcomes collected in the MOPED study was based on clinical input, feasibility of collection, perceived generalizability, and previous research. However, it should be noted that there is no standard definition of what constitutes an adverse post-discharge outcome for older ED patients. The dependent variables collected in the MOPED study and selected for outcomes variable were similar to those collected and utilized in previous studies. Nonetheless, a

better selection of dependent variables would may have improved the decision-tree analyses. For example, it would have been useful to collect more precise measurements of functional decline. The collection of repeat ED visits for patients discharged back to the community might underestimate the true rate given that repeat ED visits outside of each hospital's region were not be captured. Studies have found that older patient outcomes vary by type of ED site (Borges Da Silva et al., 2012; McCusker et al., 2012a). This suggests that the prevalence estimates reported in this study may not be generalizable across all Canadian hospitals. However, this study's findings suggest that the determinants identified in the *ALC/LTC* and *ED Revisit Models* are unlikely to vary across facility types or alternate sampling timeframes. Larger population samples from implementations of the interRAI ED-CA will help to refine and improve the models.

4.5.4 Future Research

Future research with the *ALC/LTC* and *ED Revisit Models* should focus on examining the descriptive characteristics of older ED patients identified within each model leaf. An understanding of their characteristics would help to develop and refine clinical protocols for those identified as being at higher risk. For example, it would be useful to understand the characteristics of admitted patients with informal care distress and patients who had a traumatic injury to understand what other characteristics are influencing their level of disability. Likewise, it would be useful to understand the profile of older patients discharged home with a history of falls to determine if existing interventions require calibration. Explicit analyses on the relationship between the *ALC/LTC Model*, *ED Revisit Model,* and triage acuity would also represent a useful addition to the ED practice literature. Likewise, a comparison is required to understand to what extent both models outperform existing generalized ED geriatric assessments. The ALC/LTC and ED Revisit Models' performance should be compared to that of the Assessment Urgency Algorithm already embedded in the interRAI ED-CA, which is used by home care agencies to identify persons requiring a RAI-HC assessment. This comparison can be completed with the MOPED data. Alternately, additional prospective studies are necessary to compare the performance of the ALC/LTC and ED Revisit Models to that of commonly used geriatric screeners such as the ISAR and TRST. Comparing performance from estimates reported in the literature is problematic given variations in samples and outcome measures.

Validation studies are also required to understand how well the ALC/LTC and ED Revisit Models predict adverse outcomes among relevant ED patient subgroups, including: patients with outwards signs of frailty, patients with previous falls, patients with mental illness, special subpopulations comparable to those with neurological conditions for whom the underlying relationships among variables like cognitive and ADL impairment may differ compared with the general older population, and patients already receiving community-based supportive care. This research is crucial given that the use of the interRAI ED-CA is likely to be more targeted than the MOPED Study protocol. Validations will determine to what extent the models are generalizable across sub-populations.

Perhaps the most important program of research using the *ALC/LTC* and *ED Revisit Models* will be to conduct randomized control trials to determine the modifiability of post discharge adverse outcomes by one or more interventions. Outcome measures could be controlled for using each model, or changes in expected risk within each model could be used as an outcome measure. This program of research would help to understand which of the identified risk pathways in each model are modifiable when subjected to feasible interventions. For example, the highest risk level in the *ALC/LTC Model* represents a risk pathway that would be difficult to modify. An understanding of the modifiability of each model pathway will help target limited resources toward those who are most likely to show improvement.

Chapter 5

OVERALL DISCUSSION

5.1 Summary

The goal of this dissertation was to support an enhanced role for EDs in the continuum of care for older adults by providing theoretically driven, evidence-based, and practical risk identification methods for clinical practice in home care and the ED. In doing so, this dissertation helped to expand the evidence base on the unplanned use of the ED by home care clients, the profile of older adults in the ED and their discharge, and their outcomes post discharge.

Chapter 2 examined the person-level determinants of unplanned ED use among long-stay home care clients. It established that home care clients, and particularly long-stay clients, account for a non-trivial proportion of unplanned ED visits by older adults. Also, unplanned ED visits were common among long-stay home care clients – occurring in close to two of every five clients within 6 months of an assessment. The *ED Model* showed that cardio-respiratory symptoms and unstable chronic conditions were the main drivers of unplanned ED use among home care clients. Functional disability or informal care status did not factor prominently in the *ED Model.* The risk pathways articulated in the *ED Model* were generalizable across jurisdictions that had varying geography and urbanization. The *ED Model* is a necessary, empirically based decision support system that can be used to identify risk of unplanned ED use, to anticipate disease exacerbations, to target service provision, and to notify and collaborate with primary care. Need based factors, as described by the Andersen Behaviour Model, were the most prominent class of determinants for predicting unplanned ED use, whereas predisposing and enabling factors were modest determinants.

Chapter 3 investigated the profile of older ED patents and examined their person-level determinants of acute inpatient admission. This chapter found that the majority of older ED patients were dependent on others for basic tasks of daily living, and many had fragile informal care or lived alone. Triage acuity appeared unsuited for the identification and prioritization of geriatric disabilities and conditions. Previous ED or hospital use was associated with chronic geriatric disabilities and conditions as well as informal caregiver distress, suggesting that chronic

needs are often unmet and likely drive repeat ED use. The *Admission Model* indicated that multiple divergent factors drive the decision to admit an older ED patient to inpatient acute care, including: acuity, instability, changes in ADL, cognition, nutrition, and anhedonia. The presence of non-acute covariates in the *Admission Model* suggested that strategies are necessary to increase the transitional care capacity of EDs into community-based care, particular for non-acute older ED patients with impaired cognition and mood symptoms.

Chapter 4 examined the determinants of key adverse outcomes post ED discharge including: ALC designation or LTC placement, and unplanned repeat ED visits. Approximately one in every five older ED patients admitted to acute care had an ALC designation or LTC placement. Roughly consistent with previous use reported in chapter 3, two in every five older ED patients discharged back to the community had an unplanned repeat ED visit within 90 days. The *ALC/LTC* and *ED Revisit Models* provided moderately accurate, visual representations of the person-level determinants that drive each outcome. Overall, the *ALC/LTC Model* showed that cognitive and ADL impairment, and particularly premorbid impairment, as well as informal care status were predominant determinants of ALC/LTC among admitted ED patients. The *ALC/LTC Model* was generalizable across MOPED Study ED sites despite their variation in outcomes prevalence. It can be used within the interRAI ED-CA to target and inform inpatient specialized geriatric services and early discharge planning. The *ED Revisit Model* indicated that previous ED or hospital use, preexisting ADL impairment, mood, falls, and chronic disease symptoms drive unplanned repeat ED use consistently across MOPED Study ED sites. The *ED Revisit Model* can be used within the interRAI ED-CA to initiate community-based interventions by supportive care, primary care, and hospital outreach teams.

5.2 Broad Implications for Care

The four multivariate models produced in this dissertation suggest that fairly unique sets of risk factors are associated with the transition into the ED, transition from the ED, and outcomes after the ED visit. The *ED Model* for home care suggests that the demonstrated propensity to visit the ED and somatic disease factors mainly drive unplanned ED visits. The *Admission Model* indicates that acuity, disability, and mental health are associated with the decision to admit older ED patents to inpatient acute care or back to the community. The *ALC/LTC Model* indicates that

disability as well as informal care status may affect ALC designation and LTC placements for those admitted to acute care, whereas the *ED Revisit Model* indicates that a mix of demonstrated propensity to visit the ED, instability, disability, and mood are related to repeat ED use for those discharged back to the community. That relatively distinct risk factor pathways drive separate transitions and outcomes suggests that geriatric programs and interventions should be compared to the risk pathways in their relevant model to ensure that their goals and resources are in alignment. The use of any risk identification tool will be ineffective unless there is adequate alignment between interventions and identified risk pathways. The outcome-based models in this dissertation were designed to be graphic in order to allow for easier targeting and care planning at the point of care. Aligning programs and interventions that endeavor to prevent avoidable ED use and adverse post discharge outcomes with the risk pathways identified in this dissertation should be a priority for any intervention that seeks to modify unplanned ED use, acute admission, or repeat ED use among older adults.

Though unique risk pathways were associated with each outcome or transition, sub-elements reflecting unmet needs can be identified across one or more of the multivariate models. Previous ED or hospital use was a prominent element in the *ED Model* for home care, in differentiating the profile of older ED patients, and in the *ED Revisit Model.* The influence of previous ED or hospital use across the models indicates that an unknown combination of unmet needs and propensity are associated with ED care seeking behavior among older adults at multiple points of ED transition. If the needs of older adults were met in community-based care it is unlikely that previous ED or hospital use would be a prominent determinant of unplanned ED use, especially among home care clients who are already receiving community supportive care. Likewise, if the needs of older adults were met in the ED or as a result of care initiated in the ED then it is unlikely that previous ED or hospital use would be strongly associated with chronic disability, chronic conditions, informal caregiver distress, and future unplanned revisits. The effect of previous ED or hospital use is a clear indication that existing community-based care and emergency care fails to meet the needs of older adults. In particular, it is clear that episode-based care models are not effective for many older adults.

Cardio-respiratory symptoms, and specifically dyspnea, were predictive of ED use among home care clients as well as repeat ED use among older ED patients. These findings support a much

stronger emphasis on cardio-respiratory conditions in community-based care and the ED. Mental health was also a common sub-element identified in the *ED Model* for home care, the profile of older ED patients, the *Admission Model*, and in the *ED Revisit Model*. In particular, mental health symptoms were found to moderate the effect of chronic disability or poor prognoses in the prediction of unplanned ED use and repeat ED use. These findings suggest that older adults have poor access to mental health care in the community. Also, they suggest that EDs fail to identify or initiate community-based mental health care for older adults. The extent to which these findings reflect a preconceived expectation of negative mood symptoms among older adults, and particularly those with declining health, can only be hypothesized. However, it is clear that mental health is a prominent unmet need. Community-based care and emergency care should have a much stronger emphasis on helping older adults cope with declines as well as help to direct meaningful social and cultural engagement for older adults living the community. Chronic disability was also a prominent component in the profile of older ED patients as well as the risk of post-discharge adverse outcomes. This suggests that hospitals often fail to identify and manage disability in older adults. It also suggests that hospitals and community-based supportive care fail to effectively coordinate timely post-hospital supportive services. That chronic disability was not a component of the *ED Model* for home care suggest that chronic disability is well compensated in home care and should be expanded for post-acute older adults.

5.3 Broad Implications for Assessment

This dissertation suggests that assessment and decision-making paradigms in home care and emergency care are not always closely aligned to their goals of care. Assessment and decision-making systems should reflect the needs and expectations of health care users. Existing paradigms in both sectors seem to be more aligned with their traditional role rather than their optimal role in the continuum of care for older adults. Overall, this dissertation suggests that a paradigm shift is necessary to enhance the identification and management of chronic disease, chronic disability, and mental health in home care and emergency care.

Unplanned ED use was common among older adults and consistent across home care agencies located in different regional health care authorities. The *ED Model* for home care is novel relative to the decision-support frameworks that are commonly used in home care. In addition, the *ED*

Model was generalizable across home care agencies. Therefore it would appear that home care does not currently have the necessary assessment and decision-making paradigms to prevent the unplanned use of the ED by its clients. The alternate paradigm represented in the *ED Model* would help the home care sector play a necessary role in the prevention of avoidable ED use. Specifically it would improve the identification and management of predictive symptoms and chronic conditions, including co-management with primary care. The *ED Model* should be incorporated as a standard output measure in the RAI-HC and adopted by all home care agencies in order to introduce a new and essential paradigm to home care. More broadly, the *ED Model* should be considered for inclusion within all community-based assessments in the interRAI Suite, the interRAI Clinical Assessment Protocols (CAPs), and, potentially, for risk adjustment in the Home Care Quality Indicators (HCQIs).

Descriptive and inferential findings from this dissertation suggest that EDs require an alternate geriatric paradigm to complement the existing acuity-based, episodic paradigm. The profile of older ED patients demonstrated that triage acuity is unsuited for the identification and prioritization of geriatric disabilities and conditions. Likewise, many of the geriatric disabilities and conditions undifferentiated by triage acuity were determinants within the *ALC/LTC* and *ED Revisit Models*. The lack of problem resolution among older adults in EDs may be related to the absence of a parallel geriatric paradigm for decision-making. Our shifting population structure as well as the high prevalence of geriatric conditions suggests the need for geriatric decision-making tools to identify geriatric clinical needs and initiate targeted interventions in inpatient acute care and in the community. The ED encounter is a crucial opportunity to assess for essential geriatric conditions. Therefore, the *ALC/LTC* and *ED Revisit Models* should be incorporated as standard output measures in the interRAI ED-CA. In addition, the interRAI ED-CA should be adopted by ED-based geriatric liaison services as their standardized assessment. The use of the interRAI ED-CA would help integrate EDs with home care and community-support agencies that already use compatible interRAI screening-level and comprehensive assessments. Likewise, the interRAI ED-CA would help integrate EDs with complex continuing care and inpatient mental health that also already use compatible interRAI assessments. Information from the interRAI ED-CA can be used to inform primary care and inpatient geriatric services when an older patient is referred from the ED. The utility of the interRAI ED-CA, and other interRAI instruments, will be fully realized if

compatible screening and assessment instruments are adopted in primary care and inpatient acute care.

The broader implication of the decision-support models created for home care and the ED is their use in enhancing the role of the ED within a larger agenda of integrated geriatric services. Clinicians, researchers, and health care planners should recognize EDs as one of the natural hubs in our health care system for the identification of geriatric needs and coordination of appropriate services. The decision-support models produced in this dissertation can help direct professional interactions and patient transitions at the boundaries between the ED and community supportive care, primary care, and inpatient acute care. The use of risk assessment tools to support professional interactions and patient transitions is likely to improve health care continuity for older persons.

5.4 Essential Research Priorities

The lack of regional or site-level variation in the *ED Model* for home care and the *ALC/LTC* and *ED Revisit Models* for the ED suggest that either very little is being done to target interventions or that these outcomes are difficult to modify. Examining whether the risk pathways identified in each model are modifiable is the most important next step for the program of research initiated in this dissertation. As discussed, the modification of some risk pathways identified in the models seems unlikely given resource constraints. However, intervention studies could determine what risk pathways are most cost-effective for intervention.

5.5 Conclusion

Efforts to optimize the role of the ED in the continuum of care for older adults should continue to be informed by applied research. This dissertation investigated the determinants of ED visits by sample of community dwelling older adults, the profiles of older ED patients, the determinants of inpatient admission from the ED, and adverse outcomes post ED discharge in order to advance conceptual understanding and clinical practice. This dissertation produced tangible and empirically-based risk assessment models for clinical practice in home care and the ED. Key questions related to the prevention of the risk pathways identified in each risk assessment model remain unanswered, and should be a focus of future research. Using the risk assessment models

in conjunction with effective interventions is likely to improve the health and well-being of older adults seeking emergency care.

REFERENCES

Ackermann, R. J., Kemle, K. A., Vogel, R. L., Griffin, R. C., & others. (1998). Emergency department use by nursing home residents. *Annals of Emergency Medicine*, *31*(6), 749-757.

ALC Expert Panel. Appropriate Level of Care: A Patient Flow, System Integration and Capacity Solution. Report. Toronto: ministry of Health and Long-Term Care, 2006.

Alternate Level of Care. (2010). Alternate level of care. [Web page]. https://www.cancercare.on.ca/ocs/alc/: Cancer Care Ontario.

Alternate Level of Care in Canada. (2009). Alternate level of care in canada.. Ottawa, Ont.: CIHI, 2009. Retrieved from Canadian Institute for Health Information (CIHI): http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=PG_1751_E&cw_topic=1751&cw_rel=AR_2610_E#full

Altmayer, C. A., Ardal, S., Woodward, G. L., & Schull, M. J. (2005). Variation in emergency department visits for conditions that may be treated in alternative primary care settings. *CJEM*, *7*(4), 252-6.

Aminzadeh, F., & Dalziel, W. B. (2002). Older adults in the emergency department: A systematic review of patterns of use, adverse outcomes, and effectiveness of interventions. *Annals of Emergency Medicine*, *39*(3), 238-47.

Analysis in Brief: Experiences with Primary Health Care in Canada. (2009a). Ottawa: CIHI.

Andersen, R., & Newman, J. F. (1973). Societal and individual determinants of medical care utilization in the United States. *The Milbank Memorial Fund Quarterly. Health and Society*, *51*(1), 95-124.

Andersen, R. M. (1995). Revisiting the behavioral model and access to medical care: Does it matter? *Journal of Health and Social Behavior*, *36*(1), 1-10.

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.*

Babitsch, B., Gohl, D., & von Lengerke, T. (2012). Re-revisiting Andersen's behavioral model of health services use: A systematic review of studies from 1998-2011. *Psychosoc Med*, *9*, Doc11.

Barnett, K., Mercer, S. W., Norbury, M., Watt, G., Wyke, S., & Guthrie, B. (2012). Epidemiology of multimorbidity and implications for health care, research, and medical education: A cross-sectional study. *Lancet*, *380*(9836), 37-43.

Baum, S. A., & Rubenstein, L. Z. (1987). Old people in the emergency room: Age-related differences in emergency department use and care. *Journal of the American Geriatrics Society*, *35*(5), 398-404.

Bazargan, M., Bazargan, S., & Baker, R. S. (1998). Emergency department utilization, hospital admissions, and physician visits among elderly African American persons. *The Gerontologist*, *38*(1), 25-36.

Belcher, J. V., & Alexy, B. (1999). High-resource hospital users in an integrated delivery system. *The Journal of Nursing Administration*, *29*(10), 30-6.

Berg, K., Finne-Soveri, H., Gray, L., Henrard, J. C., Hirdes, J., Ikegami, N., Teare, G. (2009). Relationship between interrai HC and the ICF: Opportunity for operationalizing the ICF. *BMC Health Services Research*, *9*, 47.

Bernabei, R., & Gray, L. (2009). International gerontology. In *Hazzard's Geriatric Medicine and Gerontology* (6th ed.). McGraw-Hill Professional Publishing.

Bernabei, R., Landi, F., Gambassi, G., Sgadari, A., Zuccala, G., Mor, V., Carbonin, P. (1998). Randomised trial of impact of model of integrated care and case management for older people living in the community. *BMJ (Clinical Research Ed.)*, *316*(7141), 1348-51.

Bertakis, K. D., Azari, R., Helms, L. J., Callahan, E. J., & Robbins, J. A. (2000). Gender differences in the utilization of health care services. *The Journal of Family Practice*, *49*(2), 147-52.

Biese, K. J., Roberts, E., LaMantia, M., Zamora, Z., Shofer, F. S., Snyder, G., Busby-Whitehead, J. (2011). Effect of a geriatric curriculum on emergency medicine resident attitudes, knowledge, and decision-making. *Academic Emergency Medicine*, *18 Suppl 2*, S92-6.

Billings, J., Anderson, G. M., & Newman, L. S. (1996). Recent findings on preventable hospitalizations. *Health Affairs (Project Hope)*, *15*(3), 239-49.

Black, D., & Pearson, M. (2002). Average length of stay, delayed discharge, and hospital congestion. *BMJ (Clinical Research Ed.)*, *325*(7365), 610-1.

Blaylock, A., & Cason, C. L. (1992). Discharge planning predicting patients' needs. *Journal of Gerontological Nursing*, *18*(7), 5-10.

Bocock, M. A., & Keller, H. H. (2009). Hospital diagnosis of malnutrition: A call for action. *Canadian Journal of Dietetic Practice and Research*, *70*(1), 37-41.

Borges Da Silva, R., McCusker, J., Roberge, D., Ciampi, A., Vadeboncoeur, A., Lévesque, J. F., & Belzile, E. (2012). Classification of emergency departments according to their services for community-dwelling seniors. *Academic Emergency Medicine*, *19*(5), 552-61.

Boyle, P., Pineault, R., & Roberge, D. (1992). Assessing Quebec's multi-component program to reduce emergency room overcrowding. *Canadian Public Policy*, *18*(2), 189-202.

Breiman, L. (1996). Bagging predictors. *Machine Learning*, *24*(2), 123-140.

Breiman, L., Friedman, J. H., Olshen, R. A., & Stone, C. J. (1984). *Classification and regression trees.* Monterey, CA: Cole Advanced Books & Software.

Brokaw, M., & Zaraa, A. S. (1991). A biopsychosocial profile of the geriatric population who frequently visit the emergency department. *Ohio Medicine*, *87*(7), 347-50.

Brooks, S., Warshaw, G., Hasse, L., & Kues, J. R. (1994). The physician decision-making process in transferring nursing home patients to the hospital. *Archives of Internal Medicine*, *154*(8), 902-8.

Bullard, M. J., Unger, B., Spence, J., Grafstein, E., & CTAS National Working Group. (2008). Revisions to the canadian emergency department triage and acuity scale (CTAS) adult guidelines. *CJEM*, *10*(2), 136-51.

Bullard, M. J., Villa-Roel, C., Bond, K., Vester, M., Holroyd, B. R., & Rowe, B. H. (2009). Tracking emergency department overcrowding in a tertiary care academic institution. *Healthcare Quarterly*, *12*(3), 99-106.

Burgin, A., & Schuetz, M. P. (1992). Establishing an alternate level of care unit. *The Journal of Nursing Administration*, *22*(9), 62-5.

Burrows, A. B., Morris, J. N., Simon, S. E., Hirdes, J. P., & Phillips, C. (2000). Development of a minimum data set-based depression rating scale for use in nursing homes. *Age and Ageing*, *29*(2), 165-72.

Buurman, B. M., van den Berg, W., Korevaar, J. C., Milisen, K., de Haan, R. J., & de Rooij, S. E. (2011). Risk for poor outcomes in older patients discharged from an emergency department: Feasibility of four screening instruments. *European Journal of Emergency Medicine*, *18*(4), 215-20.

Caminal, J., Starfield, B., Sánchez, E., Casanova, C., & Morales, M. (2004). The role of primary care in preventing ambulatory care sensitive conditions. *European Journal of Public Health*, *14*(3), 246-51.

Canada Health Act. Department of Justice, Canada.
Accessed 16 January 2012.
http://laws-lois.justice.gc.ca/eng/acts/C-6/

Canadian Association of Emergency Physicians. (2003). Access to acute care in the setting of emergency department overcrowding. *CJEM*, *5*(2), 81-6.

Canadian Healthcare Association. Home care in Canada: from the margins to the mainstream. Ottawa: CHA Press; 2009. ISBN: 9781896151335

Canadian Home Care Association. (2008). *Portraits of home care in Canada.* CHCA.

Canadian Institute for Health Information. Public-sector expenditures and utilization of home care services in Canada (Ottawa: CIHI, 2007).

Canadian Institute for Health Information. Understanding Emergency Department Wait Times: How Long Do People Spend in Emergency Departments in Ontario? Analysis in Brief (Ottawa: CIHI, 2007)

Canadian Institute for Health Information. Understanding Emergency Department Wait Times: Access to Inpatient Beds and Patient Flow (Ottawa: CIHI, 2007a/c).

Canadian Institute for Health Information, National Ambulatory Care Reporting System Manual, 2009–2010 (Ottawa: CIHI, 2009).

Canadian Institute for Health Information. Patient pathways: Transfers from continuing care to acute care (Ottawa: CIHI, 2009).

Canadian Institute for Health Information (2009). Alternate level of care in Canada. Ottawa: CIHI, 2009. Accessed July 20, 2009:
http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=PG_1751_E&cw_topic=1751&cw_rel=AR_2610_E#full

Canadian Institute for Health Information. Seniors' Use of Emergency Departments in Ontario, 2004–2005 to 2008–2009. Analysis in Brief (Ottawa: CIHI, 2010).

Canadian Institute for Health Information. Hospital Trends in Canada, 2005. Accessed 16 September 2011. http://secure.cihi.ca/cihiweb/products/Hospital_Trends_in_Canada_e.pdf

Caplan, G. A., Brown, A., Croker, W. D., & Doolan, J. (1998). Risk of admission within 4 weeks of discharge of elderly patients from the emergency department--the DEED study. *Age and Ageing*, *27*(6), 697-702.

Caplan, G. A., Williams, A. J., Daly, B., & Abraham, K. (2004). A randomized, controlled trial of comprehensive geriatric assessment and multidisciplinary intervention after discharge of elderly from the emergency department--the DEED II study. *Journal of the American Geriatrics Society*, *52*(9), 1417-23.

Carpenter, C. R., Griffey, R. T., Stark, S., Coopersmith, C. M., & Gage, B. F. (2011). Physician and nurse acceptance of technicians to screen for geriatric syndromes in the emergency department. *The Western Journal of Emergency Medicine*, *12*(4), 489-95.

Carpenter, G. I., Teare, G. F., Steel, K., Berg, K., Murphy, K., Bjornson, J., Hirdes, J. P. (2001). A new assessment for elders admitted to acute care: Reliability of the MDS-AC. *Aging (Milan, Italy)*, *13*(4), 316-30.

Carter, M. W., & Gupta, S. (2008). Characteristics and outcomes of injury-related ED visits among older adults. *The American Journal of Emergency Medicine*, *26*(3), 296-303.

Carter, M. W., Datti, B., & Winters, J. M. (2006). ED visits by older adults for ambulatory care-sensitive and supply-sensitive conditions. *The American Journal of Emergency Medicine*, *24*(4), 428-34.

Chappell, N. L., Dlitt, B. H., Hollander, M. J., Miller, J. A., & McWilliam, C. (2004). Comparative costs of home care and residential care. *The Gerontologist*, *44*(3), 389-400.

Chen, Y. C., Fan, J. S., Hsu, T. F., Chen, M. H., Huang, H. H., Cheng, K. W., Yang, C. C. (2012). Detection of patients presenting with adverse drug events in the emergency department. *Internal Medicine Journal*, *42*(6), 651-7.

Chin, M. H., Jin, L., Karrison, T. G., Mulliken, R., Hayley, D. C., Walter, J., Friedmann, P. D. (1999). Older patients' health-related quality of life around an episode of emergency illness. *Annals of Emergency Medicine*, *34*(5), 595-603.

Chiovenda, P., Vincentelli, G. M., & Alegiani, F. (2002). Cognitive impairment in elderly ED patients: Need for multidimensional assessment for better management after discharge. *The American Journal of Emergency Medicine*, *20*(4), 332-5.

Chung, M. K., & Bartfield, J. M. (2002). Knowledge of prescription medications among elderly emergency department patients. *Annals of Emergency Medicine*, *39*(6), 605-8.

Clevenger, C. K., Chu, T. A., Yang, Z., & Hepburn, K. W. (2012). Clinical care of persons with dementia in the emergency department: A review of the literature and agenda for research. *Journal of the American Geriatrics Society*, *60*(9), 1742-8.

Close, J. C., Lord, S. R., Antonova, E. J., Martin, M., Lensberg, B., Taylor, M., Kelly, A. (2012). Older people presenting to the emergency department after a fall: A population with substantial recurrent healthcare use. *Emergency Medicine Journal*, *29*(9), 742-7.

Collins, G. S., Mallett, S., & Altman, D. G. (2011). Predicting risk of osteoporotic and hip fracture in the United Kingdom. *BMJ (Clinical Research Ed.)*, *342*, d3651.

Commission on the Future of Health Care in Canada Building on Values: The Future of Health Care in Canada – Final Report. Ottawa, Canada, 2002.

Considine, J., Smith, R., Weiland, T., Gannon, J., Behm, C., Wellington, P., & McCarthy, S. (2010). Older peoples' experience of accessing emergency care. *Australasian Emergency Nursing Journal*, *13*, 61-69.

Costa, A. P., & Hirdes, J. P. (2010). Clinical characteristics and service needs of alternate-level-of-care patients waiting for long-term care in Ontario hospitals. *Healthcare Policy*, *6*(1), 32-46.

Costa, A. P., Poss, J. W., Peirce, T., & Hirdes, J. P. (2012). Acute care inpatients with long-term delayed-discharge: Evidence from a Canadian health region. *BMC Health Services Research*, *12*(1), 172.

Covinsky, K. E., Palmer, R. M., Fortinsky, R. H., Counsell, S. R., Stewart, A. L., Kresevic, D., Landefeld, C. S. (2003). Loss of independence in activities of daily living in older adults hospitalized with medical illnesses: Increased vulnerability with age. *Journal of the American Geriatrics Society*, *51*(4), 451-8.

Crane, S. J., Tung, E. E., Hanson, G. J., Cha, S., Chaudhry, R., & Takahashi, P. Y. (2010). Use of an electronic administrative database to identify older community dwelling adults at high-risk for hospitalization or emergency department visits: The elders risk assessment index. *BMC Health Services Research*, *10*(1), 338.

Creditor, M. C. (1993). Hazards of hospitalization of the elderly. *Annals of Internal Medicine*, *118*(3), 219-23.

Cwinn, M. A., Forster, A. J., Cwinn, A. A., Hebert, G., Calder, L., & Stiell, I. G. (2009). Prevalence of information gaps for seniors transferred from nursing homes to the emergency department. *CJEM*, *11*(5), 462-71.

Dalby, D. M., & Hirdes, J. P. (2008). The relationship between agency characteristics and quality of home care. *Home Health Care Services Quarterly*, *27*(1), 59-74.

Dalby, D. M., Hirdes, J. P., & Fries, B. E. (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.

Davies, A. J., Steen, N., & Kenny, R. A. (2001). Carotid sinus hypersensitivity is common in older patients presenting to an accident and emergency department with unexplained falls. *Age and Ageing*, *30*(4), 289-93.

Dawson, H., Weerasooriya, J., & Webster, G. (2006). Hospital admissions via the emergency department: Implications for planning and patient flow. *Healthcare Quarterly*, *11*(1), 2008.

Dendukuri, N., McCusker, J., & Belzile, E. (2004). The identification of seniors at risk screening tool: Further evidence of concurrent and predictive validity. *Journal of the American Geriatrics Society*, *52*(2), 290-6.

Denman, S. J., Ettinger, W. H., Zarkin, B. A., Coon, P. J., & Casani, J. A. (1989). Short-term outcomes of elderly patients discharged from an emergency department. *Journal of the American Geriatrics Society*, *37*(10), 937-43.

Derlet, R., Richards, J., & Kravitz, R. (2001). Frequent overcrowding in U.S. Emergency departments. *Academic Emergency Medicine*, *8*(2), 151-5.

Dove, A. F., & Dave, S. H. (1986). Elderly patients in the accident department and their problems. *British Medical Journal (Clinical Research Ed.)*, *292*(6523), 807-9.

Downing, A., & Wilson, R. (2005). Older people's use of accident and emergency services. *Age and Ageing*, *34*(1), 24-30.

Elie, M., Rousseau, F., Cole, M., Primeau, F., McCusker, J., & Bellavance, F. (2000). Prevalence and detection of delirium in elderly emergency department patients. *CMAJ*, *163*(8), 977-81.

Elkan, R., Kendrick, D., Dewey, M., Hewitt, M., Robinson, J., Blair, M., Brummell, K. (2001). Effectiveness of home based support for older people: Systematic review and meta-analysis. *BMJ (Clinical Research Ed.)*, *323*(7315), 719-25.

Ellis, G., Whitehead, M. A., O'Neill, D., Langhorne, P., & Robinson, D. (2011). Comprehensive geriatric assessment for older adults admitted to hospital. *Cochrane Database of Systematic Reviews (Online)*, (7), CD006211.

Estey, A., Ness, K., Saunders, L. D., Alibhai, A., & Bear, R. A. (2003). Understanding the causes of overcrowding in emergency departments in the capital health region in Alberta: A focus group study. *CJEM*, *5*(2), 87-94.

Ettinger, W. H., Casani, J. A., Coon, P. J., Muller, D. C., & Piazza-Appel, K. (1987). Patterns of use of the emergency department by elderly patients. *Journal of Gerontology*, *42*(6), 638-42.

Fan, J., Worster, A., & Fernandes, C. M. (2006). Predictive validity of the triage risk screening tool for elderly patients in a canadian emergency department. *The American Journal of Emergency Medicine*, *24*(5), 540-4.

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: A retrospective, population-level, cross-sectional study. *Drugs & Aging*, *28*(7), 561-73.

Foo, C. L., Siu, V. W., Tan, T. L., Ding, Y. Y., & Seow, E. (2012). Geriatric assessment and intervention in an emergency department observation unit reduced re-attendance and hospitalisation rates. *Australasian Journal on Ageing*, *31*(1), 40-6.

Fortinsky, R. H., Covinsky, K. E., Palmer, R. M., & Landefeld, C. S. (1999). Effects of functional status changes before and during hospitalization on nursing home admission of older adults. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *54*(10), M521-6.

Friedman, S. M., Mendelson, D. A., Bingham, K. W., & Kates, S. L. (2009). Impact of a comanaged geriatric fracture center on short-term hip fracture outcomes. *Archives of Internal Medicine*, *169*(18), 1712-7.

Furman, E. F. (2006). Undernutrition in older adults across the continuum of care: Nutritional assessment, barriers, and interventions. *Journal of Gerontological Nursing*, *32*(1), 22-7.

Gallagher, P., Henry, C., & O'Callaghan, N. (2008). Do relatives of elderly patients block the discharge process? *Irish Medical Journal*, *101*(3), 70-2.

George, G., Jell, C., & Todd, B. S. (2006). Effect of population ageing on emergency department speed and efficiency: A historical perspective from a district general hospital in the UK. *Emergency Medicine Journal*, *23*(5), 379-83.

Gerson, L. W., & Shvarch, L. (1982). Emergency medical service utilization by the elderly. *Annals of Emergency Medicine*, *11*(11), 610-2.

Gerson, L. W., Blanda, M., Dhingra, P., Davis, J. M., & Diaz, S. R. (2001). Do elder emergency department patients and their informants agree about the elder's functioning? *Academic Emergency Medicine*, *8*(7), 721-4.

Gerson, L. W., Counsell, S. R., Fontanarosa, P. B., & Smucker, W. D. (1994). Case finding for cognitive impairment in elderly emergency department patients. *Annals of Emergency Medicine*, *23*(4), 813-7.

Gill, T. M., Allore, H., & Guo, Z. (2003). Restricted activity and functional decline among community-living older persons. *Archives of Internal Medicine*, *163*(11), 1317-22.

Gill, T. M., Desai, M. M., Gahbauer, E. A., Holford, T. R., & Williams, C. S. (2001). Restricted activity among community-living older persons: Incidence, precipitants, and health care utilization. *Annals of Internal Medicine*, *135*(5), 313-21.

Gillick, M., & Steel, K. (1983). Referral of patients from long-term to acute-care facilities. *Journal of the American Geriatrics Society*, *31*(2), 74-8.

Ginsberg, G., Israeli, A., Cohen, A., & Stessman, J. (1996). Factors predicting emergency room utilization in a 70-year-old population. *Israel Journal of Medical Sciences*, *32*(8), 649-64.

Glasby, J., Littlechild, R., & Pryce, K. (2006). All dressed up but nowhere to go? Delayed hospital discharges and older people. *Journal of Health Services Research & Policy*, *11*(1), 52-8.

Glazier, R. (2012). *Comparison of primary care models in Ontario by demographics, case mix and emergency department use, 2008/09 to 2009/10 - ICES investigative report.* Toronto: Institute for Clinical Evaluative Sciences.

Goetgeluk, S., & Vansteelandt, S. (2008). Conditional generalized estimating equations for the analysis of clustered and longitudinal data. *Biometrics*, *64*(3), 772-80.

Graf, C. (2006). Functional decline in hospitalized older adults. *The American Journal of Nursing*, *106*(1), 58-67.

Graf, C. E., Giannelli, S. V., Herrmann, F. R., Sarasin, F. P., Michel, J. P., Zekry, D., & Chevalley, T. (2012). Identification of older patients at risk of unplanned readmission after discharge

from the emergency department - comparison of two screening tools. *Swiss Medical Weekly*, *141*, w13327.

Graf, C. E., Zekry, D., Giannelli, S., Michel, J. P., & Chevalley, T. (2011). Efficiency and applicability of comprehensive geriatric assessment in the emergency department: A systematic review. *Aging Clinical and Experimental Research*, *23*(4), 244-54.

Gray, L. C., Berg, K., Fries, B. E., Henrard, J. C., Hirdes, J. P., Steel, K., & Morris, J. N. (2009). Sharing clinical information across care settings: The birth of an integrated assessment system. *BMC Health Services Research*, *9*, 71.

Gray, L. C., Bernabei, R., Berg, K., Finne-Soveri, H., Fries, B. E., Hirdes, J. P., Ariño-Blasco, S. (2008). Standardizing assessment of elderly people in acute care: The interRAI acute care instrument. *Journal of the American Geriatrics Society*, *56*(3), 536-41.

Grief, C. L. (2003). Patterns of ED use and perceptions of the elderly regarding their emergency care: A synthesis of recent research. *Journal of Emergency Nursing*, *29*(2), 122-6.

Gruneir, A., Bell, C. M., Bronskill, S. E., Schull, M., Anderson, G. M., & Rochon, P. A. (2010). Frequency and pattern of emergency department visits by long-term care residents--a population-based study. *Journal of the American Geriatrics Society*, *58*(3), 510-7.

Gruneir, A., Silver, M. J., & Rochon, P. A. (2010). Emergency department use by older adults: A literature review on trends, appropriateness, and consequences of unmet health care needs. *Medical Care Research and Review.*

Guttman, A., Afilalo, M., Guttman, R., Colacone, A., Robitaille, C., Lang, E., & Rosenthal, S. (2004). An emergency department-based nurse discharge coordinator for elder patients: Does it make a difference? *Academic Emergency Medicine*, *11*(12), 1318-27.

Guttmann, A., Schull, M. J., Vermeulen, M. J., & Stukel, T. A. (2011). Association between waiting times and short term mortality and hospital admission after departure from emergency department: Population based cohort study from Ontario, Canada. *BMJ (Clinical Research Ed.)*, *342*, d2983.

Hammond, C. L., Pinnington, L. L., & Phillips, M. F. (2009). A qualitative examination of inappropriate hospital admissions and lengths of stay. *BMC Health Services Research*, *9*, 44.

Han, J. H., Bryce, S. N., Ely, E. W., Kripalani, S., Morandi, A., Shintani, A., Schnelle, J. (2011). The effect of cognitive impairment on the accuracy of the presenting complaint and discharge instruction comprehension in older emergency department patients. *Annals of Emergency Medicine*, *57*(6), 662-671.e2.

Hansell, S., Sherman, G., & Mechanic, D. (1991). Body awareness and medical care utilization among older adults in an HMO. *Journal of Gerontology*, *46*(3), S151-9.

Hare, M., Wynaden, D., McGowan, S., & Speed, G. (2008). Assessing cognition in elderly patients presenting to the emergency department. *International Emergency Nursing*, *16*(2), 73-9.

Hastings, S. N., & Heflin, M. T. (2005). A systematic review of interventions to improve outcomes for elders discharged from the emergency department. *Academic Emergency Medicine*, *12*(10), 978-86.

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). *Gerontologist*, *35*(2), 172-8.

Health Council of Canada. (2012a). *Progress report 2012: Health care renewal in Canada*. Toronto: Health Council of Canada.

Health Council of Canada. (2012b). *Seniors in need, caregivers in distress: What are the home care priorities for seniors in Canada?* Toronto: Health Council of Canada.

Hedges, J. R., Singal, B. M., Rousseau, E. W., Sanders, A. B., Bernstein, E., McNamara, R. M., & Hogan, T. M. (1992). Geriatric patient emergency visits. Part II: Perceptions of visits by geriatric and younger patients. *Annals of Emergency Medicine*, *21*(7), 808-13.

Hébert, R., Bravo, G., Korner-Bitensky, N., & Voyer, L. (1996). Predictive validity of a postal questionnaire for screening community-dwelling elderly individuals at risk of functional decline. *Age and Ageing*, *25*(2), 159-67.

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.

Hirdes, J. P., Curtin-Telegdi, N., Poss, J. W., Gray, L., Berg, K. O., Stolee, P., & Costa, A. P. (2009). *InterRAI contact assessment: Screening level assessment for emergency department and intake from community/hospital assessment form and user's manual.* Washington, DC: interRAI.

Hirdes, J. P., Fries, B. E., Morris, J. N., Ikegami, N., Zimmerman, D., Dalby, D. M., Jones, R. (2004). Home care quality indicators (HCQIs) based on the MDS-HC. *The Gerontologist*, *44*(5), 665-79.

Hirdes, J. P., Fries, B. E., Morris, J. N., Steel, K., Mor, V., Frijters, D., Jonsson, P. (1999). Integrated health information systems based on the RAI/MDS series of instruments. *Healthcare Management Forum*, *12*(4), 30-40.

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.

Hirdes, J. P., Ljunggren, G., Morris, J. N., Frijters, D. H., Finne Soveri, H., Gray, L., Gilgen, R. (2008). Reliability of the interrai suite of assessment instruments: A 12-country study of an integrated health information system. *BMC Health Services Research*, *8*, 277.

Hirdes, J. P., Poss, J. W., & Curtin-Telegdi, N. (2008). The method for assigning priority levels (MAPLE): A new decision-support system for allocating home care resources. *BMC Medicine*, *6*, 9.

Hirdes, J. P., Smith, T. F., Rabinowitz, T., Yamauchi, K., Pérez, E., Telegdi, N. C., Resident Assessment Instrument-Mental Health Group. (2002). The resident assessment instrument-mental health (RAI-MH): Inter-rater reliability and convergent validity. *The Journal of Behavioral Health Services & Research*, *29*(4), 419-32.

Hitcho, E. B., Krauss, M. J., Birge, S., Claiborne Dunagan, W., Fischer, I., Johnson, S., Fraser, V. J. (2004). Characteristics and circumstances of falls in a hospital setting: A prospective analysis. *Journal of General Internal Medicine*, *19*(7), 732-9.

Hollander, M. J., & Chappell, N. L. (2007). A comparative analysis of costs to government for home care and long-term residential care services, standardized for client care needs. *Canadian Journal on Aging*, *26 Suppl 1*, 149-61.

Hoogerduijn, J. G., Schuurmans, M. J., Duijnstee, M. S., de Rooij, S. E., & Grypdonck, M. F. (2007). A systematic review of predictors and screening instruments to identify older hospitalized patients at risk for functional decline. *Journal of Clinical Nursing*, *16*(1), 46-57.

Hosmer, D. W. (2000). *Applied logistic regression (2nd ed.).* New York: Wiley and Sons.

Hu, F. B., Goldberg, J., Hedeker, D., Flay, B. R., & Pentz, M. A. (1998). Comparison of population-averaged and subject-specific approaches for analyzing repeated binary outcomes. *American Journal of Epidemiology*, *147*(7), 694-703.

Hughes, S. L., Ulasevich, A., Weaver, F. M., Henderson, W., Manheim, L., Kubal, J. D., & Bonarigo, F. (1997). Impact of home care on hospital days: A meta analysis. *Health Services Research*, *32*(4), 415-32.

Hustey, F. M., & Meldon, S. (2002). Prevalence and documentation of impaired mental status in elderly emergency department patients. *Academic Emergency*, *39*(3), 248-53.

Hustey, F. M., Meldon, S. W., Smith, M. D., & Lex, C. K. (2003). The effect of mental status screening on the care of elderly emergency department patients. *Annals of Emergency Medicine*, *41*(5), 678-84.

Hustey, F. M., Mion, L. C., Connor, J. T., Emerman, C. L., Campbell, J., & Palmer, R. M. (2007). A brief risk stratification tool to predict functional decline in older adults discharged from emergency departments. *Journal of the American Geriatrics Society*, *55*(8), 1269-74.

Inouye, S. K., Bogardus, S. T., Baker, D. I., Leo-Summers, L., & Cooney, L. M. (2000). The hospital elder life program: A model of care to prevent cognitive and functional decline in older hospitalized patients. *Journal of the American Geriatrics Society*, *48*(12), 1697-706.

Inouye, S. K., Wagner, D. R., Acampora, D., Horwitz, R. I., Cooney, L. M., Hurst, L. D., & Tinetti, M. E. (1993). A predictive index for functional decline in hospitalized elderly medical patients. *Journal of General Internal Medicine*, *8*(12), 645-52.

I*nterRAI Clinical Assessment Protocols (CAPs) - for Use with InterRAI's Cummunity and Long-Term Care Assessment Instruments.* (2008). Ottawa: CIHI.

Ionescu-Ittu, R., McCusker, J., Ciampi, A., Vadeboncoeur, A. M., Roberge, D., Larouche, D., Pineault, R. (2007). Continuity of primary care and emergency department utilization among elderly people. *Canadian Medical Association Journal*, *177*(11), 1362-8.

Jacobs, J. M., Cohen, A., Rozengarten, O., Meiller, L., Azoulay, D., Hammerman-Rozenberg, R., & Stessman, J. (2007). Closure of a home hospital program: Impact on hospitalization rates. *Archives of Gerontology and Geriatrics*, *45*(2), 179-89.

Jónsson, P. V., Noro, A., Finne-Soveri, H., Jensdóttir, A. B., Ljunggren, G., Bucht, G., Schroll, M. (2008). Admission profile is predictive of outcome in acute hospital care. *Aging Clinical and Experimental Research*, *20*(6), 533-9.

Kass, G. V. (1980). An exploratory technique for investigating large quantities of categorical data. *Applied Statistics*, *29*(2), 119-127.

Kates, S. L., Mendelson, D. A., & Friedman, S. M. (2011). The value of an organized fracture program for the elderly: Early results. *Journal of Orthopaedic Trauma*, *25*(4), 233-7.

Kellermann, A. L., & Martinez, R. (2011). The ER, 50 years on. *The New England Journal of Medicine*, *364*(24), 2278-9.

Khan, Y., Glazier, R. H., Moineddin, R., & Schull, M. J. (2011). A population-based study of the association between socioeconomic status and emergency department utilization in ontario, canada. *Academic Emergency Medicine*, *18*(8), 836-43.

Kihlgren, A. L., Nilsson, M., & Sørlie, V. (2005). Caring for older patients at an emergency department -- emergency nurses' reasoning. *Journal of Clinical Nursing*, *14*(5), 601-8.

King, J. E. (2003). Running a best-subsets logistic regression: An alternative to stepwise methods. *Educational and Psychological Measurement*, *63*(3), 392-403.

Koehler, M., Rabinowitz, T., Hirdes, J., Stones, M., Carpenter, G. I., Fries, B. E., Jones, R. N. (2005). Measuring depression in nursing home residents with the MDS and GDS: An observational psychometric study. *BMC Geriatrics*, *5*, 1.

Kollek, D. (2002). Emergency department overcrowding. *Canadian Medical Association Journal*, *167*(6), 626-7.

Kumar, A., Clark, S., Boudreaux, E. D., & Camargo, C. A. (2004). A multicenter study of depression among emergency department patients. *Academic Emergency Medicine*, *11*(12), 1284-9.

Kydd, A. (2008). The patient experience of being a delayed discharge. *Journal of Nursing Management*, *16*(2), 121-6.

LaCalle, E., & Rabin, E. (2010). Frequent users of emergency departments: The myths, the data, and the policy implications. *Annals of Emergency Medicine*, *56*(1), 42-8.

Lakhan, P., Jones, M., Wilson, A., Courtney, M., Hirdes, J., & Gray, L. C. (2011). A prospective cohort study of geriatric syndromes among older medical patients admitted to acute care hospitals. *Journal of the American Geriatrics Society*, *59*(11), 2001-8.

Landi, F., Lattanzio, F., Gambassi, G., Zuccala, G., Sgadari, A., Panfilo, M., Bernabei, R. (1999). A model for integrated home care of frail older patients: The silver network project. SILVERNET-HC study group. *Aging (Milan, Italy)*, *11*(4), 262-72.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159-74.

Lee, J. S., Schwindt, G., Langevin, M., Moghabghab, R., Alibhai, S. M., Kiss, A., & Naglie, G. (2008). Validation of the triage risk stratification tool to identify older persons at risk for hospital admission and returning to the emergency department. *Journal of the American Geriatrics Society*, *56*(11), 2112-7.

Lee, L., Hillier, L. M., Stolee, P., Heckman, G., Gagnon, M., McAiney, C. A., & Harvey, D. (2010). Enhancing dementia care: A primary care-based memory clinic. *Journal of the American Geriatrics Society*, *58*(11), 2197-204.

Lee, L., Kasperski, M. J., & Weston, W. W. (2011). Building capacity for dementia care: Training program to develop primary care memory clinics. *Canadian Family Physician*, *57*(7), e249-52.

Lewis, L. M., Miller, D. K., Morley, J. E., Nork, M. J., & Lasater, L. C. (1995). Unrecognized delirium in ED geriatric patients. *The American Journal of Emergency Medicine*, *13*(2), 142-5.

Li, G., Lau, J. T., McCarthy, M. L., Schull, M. J., Vermeulen, M., & Kelen, G. D. (2007). Emergency department utilization in the United States and Ontario, Canada. *Academic Emergency Medicine*, *14*(6), 582-4.

Lim, K. H., & Yap, K. B. (1999). The presentation of elderly people at an emergency department in Singapore. *Singapore Medical Journal*, *40*(12), 742-4.

Lishner, D. M., Rosenblatt, R. A., Baldwin, L. M., & Hart, L. G. (2000). Emergency department use by the rural elderly. *The Journal of Emergency Medicine*, *18*(3), 289-97.

Lowenstein, S. R., Crescenzi, C. A., Kern, D. C., & Steel, K. (1986). Care of the elderly in the emergency department. *Annals of Emergency Medicine*, *15*(5), 528-35.

MacAdam, M. (2004). Examining home care in other countries: The policy issues. *Home Health Care Management & Practice*, *16*(5), 393-404.

Markle-Reid, M., Weir, R., Browne, G., Roberts, J., Gafni, A., & Henderson, S. (2006). Health promotion for frail older home care clients. *Journal of Advanced Nursing*, *54*(3), 381-95.

Martin, L., Poss, J. W., Hirdes, J. P., Jones, R. N., Stones, M. J., & Fries, B. E. (2008). Predictors of a new depression diagnosis among older adults admitted to complex continuing care: Implications for the depression rating scale (DRS). *Age and Ageing*, *37*(1), 51-6.

Mayo, N. E., Wood-Dauphinee, S., Gayton, D., & Scott, S. C. (1997). Nonmedical bed-days for stroke patients admitted to acute-care hospitals in Montreal, Canada. *Stroke*, *28*(3), 543-9.

Mazzaglia, G., Roti, L., Corsini, G., Colombini, A., Maciocco, G., Marchionni, N., Di Bari, M. (2007). Screening of older community-dwelling people at risk for death and hospitalization: The assistenza socio-sanitaria in Italia project. *Journal of the American Geriatrics Society*, *55*(12), 1955-60.

Mazzola, P., De Filippi, F., Castoldi, G., Galetti, P., Zatti, G., & Annoni, G. (2011). A comparison between two co-managed geriatric programmes for hip fractured elderly patients. *Aging Clinical and Experimental Research*, *23*(5-6), 431-6.

McCaig, L. F. (2005). *National Hospital Ambulatory Medical Care Survey: 2003 emergency department summary*. National Center for Health Statistics. Retrieved from http://www.cdc.gov/nchs/ahcd.htm

McCusker, J., & Verdon, J. (2006). Do geriatric interventions reduce emergency department visits? A systematic review. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *61*(1), 53-62.

McCusker, J., Bellavance, F., Cardin, S., & Trépanier, S. (1998). Screening for geriatric problems in the emergency department: Reliability and validity. Identification of seniors at risk (ISAR) steering committee. *Academic Emergency Medicine*, *5*(9), 883-93.

McCusker, J., Bellavance, F., Cardin, S., Belzile, E., & Verdon, J. (2000). Prediction of hospital utilization among elderly patients during the 6 months after an emergency department visit. *Annals of Emergency Medicine*, *36*(5), 438-45.

McCusker, J., Bellavance, F., Cardin, S., Trépanier, S., Verdon, J., & Ardman, O. (1999). Detection of older people at increased risk of adverse health outcomes after an emergency visit: The ISAR screening tool. *Journal of the American Geriatrics Society*, *47*(10), 1229-37.

McCusker, J., Cardin, S., Bellavance, F., & Belzile, E. (2000). Return to the emergency department among elders: Patterns and predictors. *Academic Emergency Medicine*, *7*(3), 249-59.

McCusker, J., Dendukuri, N., Tousignant, P., Verdon, J., Poulin de Courval, L., & Belzile, E. (2003). Rapid two-stage emergency department intervention for seniors: Impact on continuity of care. *Academic Emergency Medicine*, *10*(3), 233-43.

McCusker, J., Healey, E., Bellavance, F., & Connolly, B. (1997). Predictors of repeat emergency department visits by elders. *Academic Emergency Medicine*, *4*(6), 581-8.

McCusker, J., Jacobs, P., Dendukuri, N., Latimer, E., Tousignant, P., & Verdon, J. (2003). Cost-effectiveness of a brief two-stage emergency department intervention for high-risk elders: Results of a quasi-randomized controlled trial. *Annals of Emergency Medicine*, *41*(1), 45-56.

McCusker, J., Karp, I., Cardin, S., Durand, P., & Morin, J. (2003). Determinants of emergency department visits by older adults: A systematic review. *Academic Emergency Medicine*, *10*(12), 1362-70.

McCusker, J., Roberge, D., Ciampi, A., Lévesque, J. F., Pineault, R., Belzile, E., & Larouche, D. (2009). Primary care organization and outcomes of an emergency visit among seniors. *Healthcare Policy*, *5*(1), e115-31.

McCusker, J., Roberge, D., Ciampi, A., Silva, R. B., Vadeboncoeur, A., Larouche, D., Belzile, E. (2012a). Outcomes of community-dwelling seniors vary by type of emergency department. *Academic Emergency Medicine*, *19*(3), 304-12.

McCusker, J., Tousignant, P., Borgès Da Silva, R., Ciampi, A., Lévesque, J. F., Vadeboncoeur, A., & Sanche, S. (2012b). Factors predicting patient use of the emergency department: A retrospective cohort study. *Canadian Medical Association Journal*, *184*(6), E307-16.

McCusker, J., Verdon, J., Caplan, G. A., Meldon, S. W., & Jacobs, P. (2002). Older persons in the emergency medical care system. *Journal of the American Geriatrics Society*, *50*(12), 2103-5.

McCusker, J., Verdon, J., Tousignant, P., de Courval, L. P., Dendukuri, N., & Belzile, E. (2001). Rapid emergency department intervention for older people reduces risk of functional decline: Results of a multicenter randomized trial. *Journal of the American Geriatrics Society*, *49*(10), 1272-81.

McGee, H. M., O'Hanlon, A., Barker, M., Hickey, A., Montgomery, A., Conroy, R., & O'Neill, D. (2008). Vulnerable older people in the community: Relationship between the vulnerable elders survey and health service use. *Journal of the American Geriatrics Society*, *56*(1), 8-15.

McNamara, R. M., Rousseau, E., & Sanders, A. B. (1992). Geriatric emergency medicine: A survey of practicing emergency physicians. *Annals of Emergency Medicine*, *21*(7), 796-801.

Mehta, K. M., Pierluissi, E., Boscardin, W. J., Kirby, K. A., Walter, L. C., Chren, M. M., Landefeld, C. S. (2011). A clinical index to stratify hospitalized older adults according to risk for new-onset disability. *Journal of the American Geriatrics Society*, *59*(7), 1206-16.

Meldon, S. W., Emerman, C. L., Schubert, D. S., Moffa, D. A., & Etheart, R. G. (1997). Depression in geriatric ED patients: Prevalence and recognition. *Annals of Emergency Medicine*, *30*(2), 141-5.

Meldon, S. W., Mion, L. C., Palmer, R. M., Drew, B. L., Connor, J. T., Lewicki, L. J., Emerman, C. L. (2003). A brief risk-stratification tool to predict repeat emergency department visits and hospitalizations in older patients discharged from the emergency department. *Academic Emergency Medicine*, *10*(3), 224-32.

Metzelthin, S. F., Daniëls, R., van Rossum, E., de Witte, L., van den Heuvel, W. J., & Kempen, G. I. (2010). The psychometric properties of three self-report screening instruments for identifying frail older people in the community. *BMC Public Health*, *10*, 176.

Miller, E., Wightman, E., Rumbolt, K., McConnell, S., Berg, K., Devereaux, M., & Campbell, F. (2009). Management of fall-related injuries in the elderly: A retrospective chart review of patients presenting to the emergency department of a community-based teaching hospital. *Physiotherapy Canada*, *61*(1), 26-37.

Ministry of Health and Long-Term Care (MOHLTC). (2008). News release: Ontario tackles ER waits with $109 million investment. [Web page] Retrieved from http://www.health.gov.on.ca/english/media/news_releases/archives/nr_08/may/nr_20080530.html

Ministry of Health and Long-Term Care (MOHLTC). (2009). Public information: Ontario's aging at home strategy. [Web page] Retrieved from http://www.health.gov.on.ca/english/public/program/ltc/33_ontario_strategy.html

Mion, L. C., Palmer, R. M., Anetzberger, G. J., & Meldon, S. W. (2001). Establishing a case-finding and referral system for at-risk older individuals in the emergency department setting: The SIGNET model. *Journal of the American Geriatrics Society*, *49*(10), 1379-86.

Mion, L. C., Palmer, R. M., Meldon, S. W., Bass, D. M., Singer, M. E., Payne, S. M., Emerman, C. (2003). Case finding and referral model for emergency department elders: A randomized clinical trial. *Annals of Emergency Medicine*, *41*(1), 57-68.

Moons, P., De Ridder, K., Geyskens, K., Sabbe, M., Braes, T., Flamaing, J., & Milisen, K. (2007). Screening for risk of readmission of patients aged 65 years and above after discharge from the emergency department: Predictive value of four instruments. *European Journal of Emergency Medicine*, *14*(6), 315-23.

Morris, J. N., Fries, B. E., Mehr, D. R., Hawes, C., Phillips, C., Mor, V., & Lipsitz, L. A. (1994). MDS cognitive performance scale. *Journal of Gerontology*, *49*(4), M174-82.

Morris, J. N., Fries, B. E., Steel, K., Ikegami, N., Bernabei, R., Carpenter, G. I., Topinková, E. (1997). Comprehensive clinical assessment in community setting: Applicability of the MDS-HC. *Journal of the American Geriatrics Society*, *45*(8), 1017-24.

Moseley, M. G., Hawley, M. P., & Caterino, J. M. (2013). Emergency department observation units and the older patient. *Clinics in Geriatric Medicine*, *29*(1), 71-89.

Murphy, J. F., & Hepworth, J. T. (1996). Age and gender differences in health services utilization. *Research in Nursing & Health*, *19*(4), 323-9.

Murray, K. J., Hill, K., Phillips, B., & Waterston, J. (2005). A pilot study of falls risk and vestibular dysfunction in older fallers presenting to hospital emergency departments. *Disability and Rehabilitation*, *27*(9), 499-506.

Murray, M., Bullard, M., Grafstein, E., CTAS Natioanal Working Group, & CEDIS National Working Group. (2004). Revisions to the canadian emergency department triage and acuity scale implementation guidelines. *CJEM*, *6*(6), 421-7.

Noro, A., Poss, J. W., Hirdes, J. P., Finne-Soveri, H., Ljunggren, G., Björnsson, J., Jonsson, P. V. (2011). Method for assigning priority levels in acute care (MAPLE-AC) predicts outcomes of acute hospital care of older persons--a cross-national validation. *BMC Medical Informatics and Decision Making*, *11*, 39.

Oates, J., Heslop, L., & Boord, N. (1997). The elderly adult in the emergency department. *International Journal of Nursing Practice*, *3*(3), 166-72.

Oeseburg, B., Wynia, K., Middel, B., & Reijneveld, S. A. (2009). Effects of case management for frail older people or those with chronic illness: A systematic review. *Nursing Research*, *58*(3), 201-10.

Onder, G., Liperoti, R., Bernabei, R., & Landi, F. (2008). Case management, preventive strategies, and caregiver attitudes among older adults in home care: Results of the ADHOC study. *Journal of the American Medical Directors Association*, *9*(5), 337-41.

Ontario Association for Community Care Access Centres, & Ontario Hospital Association. (2006). *Alternate level of care - challenges and oppertunities. A collaborative position paper* [Online]. OHA. Retrieved from http://www.oha.com/Client/OHA/OHA_LP4W_LND_WebStation.nsf/resources/Alternate+Level+of+Care+-+Challenges+and+Opportunities/$file/Alternate_LevelofCare_May2006.pdf

Ontario Home Care Association. (2010). *Home care in 2010 – essential for an aging population*. Toronto: Ontario Home Care Association.

Orces, C. H. (2013). Emergency department visits for fall-related fractures among older adults in the USA: A retrospective cross-sectional analysis of the national electronic injury surveillance system all injury program, 2001-2008. *BMJ Open*, *3*(1).

Ospina, M. B., Bond, K., Schull, M., Innes, G., Blitz, S., & Rowe, B. H. (2007). Key indicators of overcrowding in canadian emergency departments: A delphi study. *CJEM*, *9*(5), 339-46.

Ostry, A. S., Tomlin, K. M., Cvitkovich, Y., Ratner, P. A., Park, I. H., Tate, R. B., & Yassi, A. (2004). Choosing a model of care for patients in alternate level care: Caregiver perspectives with respect to staff injury. *The Canadian Journal of Nursing Research*, *36*(1), 142-57.

Ostry, A. S., Yassi, A., Ratner, P. A., Park, I., Tate, R., & Kidd, C. (2003). Work organization and patient care staff injuries: The impact of different care models for "alternate level of care" patients. *American Journal of Industrial Medicine*, *44*(4), 392-9.

Paddock, K., & Hirdes, J. P. (2003). Acute health care service use among elderly home care clients. *Home Health Care Services Quarterly*, *22*(1), 75-85.

Parboosingh, E. J., & Larsen, D. E. (1987). Factors influencing frequency and appropriateness of utilization of the emergency room by the elderly. *Medical Care*, *25*(12), 1139-47.

Peterson, L. K., Fairbanks, R. J., Hettinger, A. Z., & Shah, M. N. (2009). Emergency medical service attitudes toward geriatric prehospital care and continuing medical education in geriatrics. *Journal of the American Geriatrics Society*, *57*(3), 530-5.

Pines, J. M., Mullins, P. M., Cooper, J. K., Feng, L. B., & Roth, K. E. (2013). National trends in emergency department use, care patterns, and quality of care of older adults in the united states. *Journal of the American Geriatrics Society*, *61*(1), 12-7.

Poss, J. W., Jutan, N. M., Hirdes, J. P., Fries, B. E., Morris, J. N., Teare, G. F., & Reidel, K. (2008). A review of evidence on the reliability and validity of minimum data set data. *Healthcare Management Forum*, *21*(1), 33-9.

Powell, D. G. (1984). Canadian emergency medicine: Its past and its current status. *The American Journal of Emergency Medicine*, *2*(2), 171.

Richardson, D. B. (1992). Elderly patients in the emergency department: A prospective study of characteristics and outcome. *The Medical Journal of Australia*, *157*(4), 234-9.

Richardson, D. B., & Mountain, D. (2009). Myths versus facts in emergency department overcrowding and hospital access block. *The Medical Journal of Australia*, *190*(7), 369-74.

Roberts, D. C., McKay, M. P., & Shaffer, A. (2008). Increasing rates of emergency department visits for elderly patients in the united states, 1993 to 2003. *Annals of Emergency Medicine*, *51*(6), 769-74.

Roberts, R. M., Dalton, K. L., Evans, J. V., & Wilson, C. L. (2007). A service model of short-term case management for elderly people at risk of hospital admission. *Australian Health Review : A Publication of the Australian Hospital Association*, *31*(2), 173-83.

Robinson, S., & Mercer, S. (2007). Older adult care in the emergency department: Identifying strategies that foster best practice. *Journal of Gerontological Nursing*, *33*(7), 40-7.

Rock, B. D., Beckerman, A., Auerbach, C., Cohen, C., Goldstein, M., & Quitkin, E. (1995). Management of alternate level of care patients using a computerized database. *Health & Social Work*, *20*(2), 133-9.

Rockwood, K., Fox, R. A., Stolee, P., Robertson, D., & Beattie, B. L. (1994). Frailty in elderly people: An evolving concept. *CMAJ*, *150*(4), 489-95.

Roethler, C., Adelman, T., & Parsons, V. (2011). Assessing emergency nurses' geriatric knowledge and perceptions of their geriatric care. *Journal of Emergency Nursing*, *37*(2), 132-7.

Romanow, R. (2002). *Commission on the future of health care*. Ottawa: Queens Printer of Canada.

Rosenblatt, R. A., Wright, G. E., Baldwin, L. M., Chan, L., Clitherow, P., Chen, F. M., & Hart, L. G. (2000). The effect of the doctor-patient relationship on emergency department use among the elderly. *American Journal of Public Health*, *90*(1), 97.

Rosenfeld, T., Fahey, P., Price, M., & Leeder, S. (1990). The fate of elderly patients discharged from the accident and emergency department of a general teaching hospital. *Community Health Studies*, *14*(4), 365-72.

Rowe, B. H., Bond, K., Ospina, M. B., Blitz, S., Schull, M., Sinclair, D., & Bullard, M. (2006). Data collection on patients in emergency departments in canada. *CJEM*, *8*(6), 417-24.

Rowland, K., Maitra, A. K., Richardson, D. A., Hudson, K., & Woodhouse, K. W. (1990). The discharge of elderly patients from an accident and emergency department: Functional changes and risk of readmission. *Age and Ageing*, *19*(6), 415-8.

Rubin, F. H., Neal, K., Fenlon, K., Hassan, S., & Inouye, S. K. (2011). Sustainability and scalability of the hospital elder life program at a community hospital. *Journal of the American Geriatrics Society*, *59*(2), 359-65.

Runciman, P., Currie, C. T., Nicol, M., Green, L., & McKay, V. (1996). Discharge of elderly people from an accident and emergency department: Evaluation of health visitor follow-up. *Journal of Advanced Nursing*, *24*(4), 711-8.

Rutschmann, O. T., Chevalley, T., Zumwald, C., Luthy, C., Vermeulen, B., & Sarasin, F. P. (2005). Pitfalls in the emergency department triage of frail elderly patients without specific complaints. *Swiss Medical Weekly*, *135*(9-10), 145-50.

Salanitro, A. H., Hovater, M., Hearld, K. R., Roth, D. L., Sawyer, P., Locher, J. L., Ritchie, C. S. (2012). Symptom burden predicts hospitalization independent of comorbidity in community-dwelling older adults. *Journal of the American Geriatrics Society*, *60*(9), 1632-7.

Saliba, D., Elliott, M., Rubenstein, L. Z., Solomon, D. H., Young, R. T., Kamberg, C. J., Wenger, N. S. (2001). The vulnerable elders survey: A tool for identifying vulnerable older people in the community. *Journal of the American Geriatrics Society*, *49*(12), 1691-9.

Salter, A. E., Khan, K. M., Donaldson, M. G., Davis, J. C., Buchanan, J., Abu-Laban, R. B., McKay, H. A. (2006). Community-dwelling seniors who present to the emergency department with a fall do not receive guideline care and their fall risk profile worsens significantly: A 6-month prospective study. *Osteoporosis International*, *17*(5), 672-83.

Salvi, F., Morichi, V., Grilli, A., Giorgi, R., De Tommaso, G., & Dessì-Fulgheri, P. (2007). The elderly in the emergency department: A critical review of problems and solutions. *Internal and Emergency Medicine*, *2*(4), 292-301.

Salvi, F., Morichi, V., Grilli, A., Spazzafumo, L., Giorgi, R., Polonara, S., Dessì-Fulgheri, P. (2009). Predictive validity of the identification of seniors at risk (ISAR) screening tool in elderly patients presenting to two Italian emergency departments. *Aging Clinical and Experimental Research*, *21*(1), 69-75.

Sanders, A. B. (1992). Care of the elderly in emergency departments: Conclusions and recommendations. *Annals of Emergency Medicine*, *21*(7), 830-834.

Sarma, S., Hawley, G., & Basu, K. (2009). Transitions in living arrangements of Canadian seniors: Findings from the NPHS longitudinal data. *Social Science & Medicine (1982)*, *68*(6), 1106-13.

Sayers, G. M. (1997). Non-admitted elderly in the accident and emergency department. *Irish Journal of Medical Science*, *166*(4), 263-6.

Schoen, C., Osborn, R., Squires, D., Doty, M. M., Pierson, R., & Applebaum, S. (2010). How health insurance design affects access to care and costs, by income, in eleven countries. *Health Affairs*, *29*(12), 2323-34.

Schull, M. J., Kiss, A., & Szalai, J. P. (2007). The effect of low-complexity patients on emergency department waiting times. *Annals of Emergency Medicine*, *49*(3), 257-64.

Schull, M. J., Lazier, K., Vermeulen, M., Mawhinney, S., & Morrison, L. J. (2003). Emergency department contributors to ambulance diversion: A quantitative analysis. *Annals of Emergency Medicine*, *41*(4), 467-76.

Schull, M. J., Morrison, L. J., Vermeulen, M., & Redelmeier, D. A. (2003). Emergency department overcrowding and ambulance transport delays for patients with chest pain. *Canadian Medical Association Journal*, *168*(3), 277-83.

Schull, M. J., Slaughter, P. M., & Redelmeier, D. A. (2002). Urban emergency department overcrowding: Defining the problem and eliminating misconceptions. *CJEM*, *4*(2), 76-83.

Schull, M. J., Szalai, J. P., Schwartz, B., & Redelmeier, D. A. (2001). Emergency department overcrowding following systematic hospital restructuring: Trends at twenty hospitals over ten years. *Academic Emergency Medicine*, *8*(11), 1037-43.

Schumacher, J. G., Deimling, G. T., Meldon, S., & Woolard, B. (2006). Older adults in the emergency department: Predicting physicians' burden levels. *The Journal of Emergency Medicine*, *30*(4), 455-60.

Seggewiss, K. (2009). Variations in home care programs across Canada demonstrate need for national standards and pan-Canadian program. *CMAJ*, *180*(12), E90-2.

Shah, M. N., Glushak, C., Karrison, T. G., Mulliken, R., Walter, J., Friedmann, P. D., Chin, M. H. (2003). Predictors of emergency medical services utilization by elders. *Academic Emergency Medicine*, *10*(1), 52-8.

Shah, M. N., Rathouz, P. J., & Chin, M. H. (2001). Emergency department utilization by noninstitutionalized elders. *Academic Emergency Medicine*, *8*(3), 267-73.

Shapiro, S. E., Clevenger, C. K., & Evans, D. D. (2012). Enhancing care of older adults in the emergency department. *Adv Emerg Nurs J*, *34*(3), 197-203.

Shelton, P., Sager, M. A., & Schraeder, C. (2000). The community assessment risk screen (CARS): Identifying elderly persons at risk for hospitalization or emergency department visit. *The American Journal of Managed Care*, *6*(8), 925-33.

Shortliffe, E. C., Hamilton, T. S., & Noroian, E. H. (1958). The emergency room and the changing pattern of medical care. *The New England Journal of Medicine*, *258*(1), 20-5.

Singal, B. M., Hedges, J. R., Rousseau, E. W., Sanders, A. B., Berstein, E., McNamara, R. M., & Hogan, T. M. (1992). Geriatric patient emergency visits. Part I: Comparison of visits by geriatric and younger patients. *Annals of Emergency Medicine*, *21*(7), 802-7.

Sinha, S. K., Bessman, E. S., Flomenbaum, N., & Leff, B. (2011). A systematic review and qualitative analysis to inform the development of a new emergency department-based geriatric case management model. *Annals of Emergency Medicine*, *57*(6), 672-82.

Snyder, R. J. (2005). Treatment of nonhealing ulcers with allografts. *Clinics in Dermatology*, *23*(4), 388-95.

Soghikian, K., Midanik, L. T., Polen, M. R., & Ransom, L. J. (1991). The effect of retirement on health services utilization: The Kaiser Permanente retirement study. *Journal of Gerontology*, *46*(6), S358-60.

Somme, D., Lazarovici, C., Dramé, M., Blanc, P., Lang, P. O., Gauvain, J. B., . . . Saint-Jean, O. (2011). The geriatric patient: Use of acute geriatrics units in the emergency care of elderly patients in France. *Archives of Gerontology and Geriatrics*, *52*(1), 40-5.

Statistics Canada. (2006). *Health Reports, Volume 17, No 4*.

Stiell, A., Forster, A. J., Stiell, I. G., & van Walraven, C. (2003). Prevalence of information gaps in the emergency department and the effect on patient outcomes. *CMAJ*, *169*(10), 1023-8.

Strange, G. R., & Chen, E. H. (1998). Use of emergency departments by elder patients: A five-year follow-up study. *Academic Emergency*, *5*(12), 1157-62.

Strange, G. R., Chen, E. H., & Sanders, A. B. (1992). Use of emergency departments by elderly patients: Projections from a multicenter data base. *Annals of Emergency Medicine*, *21*(7), 819-24.

Stuck, A. E., Beck, J. C., & Egger, M. (2004). Preventing disability in elderly people. *Lancet*, *364*(9446), 1641-2.

Tan, K. M., Lannon, R., O'Keeffe, L., Barton, D., Ryan, J., O'Shea, D., & Hughes, G. (2012). Geriatric medicine in the emergency department. *Irish Medical Journal*, *105*(8), 271-4.

Tellis-Nayak, V., & Tellis-Nayak, M. (1986). An alternate level of care, the prospective payment system and the challenge of extended care. *Social Science & Medicine (1982)*, *23*(7), 665-71.

Thomas, R., Worrall, G., Elgar, F., & Knight, J. (2007). Can they keep going on their own? A four-year randomized trial of functional assessments of community residents. *Canadian Journal on Aging*, *26*(4), 379-90.

Tinetti, M. E., Baker, D. I., McAvay, G., Claus, E. B., Garrett, P., Gottschalk, M., Horwitz, R. I. (1994). A multifactorial intervention to reduce the risk of falling among elderly people living in the community. *The New England Journal of Medicine*, *331*(13), 821-7.

Tomita, N., Yoshimura, K., & Ikegami, N. (2010). Impact of home and community-based services on hospitalisation and institutionalisation among individuals eligible for long-term care insurance in japan. *BMC Health Services Research*, *10*, 345.

Tune, L. (2001). Assessing psychiatric illness in geriatric patients. *Clinical Cornerstone*, *3*(3), 23-36.

Upfold, J. (2002). Emergency department overcrowding: Ambulance diversion and the legal duty to care. *CMAJ*, *166*(4), 445-6.

Veillette, N., Demers, L., Dutil, E., & McCusker, J. (2008). Item analysis of the functional status assessment of seniors in the emergency department. *Disability and Rehabilitation*, *16*, 1-8.

Vermeulen, M. J., Ray, J. G., Bell, C., Cayen, B., Stukel, T. A., & Schull, M. J. (2009). Disequilibrium between admitted and discharged hospitalized patients affects emergency department length of stay. *Annals of Emergency Medicine*, *54*(6), 794-804.

Vesnaver, E., & Keller, H. H. (2011). Social influences and eating behavior in later life: A review. *Journal of Nutrition in Gerontology and Geriatrics*, *30*(1), 2-23.

Victor, C. R., Healy, J., Thomas, A., & Seargeant, J. (2000). Older patients and delayed discharge from hospital. *Health & Social Care in the Community*, *8*(6), 443-452.

Wadman, M. C., Lyons, W. L., Hoffman, L. H., & Muelleman, R. L. (2011). Assessment of a chief complaint-based curriculum for resident education in geriatric emergency medicine. *The Western Journal of Emergency Medicine*, *12*(4), 484-8.

Walker, J. D., Morris, K., & Frood, J. (2009). Alternate level of care in Canada: A summary. *Healthcare Quarterly*, *12*(2), 21-23.

Walker, L., Jamrozik, K., & Wingfield, D. (2005). The sherbrooke questionnaire predicts use of emergency services. *Age and Ageing*, *34*(3), 233-7.

Walter-Ginzburg, A., Chetrit, A., Medina, C., Blumstein, T., Gindin, J., & Modan, B. (2001). Physician visits, emergency room utilization, and overnight hospitalization in the old-old in israel: The cross-sectional and longitudinal aging study (CALAS). *Journal of the American Geriatrics Society*, *49*(5), 549-56.

Warburton, R. N. (2005). Preliminary outcomes and cost-benefit analysis of a community hospital emergency department screening and referral program for patients aged 75 or more. *International Journal of Health Care Quality Assurance*, *18*(6-7), 474-84.

Watson, W. T., Marshall, E. S., & Fosbinder, D. (1999). Elderly patients' perceptions of care in the emergency department. *Journal of Emergency Nursing:*, *25*(2), 88-92.

Weissert, W. G., & Hedrick, S. C. (1994). Lessons learned from research on effects of community-based long-term care. *Journal of the American Geriatrics Society*, *42*(3), 348-53.

Wellens, N. I., Van Lancker, A., Flamaing, J., Gray, L., Moons, P., Verbeke, G., Milisen, K. (2011). Interrater reliability of the interrai acute care (interrai AC). *Archives of Gerontology and Geriatrics.*

Westgate, P. M. (2012). A bias correction for covariance estimators to improve inference with generalized estimating equations that use an unstructured correlation matrix. *Statistics in Medicine.*

Wilber, S. T., Blanda, M., & Gerson, L. W. (2006). Does functional decline prompt emergency department visits and admission in older patients? *Academic Emergency Medicine*, *13*(6), 680-2.

Wilkins, K. (2006). *Government-subsidized home care*. Ottawa: Statistics Canada. Health Reports.

Wilson, D., & Truman, C. (2005). Comparing the health services utilization of long-term-care residents, home-care recipients, and the well elderly. *The Canadian Journal of Nursing Research*, *37*(4), 138-54.

Wofford, J. L., Schwartz, E., & Byrum, J. E. (1993). The role of emergency services in health care for the elderly: A review. *Journal of Emergency Medicine*, *11*(3), 317-326.

Wolinsky, F. D., Coe, R. M., Miller, D. K., Prendergast, J. M., Creel, M. J., & Chávez, M. N. (1983). Health services utilization among the noninstitutionalized elderly. *Journal of Health and Social Behavior*, *24*(4), 325-37.

Wolinsky, F. D., Liu, L., Miller, T. R., An, H., Geweke, J. F., Kaskie, B., Wallace, R. B. (2008). Emergency department utilization patterns among older adults. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *63*(2), 204-9.

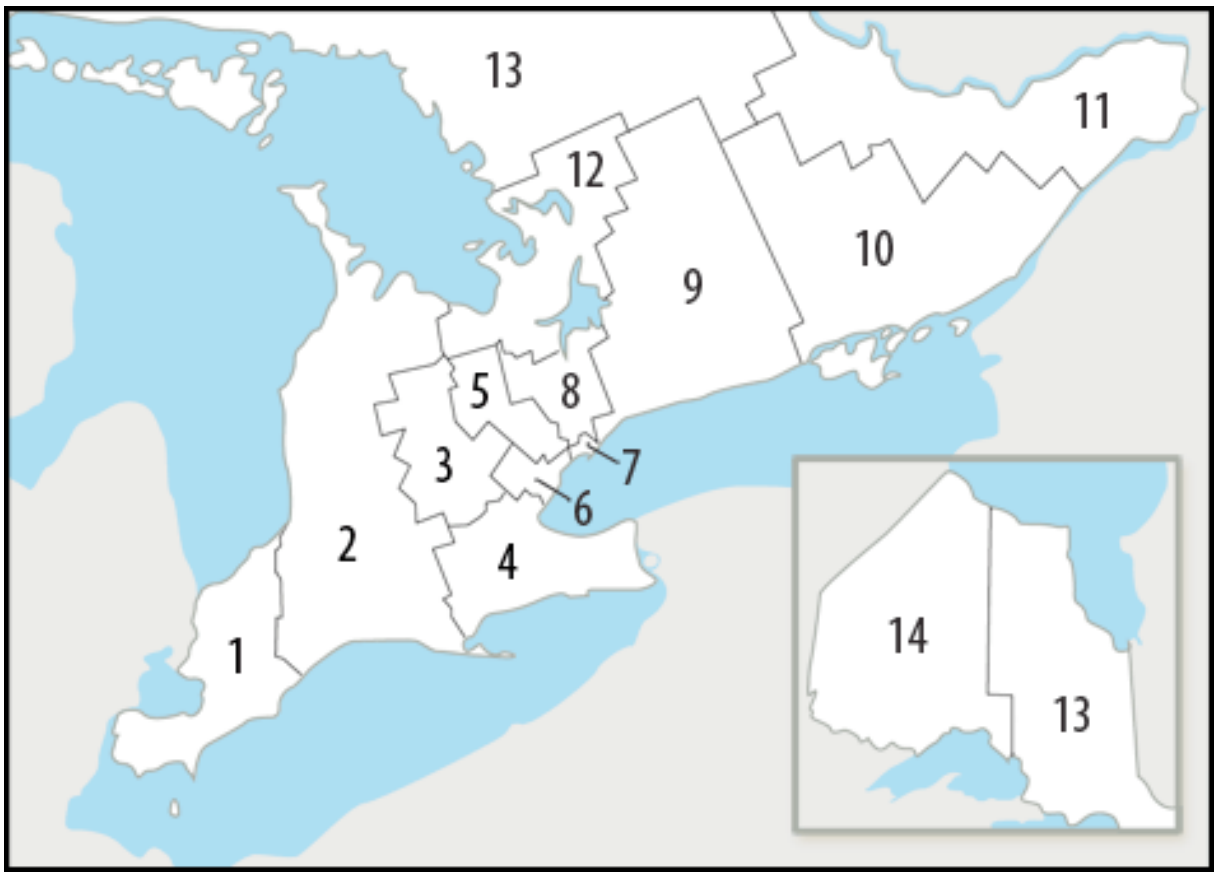
Wong, D. D., Wong, R. P., & Caplan, G. A. (2007). Self-rated health in the unwell elderly presenting to the emergency department. *Emergency Medicine Australasia*, *19*(3), 196-202.

Xu, K. T., Nelson, B. K., & Berk, S. (2009). The changing profile of patients who used emergency department services in the United States: 1996 to 2005. *Annals of Emergency Medicine*, *54*(6), 805-810.e1-7.

APPENDICES

Appendix A: Local Health Integration Network (LHIN) Boundaries in Ontario

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West



Source: http://www.lhins.on.ca/FindYourLHIN.aspx?ekmensel=e2f22c9a_72_254_btnlink#hnhb

Appendix B: Estimated Home Care Service Penetration among Older Adults in Ontario

ONTARIO:

Number of persons age 65 or older in Ontario (2006): 1,608,698
Source:
Statistics Canada. A Portrait of Seniors in Canada, 2006.
Accessed 12 January 2012.
http://www.statcan.gc.ca/ads-annonces/89-519-x/index-eng.htm

Number of persons age 65 or older in Ontario Served by CCACs (Fiscal 2007/08): 303,664
Source:
Ontario Association of Community Care Access Centres. Provincial Data.
Accessed 12 January 2012.
http://www.ccac-ont.ca/Content.aspx?EnterpriseID=15&LanguageID=1&MenuID=1378

Proportion of person ages 65 or older in Ontario Served by CCACs

= 303,664 / 1,608,698 = 18.87%

REGIONAL (CONFIRMATION) SAMPLE:

HNHB CCAC Age Range Penetration Rates
Based on 2007/08 Activity

CCAC Clients	HNHB Population	Penetration Rate	Age Range
10,490	328,338	3.195%	0-19
22,472	851,655	2.639%	20-64
11,362	107,199	10.599%	65-74
20,673	78,821	26.228%	75-84
13,693	26,093	52.478%	85+
45,728	212,113	21.558%	65+

Source: HNHB CCAC Decision Support Director – Jane Blums

Appendix C: Estimated Long-stay Home Care Service Penetration among Older Adults in the Hamilton Niagara Haldimand Brant (HNHB) Local Health Integration Network

HNHB LOCAL HEALTH INTEGRATION NETWORK:

Number of persons age 65 or older in HNHB Local Health Integration Network (2009): 220,192
Source:
Hamilton Niagara Haldimand Brant Local Health Integration Network. HNHB LHIN health Atlas, 3.1.2 HNHB LHIN Population.
Accessed 12 January 2012.
http://www.hnhblhin.on.ca/Page.aspx?id=6936&ekmensel=e2f22c9a_72_356_6936_2

Number of persons age 65 or older in HNHB Local Health Integration Network served by the HNHB CCAC as long-stay home care clients in calendar 2009: 18,161
Source:
HNHB Client, Referral, and Service Data. HNHB CCAC.

Proportion of person ages 65 or older in HNHB Served by the HNHB CCAC

= 18,161 / 220,192= 8.24%

Appendix D: Long-stay Home Care Service Penetration among Older Adults in Ontario aged 85 years or older

Clients 85 & living in community supported by CCAC Receiving Long Stay Services

	2007/08	2008/09
CCAC NAME	**Clients receiving services SRC codes 93 or 94**	**Clients receiving services SRC codes 93 or 94**
ERIE ST. CLAIR	31%	31%
SOUTH WEST	32%	30%
WATERLOO WELLINGTON	33%	33%
HAMILTON NIAGARA HALDIMAND BRANT	34%	33%
CENTRAL WEST	28%	27%
MISSISSAUGA HALTON	32%	32%
TORONTO CENTRAL	27%	30%
CENTRAL	33%	34%
CENTRAL EAST	30%	31%
SOUTH EAST	36%	32%
CHAMPLAIN	35%	36%
NORTH SIMCOE MUSKOKA	42%	43%
NORTH EAST	39%	41%
NORTH WEST	39%	40%
PROVINCE	**33%**	**33%**

Percent of population 85+ living in community (not living in a LTC home) that received CCAC services during the year with SRC codes of 93 or 94.

Source: Copied from the OACCAC - MSAA Indicator "Percent of the Population 85+ living in community supported by CCAC (annual data from OACCAC)" OACCAC has not provided this after these 2 fiscal years. Access granted by the HNHB CCAC.

Appendix E: Summary of Literature on Determinants of Emergency Department Utilization among Community Dwelling Older Adults, by Study Type

Study	Sample	Age	Design	Determinants Tested (Bold = Significant Effect)
COHORT STUDIES				
Crane et al., 2010 USA	N= 12,650 Sample from PCP clinic roster.	60+	Retrospective **Risk period**: 2 years **Dependent Variable**: # of ED visits **Source**: Physician records **Obs. period:** 2 years **Source:** Physician records **Analytic Methods:** Multivariate Stepwise Indexed scores by rank	Elders Risk Assessment Index **Age** **Martial status** **Prior hospital admissions** **Diabetes** **CAD or CHF** **Stroke** **COPD** **Cancer (Excl. skin)** **Dementia** Sex Race Hip fracture
Gill et al., 2003 USA	N= 754 Non-disabled members of a large health plan.	70+	Prospective **Risk period:** 15 months **Dependent Variable:** Monthly rate of ED visits **Source:** Tel. survey **Obs. period:** 15 months **Source:** Tel. survey **Analytic Methods:** ED rate comparison	**Restrictive activity**
Hansell et al., 1991 USA	N= 690 HMO members sample. (66% RR)	62+	Prospective **Risk period:** 1 year **Dependent Variable:** Number of ED visits **Source:** Medical records **Obs. period:** P.I.T. **Source:** Survey	**Stressful life events** **Higher body awareness** Female Education Marital status Financial status Health limitations on activities Depressed mood

			Analytic Methods: Multivariate Regression	
Shelton et al., 2000 USA	N= 1,465 Sample of Medicare fee-for-service patients. (90% RR)	65+	Prospective **Risk period:** 12 months **Dependent Variable:** Any ED visit **Source:** Claims records **Obs. period:** 12 months **Source:** Survey & Claims records **Analytic Methods:** Logistic regression	**Number of comorbidities** **Number of medications** **Prior hospital admissions** Age Sex Race Education Marital status Living arrangement Health perception Physical health Mental health Presence of pain Energy/fatigue level Restricted-activity bed days
Walker et al., 2005 UK	N= 2,307 PCP clinic sample.	75+	**Risk period:** Max. 2 years **Dependent Variable:** Any ED visit **Source:** Medical records **Obs. period:** P.I.T. **Source:** Survey **Analytic Methods:** Logistic regression	**Age** Sex <u>Sherbrooke Questionnaire</u> **Problem with memory** **Problem with sight** **Uses a walking aid** **Taking three or more medications** Problem with hearing Living alone
CROSS-SECTIONAL STUDIES				
Bazargan et al., 1998 USA	N=998 Radom sample of low-income African American community dwellers with senior services. (88.5% RR)	62+	**Dependent Variable:** # of ED visits **Source:** Survey **Analytic Methods:** Poisson Regression	<u>Predisposing</u> **Health locus of control** Age Education Living arrangement <u>Enabling</u> **Perceived accessibility to PCP** **Perceived support** Residential stability Office-based physician visits Health insurance

				Need **Self-reported health** **Heart disease** **Eye problems** Hypertension Diabetes Arthritis Respiratory diseases Kidney problems Teeth problems Ear problems Blood circulation problems Stroke Cancer
Ginsberg et al., 1996 Isreal	N= 605 Sample of community residents.	70+	**Dependent Variable:** Any ED visit **Source**: Survey **Analytic Methods:** Logistic regression	**Prior hospital admissions** **Use of sleeping pills** **Driving a car** **Distance from PCP** **Self-reported health** Help from children increased
Ionescu-Ittu et al., 2007 Canada	N= 95 173 Random provincial community sample.	65+	**Dependent Variable:** Rate of ED use per 1000 days at risk Source: Provincial databases **Analytic Methods:** Rate comparison	**Urban v. rural** **Socioeconomic status** **PCP access** **Presence of regular PCP** **Continuity of primary care** Use of hospital and ambulatory physician services
Lishner et al., 2000 USA	N= 354,782 Medicare beneficiaries in Washington State.	65+	**Dependent Variable:** Any ED visit **Source:** Medicare data **Analytic Methods:** Logistic regression	**Urban v. rural**
McCusker et al., 2009 Canada	N= 66,216 ED patients (non-institutional).	65+	**Dependent Variable:** Any re-visit from index **Source:** Survey & Physician billings **Analytic Methods:** Multinomial logistic regression	**Primary care global score (scope of services, continuity, and accessibility)** SES (post code) Primary care scope of services Primary care continuity Primary care accessibility

McGee et al., 2008 Ireland	N= 2,033 Random community sample. (68% RR)	65+	**Dependent Variable:** Any ED visit **Source**: Survey **Analytic Methods:** Chi-sq.	**Vulnerability (Vulnerable Elders Survey)**
Murphy & Hepworth, 1996 USA	N= 759 Random sample of urban HMO enrollees.	65+	**Dependent Variable:** Number of ED visits **Source**: Medicare records **Analytic Methods:** Multiple regression	**Age** Gender
Parboosingh & Larsen, 1987 Canada	N= 75 Random single-site sample of ED users (non-institutional).	65+	**Dependent Variable:** Number of ED visits **Source**: Survey & Administrative records **Analytic Methods:** Multi level regression	<u>Predisposing</u> **Attitude toward health care** Age Sex Marital status Education Living alone Occupation <u>Enabling</u> **Prior hospital use** **Sources of health care** Prior ED use Use of PCP Social support <u>Need</u> Perceived severity Self-rated health Conditions ADL assistance
Rosenblatt et al., 2000 USA	N= 354,782 Sample of Medicare enrollees.	65+	**Dependent Variable:** any ED visits **Source:** Medicare records **Analytic Methods:** Logistic Regression	**Age** **Access to PCP**

Shah et al., 2001 USA	N= 9,784 National non-institutional sample of Medicare enrollees.	66+	**Dependent Variable:** Any ED claim **Source**: Survey & Administrative records **Analytic Methods:** Logistic regression	Predisposing **Age** **Education** **Lives Alone** Gender Race Enabling Income Insurance Lack usual source of care Trouble getting care Delayed care due to cost Need **Self-reported health** **ADL help** **Charleston Comorbidity index**
Soghikian et al., 1991 USA	N= 1,073 HMO members sample. (80% RR)	60+	**Dependent Variable:** ED visits per year **Source:** Medical records **Analytic Methods:** Multiple regression	Retirement status
Walter-Ginzburg et al., 2001 Isreal	N= 1,487 Random age-stratified community sample. (76% RR)	75+	**Dependent Variable:** Any ED visits **Source**: Survey **Analytic Methods:** Logistic regression	Predisposing Age Sex Place of birth Education Enabling **Marital status** Income Living arrangements Social contact Need **Number of comorbidities** **Self-reported health** **Activity engagement** Depression symptoms ADL difficulty

Wolinsky et al., 1983 USA	N= 401 Non-institutional random sample of community residents.	65+	**Dependent Variable:** Number of ED visits **Source:** Survey **Analytic Methods:** Multivariate regression	Predisposing **Widowed** Locus of Control Sex Race Age Lives Alone Index of Social Position Enabling **Presence of regular PCP** Income Supplemental Insurance Regular DDS Need **Nutritional Risk** Perceived Health Mental Orientation ADL IADL Sensory Functions Mental Health Nutritional Knowledge

Table Abbreviations:
PCP = Primary Care Physician
HMO = Health Management Organization (U.S.A. only)
P.I.T. = Point in Time
DDS = Doctor of Dental Surgery (Dentist)
RR = Response Rate

Appendix F: Andersen Behavioural Model

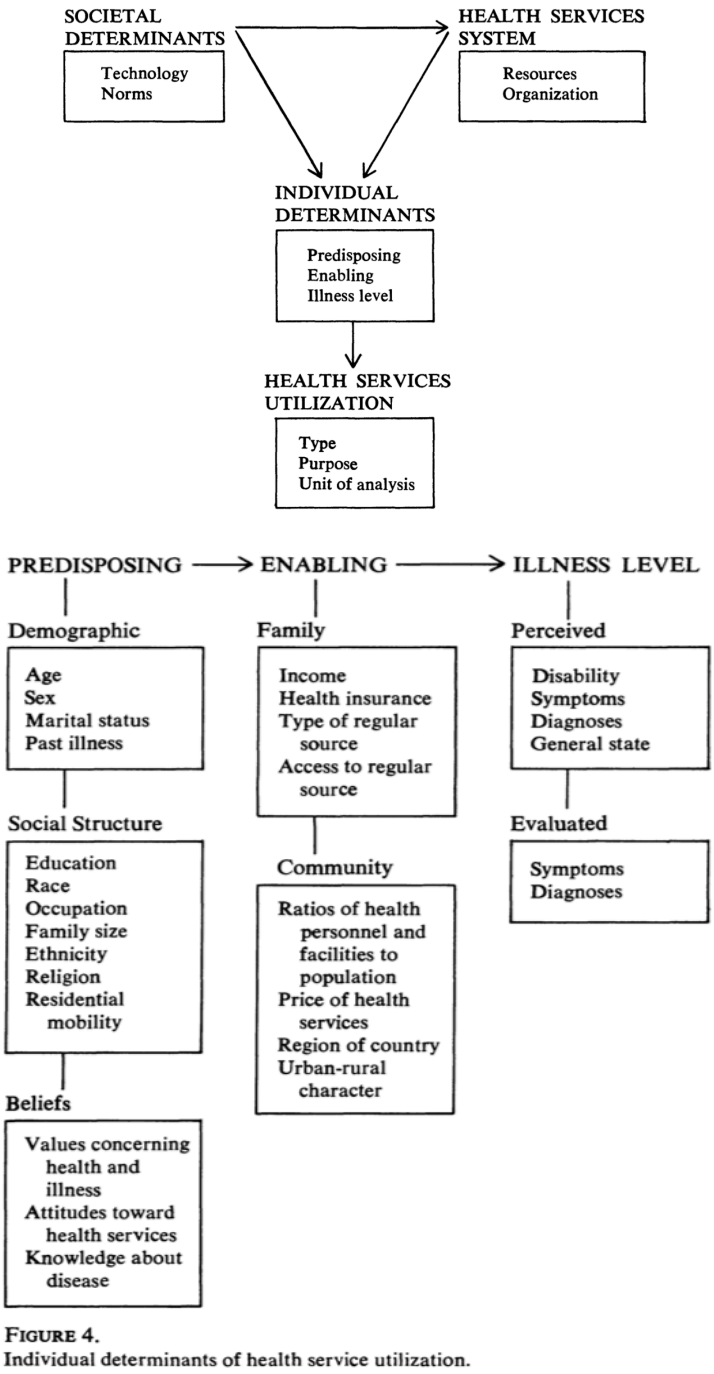


FIGURE 4.
Individual determinants of health service utilization.

Source: Andersen & Newman, 1973

Appendix G: McCusker et al. Andersen Conceptual Model

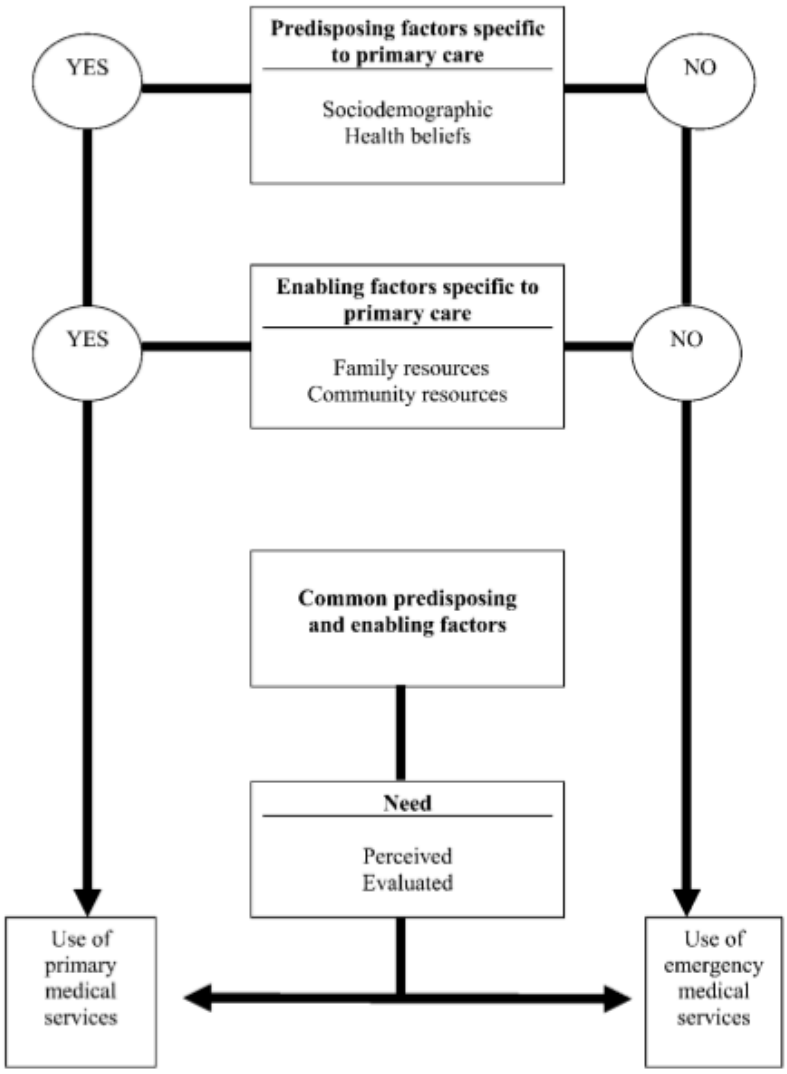


Figure 1. Modified Andersen model of emergency medical services.

Source: McCusker et al., 2003

Appendix H: Gruneir et al. Conceptual Model

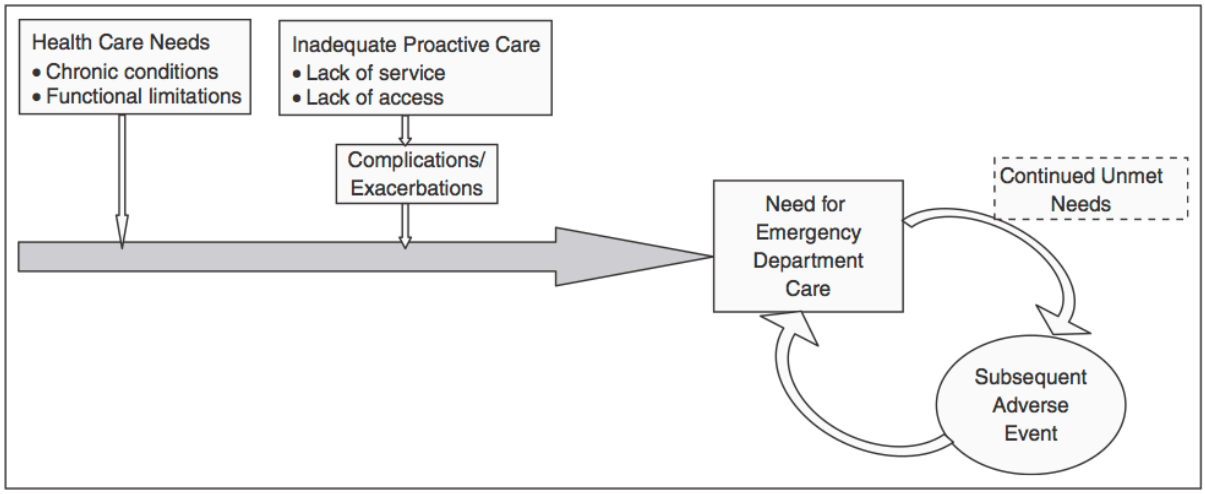


Figure 1. Conceptual model illustrating factors that influence emergency department use by older adults
Source: Adapted from Andersen (1995) and McCusker et al. (2003).

Source: Gruneir et al., 2010

Appendix I: Summary of Prognostic Tools Developed or Tested to Predict ED Utilization

Authors, Year	Items	Population	Information Collection	Dependent Variable	AUC
Elders Risk Assessment Index (ERA) Crane et al., 2010 United States	1.Age 2.Martial status 3.Prior hospital admissions 4.Diabetes 5.CAD or CHF 6.Stroke 7.COPD 8.Cancer (Excl. skin) 9.Dementia	Sample from PCP clinic roster. Age(s): 60+ N= 12,650	Electronic records	# ED visits	0.64
Vulnerable Elders Survey (VES) McGee et al., 2008 Ireland	1.Age 2.Fair or Poor Health 3.Difficulty: a. Stooping b. Lifting c. Reaching above shoulder d. Writing e. Walking quarter mile f. Heavy housework 4.Dependence due to conditions: a. Shopping b. Finances c. Walking in room d. Light housework e. Bathing	Random community sample. Age(s): 65+ N= 2,033	Assessor driven survey	Any ED visit	Unknown
Community Assessment Risk Screen (CARS) Shelton et al., 2000 United States	1.Having 2 or more comorbidities 2.Taking 5 or more prescription medications 3.Having had a hospitalization or ED visits in the previous year	Sample of Medicare fee-for-service patients. Age(s): 65+ N= 1,465	Self-report	Any ED visit	0.67

Sherbrooke Questionnaire Walker et al., 2005 U.K.	1. Problem with memory 2. Problem with sight 3. Uses a walking aid 4. Taking three or more medications 5. Problem with hearing 6. Living alone	PCP clinic sample. Age(s): 75+ N= 2,307	Self-report	Any ED visit	Unknown

Table Abbreviations:
CAD = Coronary Artery Disease
CHF = Congestive Heart Failure
COPD = Chronic Obstructive Pulmonary Disorder

Appendix J: Summary and Risk Scales embedded in the RAI-HC Assessment

Outcome	Definition	Items	Range
CPS Score	**Cognitive Performance Scale** •measures cognitive status •scores correlate with MMSE	Short term memory (B1a) Cognitive skills for daily decision making (B2a) Making self understood (C2) Eating (H2g)	0 - 6 0=intact 6=severe impairment
ADL Hierarchy Score	**Activities of Daily Living Hierarchy Score** • measures client's ability to perform basic ADLs • early loss ADLs (e.g. hygiene) are given lower scores than those lost at a later stage (e.g. eating)	Personal hygiene (H2i) Toilet use (H2h) Locomotion (H2c) Eating (H2g)	0 - 6 0=independent 6=total dependence
ADL Long Score	**Activities of Daily Living Long Score** • measures client's ability to perform all ADLs	Bed mobility (H2a) Transfer (H2b) Locomotion (H2c,d) Eating (H2g) Toilet Use (H2h) Personal Hygiene (H2i) Dressing Upper/Lower Body (H2e,f)	0 – 28 0=independent 28=total dependence
CHESS Score	**Changes in Health, End-Stage Disease and Signs and Symptoms** •detects frailty and health instability	Vomiting (K2e) Dehydration (L2c) Leaving food uneaten (L2b) Weight loss (L1a) Shortness of breath (K3e) Edema (K3d) End stage disease (K8e) Decline in cognition (B2b) Decline in ADL (H3)	0 - 5 0=stable 5=predictive of adverse outcomes (pain, poor health, caregiver stress, hospitalization, death)
MAPLe Score	**Method for Assigning Priority Level** •identifies clients who are likely to require admission to a LTCH or have adverse health outcomes •sublevels identify variations in client populations within each level	ADL Hierarchy Score (0 – 6) Cognitive Performance Scale (0 – 6) Behaviour (E3b-e) Worsening of Decision Making (B2b) Environment (O1c-g) Medication Management (H1d-B, Q1) Ulcers (N2a,b) Few Meals (L2a) Swallowing (L3) Falls (K5)	Low Mild Moderate High Very high Low=least likely to require LTC or have adverse health outcomes

		Institutional Risk CAP Wandering (E3a) Geriatric Screener Meal Preparation (H1aB)	Very High=most likely
DRS Score	**Depression Rating Scale** •clinical screen for depression •validated against Hamilton Depression Rating Scale, Cornell Scale for Depression, Calgary Depression Scale	Negative statements (E1a) Persistent anger (E1b) Unrealistic fears (E1c) Repetitive health complaints (E1d) Repetitive anxious complaints (E1e) Sad facial expression (E1f) Crying, tearful (E1g)	0 - 14 3 or greater= potential depression
ADL Short Score	**Activities of Daily Living Short Score** •measures ability to perform basic ADLs	Personal hygiene (H2i) Toilet use (H2h) Locomotion (H2c) Eating (H2g)	0 - 16 0=independent 16=total dependence
Pain Score	**Pain Scale** •predictive of pain	Frequency of pain (K4a) Intensity of pain (K4b)	0 - 3
IADL Living Difficulty Score	**Instrumental Activities of Daily Living Difficulty Score** •measures difficulty with basic IADLs	Meal preparation (H1aB) Ordinary Housework (H1bB) Phone use (H1eB)	0 - 6 0=no difficulty 6=great difficulty
IADL Living Involvement Score	**Instrumental Activities of Daily Living Involvement Score** •measures performance in all IADLs	Meal preparation (H1aA) Ordinary Housework (H1bA) Managing Finances (h1cA) Managing Medications (H1dA) Phone use (H1eA) Shopping (H1fA) Transportation (H1gA)	0 - 21 0=independent 21=total dependence

Source: HNHB RAI-HC Community or Hospital Outcomes Quick Reference

Appendix K: Summary of interRAI CAPs for Home Care

CAP	Output
Functional Performance	
Physical Activities Promotion	Potential For Improvement
Instrumental ADL	Potential For Improvement
Activities of Daily Living	Level 1 - Prevent Decline Level 2 - Facilitate Improvement
Home Environment Optimization	Problem With Home And Individual Frailty
Institutional Risk	Triggered
Cognition & Mental Health	
Cognitive Loss	Level 1 - Monitor For Risk Of Cognitive Decline Level 2 - Prevent Decline
Delirium	Triggered
Communication	Level 1 – Potential For Improvement Level 2 – Risk Of Decline
Mood	Level 1- Medium Risk Level 2- High Risk
Behavior	Level 1- Prevent Almost Daily Behavior Level 2- Reduce Daily Behaviour
Abusive Relationship	Level 1- Moderate Risk Level 2- High Risk
Social Life	
Activities	Triggered
Informal Support	Triggered
Social Relationship	Triggered
Clinical Issues	
Falls	Level 1- Medium Risk Level 2- High Risk
Pain	Level 1- Medium Priority Level 2- High Priority
Pressure Ulcer	Level 1 - Has Stage 2 Ulcer Or Greater Level 2 - Risk Of Developing Stage 2 Ulcer Level 3 - Has Stage 1 Ulcer
Cardio-Respiratory Conditions	Triggered
Undernutrition	Triggered
Dehydration	Level 1 - Low Level Level 2 - High Level
Feeding Tube	Level 1 - Some Residual Cognitive Ability Level 2 - Absence Of Cognitive Ability
Prevention	Level 1 - Recent Physician Visit Level 2 – No Recent Physician Visit
Appropriate Medications	Triggered
Tobacco and Alcohol Use	Triggered

Urinary Incontinence	Level 1 - Prevent Decline Level 2 - Facilitate Improvement
Bowel Conditions	Level 1 - Risk Of Decline Level 2 - Facilitate Improvement

Appendix L: Clinical Panel Members

Name	Title	Organization	Location
Christophe Bula, MD	Chief of Geriatrics	Geriatric Medicine and Geriatric Rehabilitation, Department of Medicine, University of Lausanne Medical Center	Lausanne, Switzerland
	Professor	Department of Medicine, University of Lausanne	
Ellen Burkett, MD	Senior Physician, Emergency Services	Princess Alexandria Hospital, Queensland Health	Brisbane, Australia
Len Gray, MD PhD	Professor	School of Medicine, University of Queensland	Brisbane, Australia
	Director	Centre for Research in Geriatric Medicine and the Centre for Online Health, University of Queensland	
	Fellow	interRAI	
Marie-Jeanne Kergoat, MD	Professor and Director of Geriatric Training Program	Faculty of Medicine, Université de Montréal	Montreal, Quebec
	Founder and Director	Memory Clinic at Institut universitaire de gériatrie de Montréal (IUGM)	
	Head	Department of Specialized Medicine, Institut universitaire de gériatrie de Montréal (IUGM)	
	Associate Fellow	interRAI	
Don Melady, MD	Emergency Physician Co-Chair, Geriatric Mental Health Program (ED-GMH)	Schwartz-Reisman Emergency Department, Mount Sinai Hospital	Toronto, Ontario

Name	Title	Organization	Location
Samir Sinha MD DPhil	Director of Geriatrics	Mount Sinai and the University Health Network Hospitals	Toronto, Ontario
	Senior Strategy Leader	Ontario Ministry of Health and Long-term Care	
	Associate Fellow	interRAI	
Fredrik Sjostrand MD PhD	Senior Researcher, Staff Emergency Physician, Staff Geriatrician	Karolinska Institutet	Stockholm, Sweden
	Associate Fellow	interRAI	
Walter Swoboda MD	Vice head physician	Geriatrics and the Medical Clinic, Department of Geriatrics at the Fredric Alexander University	Nuremberg, Germany
	Fellow	interRAI	

Appendix M: Resident Assessment Instrument Home Care (RAI-HC) Canadian Version (Modified for Clinical Panel Ratings)

Electronic distribution is limited by interRAI copy write. See www.interrai.org for access.

Appendix N: Average RAI-HC Item Ranking by Clinical Panel (229 Items)

Legend:

^ Of 6 clinical panel members, the number who rated the item the highest (3)

* Average rating of 6 clinical panel members. Rating were from 1 (Least Predictive) to 3 (Most Predictive)

Item	# of '3' Scored ^	Average Ranking *
Demographic Items		
Sex	0	1.8
Aboriginal Origin	0	1.2
Marital Status	0	1.7
Education	0	1.2
Where Lived at Time of Referral	1	1.8
Who Lived with at Time of Referral	0	1.8
Prior nursing home placement	4	2.7
Residential History	0	1.2
Cognition Status		
Short-term Memory	0	1.5
Procedural Memory	0	1.2
Cognitive Skills for Daily Decision Making	0	1.3
Worsening Daily Decision Making	3	2.5
Acute change in Mental Status (last 7 days)	6	3.0
Acute change in Mental Status (last 90 days)	6	3.0
Communication Status		
Hearing	0	1.0
Making self understood	0	1.3
Ability to understand others	0	1.2
Communication Decline (90 days)	2	2.0
Vision Status		
Ability to see in adequate light	0	1.2
Visual Limitation/Difficulties	1	1.5
Vision Decline (last 90 days)	2	2.0
Mood & Behavioural Patterns		
A feeling of sadness or being depressed	1	2.2
Persistent anger with self or others	0	1.2
Expressions of what appear to be unrealistic fears	1	1.8
Repetitive health complaints	3	2.5
Repetitive anxious complaints/concerns (non-health related)	1	2.0
Sad, pained, worried facial expressions	0	1.2
Recurrent crying, tearfulness	0	1.5
Withdrawal from activities of interest	0	1.2
Reduced social interaction	0	1.3

Mood Decline	1	2.0
Wandering	1	2.2
Verbally Abusive Behavioural Symptoms	3	2.3
Physically Abusive Behavioural Symptoms	3	2.5
Socially Inappropriate/Disruptive Behavioural Symptoms	3	2.5
Resists Care	1	2.0
Changes in Behavioural Symptoms (last 90 days)	4	2.7
Social Functioning		
Ease of interacting with others	0	1.0
Openly Expresses Conflict	0	1.3
Change in Social Activities	0	1.7
Length of time client is alone during the day (morning and afternoon)	0	1.3
Client says or indicates he/she feels lonely	0	1.3
Informal Support Services		
Lives with client	2	2.2
Relationship to client	1	1.5
Areas of help: Advice or emotional support	0	1.0
Areas of help: IADL care	0	1.2
Areas of help: ADL care	0	1.5
Willingness to increase help: emotional support	1	1.5
Willingness to increase help: IADL care	1	1.7
Willingness to increase help: ADL care	1	2.0
A caregiver is unable to continue in caring activities	6	3.0
Primary caregiver is not satisfied	0	1.7
Primary caregiver expresses feeling of distress	4	2.7
Physical Functioning		
IADL Self-performance: Meal preparation	0	1.2
IADL Difficulty: Meal preparation	0	1.2
IADL Self-performance: Ordinary housework	0	1.0
IADL Difficulty: Ordinary housework	0	1.2
IADL Self-performance: Managing finances	0	1.0
IADL Self-performance: Managing medications	0	1.7
IADL Difficulty: Managing medications	0	1.7
IADL Self-performance: Phone use	0	1.2
IADL Difficulty: Phone use	0	1.0
IADL Self-performance: Shopping	0	1.0
IADL Difficulty: Shopping	0	1.2
IADL Self-performance: Transportation	0	1.0
IADL Difficulty: Transportation	0	1.3
ADL Self-performance: Mobility in Bed	1	1.5
ADL Self-performance: Transfer	1	2.0
ADL Self-performance: Locomotion in Home	3	2.3
ADL Self-performance: Locomotion Outside of Home	0	1.5
ADL Self-performance: Dressing Upper Body	0	1.3
ADL Self-performance: Dressing Lower Body	1	1.7

ADL Self-performance: Eating	1	2.0
ADL Self-performance: Toilet Use	0	1.8
ADL Self-performance: Personal Hygiene	0	1.7
ADL Self-performance: Bathing	0	1.7
ADL Decline	6	3.0
Modes of Locomotion: Indoors	0	1.3
Modes of Locomotion: Outdoors	0	1.3
Stair Climbing	1	1.7
Stamina: Went out of the house	0	1.2
Stamina: Hours of physical activities	0	1.7
Client believes he/she is capable of increased functional independence	1	1.7
Caregivers believe client is capable of increased functional independence	0	1.3
Good prospects of recovery from current disease or conditions, improved health status expected	2	1.8
Continence		
Bladder Continence	0	1.3
Worsening of Bladder Incontinence	1	2.0
Pads/brief used	0	1.0
Indwelling catheter	0	2.0
Bowel Continence	0	1.3
Diseases		
Cerebrovascular accident (Stroke)	1	2.2
Congestive heart failure	4	2.7
Coronary artery disease	1	2.2
Hypertension	0	1.2
Irregularly irregular pulse	1	1.7
Peripheral vascular disease	2	2.2
Alzheimer’s disease	1	2.2
Dementia other than Alzheimer's Disease	1	2.2
Head trauma	1	1.8
Hemiplegia/Hemiperesis	1	1.8
Multiple Sclerosis	1	1.8
Parkinsonism	2	2.0
Arthritis	0	1.0
Hip fracture	0	1.7
Other fractures	0	1.7
Osteoporosis	0	1.0
Cataract	0	1.0
Glaucoma	0	1.0
Any psychiatric diagnosis	2	2.3
HIV infection	0	1.5
Pneumonia	2	2.3
Tuberculosis	1	1.5

Urinary tract infection	2	2.3
Cancer	2	2.2
Diabetes	3	2.5
Emphysema/COPD/Asthma	3	2.5
Renal failure	1	2.0
Thyroid disease	0	1.3
Health Conditions & Preventive Health		
Blood pressure measured	0	1.0
Received flu vaccination	0	1.2
Test for blood in stool	0	1.0
If female: received mammography	1	1.5
Diarrhea	2	2.2
Difficulty urinating or urinating 3 or more times a night	4	2.7
Fever	6	3.0
Loss of appetite	2	2.3
Vomiting	6	3.0
Chest pain pressure at rest or on exertion	2	2.2
No bowel movement in last 3 days	2	2.0
Dizziness or lightheadedness	1	1.7
Edema	1	2.0
Shortness of breath	6	3.0
Delusions	3	2.5
Hallucinations	4	2.7
Frequency with which client complains or shows evidence of pain	1	2.2
Intensity of pain	3	2.5
From client's point of view, pain intensely disrupts usual activities	3	2.3
Character of Pain	1	1.7
From client’s point of view, medication adequately controls pain	2	2.2
Falls Frequency	5	2.8
Unsteady gait	2	2.2
Limits going outdoors due to fear of falling	0	1.7
Concern regarding the amount of alcohol consumption	1	1.7
Client had to have an alcoholic drink first thing in the morning or there has been trouble because of drinking	1	1.8
Smoked or chewed tobacco daily	0	1.0
Client feels he/she has poor health	3	2.5
Has conditions or disease that make cognition, ADL, mood, or behaviour patterns unstable, fluctuating, precarious, deteriorating	4	2.7
Experiencing a flare-up of a recurrent or chronic problem	2	2.3
Treatments changed in last 30 days because of a new acute episode or condition	3	2.3

Less than six months to live	6	3.0
Fearful of a family member or caregiver	0	1.5
Unusually poor hygiene	1	1.8
Unexplained injuries, broken bones, or burns	4	2.3
Neglected, abused, or mistreated	3	2.3
Physically restrained	2	2.2
Nutrition Status		
Unintended weight loss of 5% or more in last 30 days	1	2.0
Severe malnutrition (cachexia)	4	2.5
Morbid obesity	0	1.5
In at least 2 out of the last three days, ate one or fewer meals a day	0	1.8
Noticeable decrease in the amount of food client usually eats or fluids usually consumes	3	2.2
Insufficient fluid	2	2.2
Enteral tube feeding	0	1.5
Swallowing	0	1.7
Dental Status		
Problem chewing	0	1.0
Mouth is "dry" when eating a meal	0	1.0
Problem brushing teeth or dentures	0	1.2
Skin Condition		
Skin Problems	1	1.7
Pressure Ulcer	1	2.2
Stasis Ulcer	1	2.0
Burns (second or third degree)	3	2.5
Open lesions other than ulcers, rashes, cuts	1	1.8
Skin tears or cuts	2	1.8
Surgical wound sites	1	2.0
Corns, calluses, structural problems, infections, fungi	1	1.3
History of Resolved Pressure Ulcers	1	1.5
Antibiotics, systemic or topical	0	1.7
Dressings	1	1.5
Surgical wound care	1	1.8
Other wound/ulcer care	1	1.8
Environmental Assessment		
Lighting	0	1.2
Flooring and carpeting	0	1.3
Bathroom and toilet room	0	1.3
Kitchen	0	1.0
Heating and cooling	0	1.3
Personal safety	0	1.3
Access to home	0	1.3
Access to rooms in house	0	1.2
As compared to or since last assessment client now lives with other persons	0	1.7

Client or family caregiver feels the client would be better off in another living environment	3	2.3
Formal Care		
Oxygen	1	2.2
Respirator for assistive breathing	2	2.2
All other respiratory therapy treatments (Includes suctioning, IPPB/ CPAP)	1	1.7
Alcohol/drug treatment program	0	1.7
Blood transfusion	0	1.7
Chemotherapy	5	2.8
Dialysis (includes hemodialysis and peritoneal dialysis)	3	2.2
IV Infusion - Central	3	2.3
IV Infusion - Peripheral	1	2.0
Medication by injection	0	1.3
Ostomy care	0	1.0
Radiation therapy	1	2.0
Tracheostomy care	1	2.0
Exercise therapy	0	1.0
Occupational therapy	0	1.0
Physical therapy	0	1.0
Day Centre	0	1.2
Day hospital	0	1.3
Hospice care	2	1.8
Physician or clinic visit	1	1.7
Respite care	0	2.0
Daily nurse monitoring	2	2.3
Nurse monitoring less than daily	0	1.3
Medical alert bracelet or electronic security alert	1	1.5
Skin treatment	0	1.0
Special diet	0	1.0
Admitted to Hospital in Last 90 Days	6	3.0
Visited Emergency Room in Last 90 Days but was not admitted	5	2.8
Emergent Care in Last 90 Days	4	2.7
Treatment Goals	0	1.0
Overall Change in Care Needs	2	2.2
Client made trade-offs due to limited funds	0	1.5
Medications		
Number of Medications	2	2.3
Antipsychotic/Neuroleptic	1	2.2
Anxiolytic	2	2.2
Antidepressant	1	2.0
Hypnotic	1	1.7
Medical Oversight	0	1.7
Compliance/Adherence with Medications	1	1.8

Appendix O: Selected RAI-HC Items/Covariates by Clinical Domain and Average Ranking (95 Items)

Legend:

^ Of 6 clinical panel members, the number who rated the item the highest (3)

* Average rating of 6 clinical panel members. Rating were from 1 (Least Predictive) to 3 (Most Predictive)

~ Unadjusted Odds Ratio (Dependent Variable: Any ED visit within 6 months of assessment)

+ Not significant: $p < 0.5$

Item	# of '3' Scored ^	Average Ranking *	OR ~
Demographic Items			
Prior nursing home placement	4	2.7	1.15
Cognition Status			
Acute change in Mental Status (last 7 days)	6	3.0	1.42
Acute change in Mental Status (last 90 days)	6	3.0	1.30
Worsening Daily Decision Making	3	2.5	1.14
Communication Status			
Communication Decline (90 days)	2	2.0	1.13
Vision Status			
Vision Decline (last 90 days)	2	2.0	1.20
Mood and Behavioural Patterns			
Changes in Behaviour Symptoms (last 90 days)	4	2.7	1.23
Repetitive health complaints	3	2.5	1.33
Physically Abusive Behavioural Symptoms	3	2.5	1.13
Socially Inappropriate/Disruptive Behavioural Symptoms	3	2.5	1.03+
Verbally Abusive Behavioural Symptoms	3	2.3	1.16
A feeling of sadness or being depressed	1	2.2	1.27
Wandering	1	2.2	1.03+
Repetitive anxious complaints/concerns (non-health related)	1	2.0	1.19
Mood Decline	1	2.0	1.38
Resists Care	1	2.0	1.08
Informal Support Services			
A caregiver is unable to continue in caring activities	6	3.0	1.10
Primary caregiver expresses feeling of distress	4	2.7	1.23
Lives with client	2	2.2	0.93
Willingness to increase help: ADL care	1	2.0	0.98
Physical Functioning			
ADL Decline	6	3.0	1.38
ADL Self-performance: Locomotion in Home	3	2.3	1.15
ADL Self-performance: Transfer	1	2.0	1.26
ADL Self-performance: Eating	1	2.0	1.01
Good prospects of recovery from current disease or	2	1.8	0.95

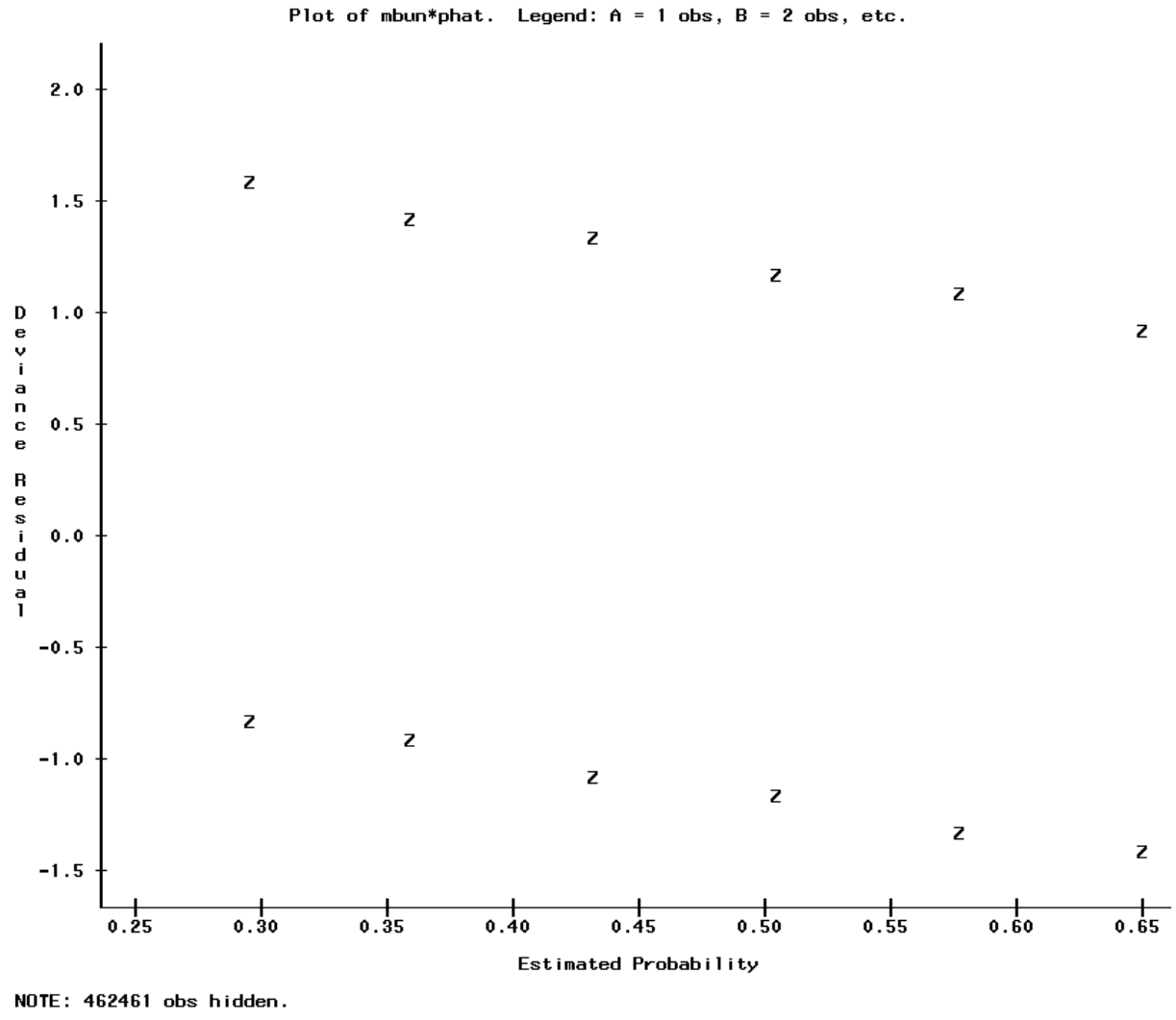
conditions			
Continence			
Worsening of Bladder Incontinence	1	2.0	1.21
Indwelling catheter	0	2.0	1.69
Diseases			
Congestive heart failure	4	2.7	1.61
Diabetes	3	2.5	1.24
Emphysema/COPD/Asthma	3	2.5	1.54
Any psychiatric diagnosis	2	2.3	1.15
Pneumonia	2	2.3	1.75
Urinary tract infection	2	2.3	1.43
Peripheral vascular disease	2	2.2	1.35
Cancer	2	2.2	1.34
Cerebrovascular accident (Stroke)	1	2.2	1.14
Coronary artery disease	1	2.2	1.39
Alzheimer's disease	1	2.2	0.78
Dementia other than Alzheimer's Disease	1	2.2	0.98
Parkinsonism	2	2.0	1.09
Renal failure	1	2.0	1.63
Health Conditions & Preventive Health			
Fever	6	3.0	1.65
Vomiting	6	3.0	1.83
Shortness of breath	6	3.0	1.59
Less than six months to live	6	3.0	1.42
Falls Frequency	5	2.8	1.12
Difficulty urinating or urinating 3 or more times a night	4	2.7	1.18
Hallucinations	4	2.7	1.20
Has conditions or disease that make cognition, ADL, mood, or behaviour patterns unstable, fluctuating, precarious, deteriorating	4	2.7	1.21
Delusions	3	2.5	1.10
Intensity of pain	3	2.5	1.10
Client feels he/she has poor health	3	2.5	1.48
Unexplained injuries, broken bones, or burns	4	2.3	1.67
From client's point of view, pain intensely disrupts usual activities	3	2.3	1.17
Treatments changed in last 30 days because of a new acute episode or condition	3	2.3	1.54
Neglected, abused, or mistreated	3	2.3	1.34
Loss of appetite	2	2.3	1.70
Experiencing a flare-up of a recurrent or chronic problem	2	2.3	1.48
Diarrhea	2	2.2	1.49
Chest pain pressure at rest or on exertion	2	2.2	1.67
From client's point of view, medication adequately controls pain	2	2.2	1.50
Unsteady gait	2	2.2	1.24

Physically restrained	2	2.2	0.98+
Frequency with which client complains or shows evidence of pain	1	2.2	1.06
No bowel movement in last 3 days	2	2.0	1.46
Edema	1	2.0	1.25
Nutrition Status			
Severe malnutrition (cachexia)	4	2.5	1.57
Noticeable decrease in the amount of food client usually eats or fluids usually consumes	3	2.2	1.60
Insufficient fluid	2	2.2	1.35
Unintended weight loss of 5% or more in last 30 days	1	2.0	1.57
Skin Condition			
Burns (second or third degree)	3	2.5	1.26
Pressure Ulcer	1	2.2	1.03
Stasis Ulcer	1	2.0	1.20
Surgical wound sites	1	2.0	1.18
Skin tears or cuts	2	1.8	1.56
Environmental Assessment			
Client or family caregiver feels the client would be better off in another living environment	3	2.3	1.15
Formal Care			
Admitted to Hospital in Last 90 Days	6	3.0	1.61
Chemotherapy	5	2.8	1.41
Visited Emergency Room in Last 90 Days but was not admitted	5	2.8	1.51
Emergent Care in Last 90 Days	4	2.7	1.20
IV Infusion - Central	3	2.3	1.57
Daily nurse monitoring	2	2.3	1.28
Dialysis (includes hemodialysis and peritoneal dialysis)	3	2.2	1.96
Respirator for assistive breathing	2	2.2	1.33
Overall Change in Care Needs	2	2.2	1.21
Oxygen	1	2.2	2.02
IV Infusion - Peripheral	1	2.0	1.64
Radiation therapy	1	2.0	1.66
Tracheostomy care	1	2.0	1.68
Respite care	0	2.0	1.07
Hospice care	2	1.8	1.37
Medications			
Number of Medications	2	2.3	1.09
Anxiolytic	2	2.2	1.25
Antipsychotic/Neuroleptic	1	2.2	1.04
Antidepressant	1	2.0	1.20

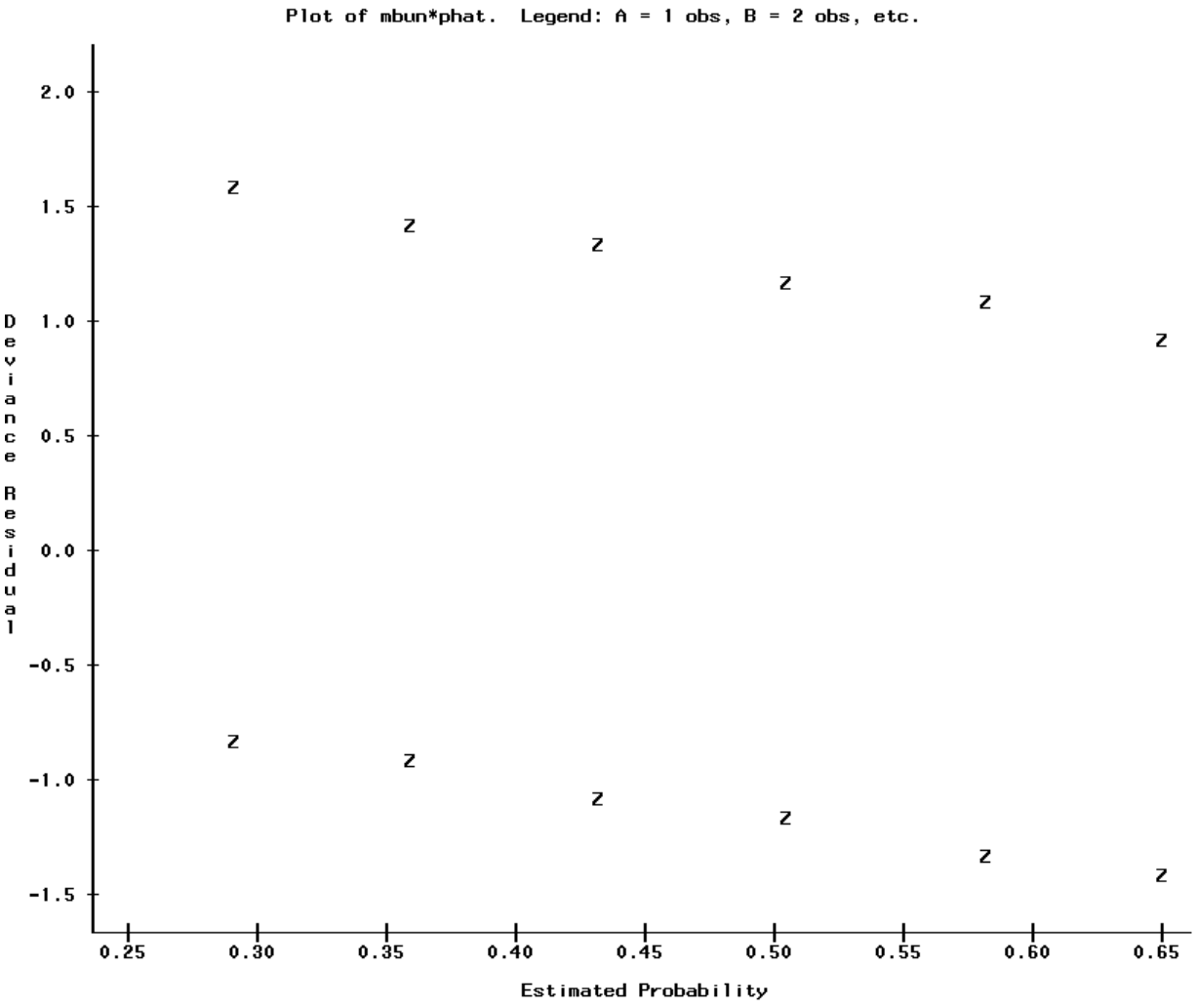
Appendix P: Client 'Phenotypes' Predictive of High ED Utilization

1	Male, and living alone.
2	Female, over age 85, and living alone.
3	Male with behaviors.
4	Cardio-respiratory symptoms: including dyspnea, chest pain, dizziness, edema, CHF.
5	Female, living alone, and weight-loss.
6	Anxious, presence of pain, and living with spouse.
7	Dementia, and previous falls.
8	Male, over age 75, dementia, with spouse.
9	Caregiver or family distress, and dementia.
10	Chronic pain, and under age 65.

Appendix Q: *ED Model* Deviance Residual Plot, Derivation Sample Partition (N=462,773), Ontario and WRHA



Appendix R: *ED Model* Deviance Residual Plot, Validation Sample Partition (N=154,262), Ontario and WRHA



Appendix S: Predisposing and Enabling Characteristics available in the RAI-HC Assessment

Predisposing	Enabling
Age	Relationship to Primary Caregiver
Sex	Relationship to Secondary Caregiver
Marital Status	Living Arrangement
Education	Living Arrangement (Primary Caregiver)
Living Location	Living Arrangement (Secondary Caregiver)
	Caregiver Distress

Appendix T: Canadian Triage and Acuity Scale (CTAS)

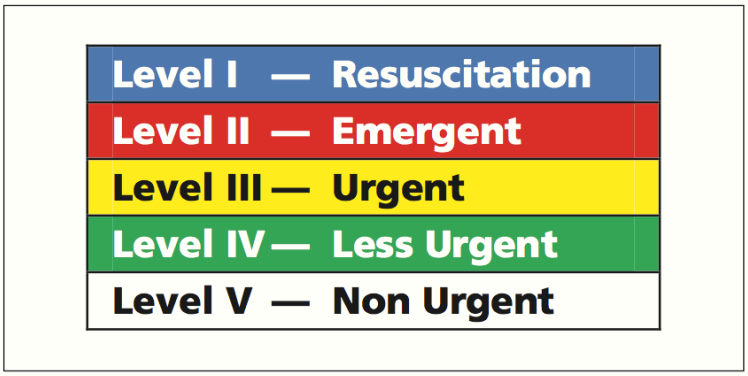


Fig. 1. Canadian Emergency Department Triage and Acuity Scale colour scheme.

Source: Bullard et al., 2008

Appendix U: interRAI ED Contact Assessment (MOPED Study Version)

Electronic distribution is limited by interRAI copy write. See www.interrai.org for access.

Appendix V: 90-Day MOPED Study Hospital and Home Care Tracking Forms

See insert on next page.

90 DAY HOSPITAL TRACKING FORM

Completed for: All persons assessed with the interRAI ED Screener
Completed by: Hospital staff (e.g., records staff and/or clinical staff)

SECTION AC. NON IDENTIFIABLE LINKING INFORMATION

1 NUMERIC IDENTIFIERS (Auto Entry)

a. TREAT Patient ID

b. Case record number

2 90 DAY TRACKING PERIOD (Auto Entry)

a. ED screening reference date (Start of 90 day period)
Year Month Day

b. 90-day follow up date (End of 90 day period)
i.e., the date that is 90 days after the ED screening reference date
Year Month Day

e.g. If the ED Screening reference date was 2009/01/22 the 90 day follow up reference date would be 2010/04/22

3 FORM COMPLETION DATE

Date that this 90 day follow up form was completed
Year Month Day

90 DAY TRACKING INFORMATION

4 HOSPITAL ADMISSION

a. Was the patient admitted to the hospital post ED visit (see 2a: ED screening reference date)?
0. No 1. Yes

b. If yes, provide the date of hospital admission
Year Month Day

IF THE PATIENT WAS NOT ADMITTED TO THE HOSPITAL POST ED VISIT (E.G., HOME CARE REFERRAL) SKIP TO ITEM 10.

5 GERIATRIC ASSESSMENT

a. Did the patient receive ANY special geriatric assessment/ consultation within the 90 day tracking period?
0. No 1. Yes

b. If yes, provide the date of geriatric assessment/ consultation
Year Month Day

6 REHAB ADMISSION (If applicable)

a. Was the patient admitted to a Rehabilitation unit/setting within the 90 day tracking period?
0. No 1. Yes

b. If yes, provide the date of Rehabilitation unit/setting admission
Year Month Day

90 DAY TRACKING INFORMATION (Cont)

7 ICU ADMISSION

a. Was the patient admitted to the ICU within the 90 day tracking period?
0. No 1. Yes

b. If yes, provide the date of ICU admission
Year Month Day

8 ALTERNATE LEVEL OF CARE (ALC)

a. Was the patient designated ALC within the 90 day tracking period?
0. No 1. Yes

b. If yes, provide the date of ALC designation
Year Month Day

9 DISCHARGE FROM HOSPITAL

a. Was the patient discharged from the hospital within the 90 day tracking period?
0. No 1. Yes

b. If yes, provide the date of hospital discharge
Year Month Day

c. If yes, select the discharge destination

1. Private home / apartment / rented room
2. Board and care
3. Assisted living or semi-independent living
4. Mental health residence
—e.g., psychiatric group home
5. Group home for persons with physical disability
6. Setting for persons with intellectual disability
7. Psychiatric hospital or unit
8. Homeless (with or without shelter)
9. Long-term care facility (nursing home)
10. Rehabilitation hospital / unit
11. Hospice facility / palliative care unit
12. Acute care hospital
13. Correctional facility
14. Death
15. Other: Specify_____

10 SUBSEQUENT HOSPITAL ADMISSIONS

a. Number of times that the person was admitted/re-admitted within the 90 day tracking period.
(Do not include the hospital admission recorded in 4a/b, if applicable).

b. If any, provide the date of the **first** admission
Year Month Day

c. Provide the date of hospital discharge for the **first** admission (if discharged within the 90 day tracking period)
Year Month Day

11 SUBSEQUENT EMERGENCY DEPARTMENT USE

a. Number of times that the person visited the ED within the 90 day tracking period
(Do not include the ED visit recorded in 2a).

b. If any, provide the date of the **first** ED visit
Year Month Day

c. If any, provide the date of the **second** ED visit
Year Month Day

90 DAY HOME CARE TRACKING FORM

Completed for: All assessed persons who where referred to home care or where existing home care clients
Completed by: Home care staff (e.g., records staff and/or case manager(s))

SECTION HC. NON IDENTIFIABLE LINKING INFORMATION		
1	NUMERIC IDENTIFIERS (Auto Entry)	**a. TREAT Patient ID** ☐☐☐☐☐☐☐ **b.** Case record number ☐☐☐☐☐☐☐☐☐☐☐☐
2	90 DAY TRACKING PERIOD (Auto Entry)	**a. ED screening reference date (Start of 90 day period)** ☐☐☐☐ ☐☐ ☐☐ Year Month Day **b. 90-day follow up date (End of 90 day period)** i.e., the date that is 90 days after the ED screening reference date ☐☐☐☐ ☐☐ ☐☐ Year Month Day e.g. If the the ED Screening reference date was 2009/01/22 the 90 day follow up reference date would be 2010/04/22
3	FORM COMPLETION DATE	Date that this 90 day tracking form was completed ☐☐☐☐ ☐☐ ☐☐ Year Month Day

90 DAY TRACKING INFORMATION		
4	ADMISSION TO HOME CARE	a. Was the person admitted to home care within the tracking period? 0. No 1. Yes b. Was the person an existing home care client? 0. No 1. Yes c. If yes to A or B, provide the date of admission (use the admission closest to the ED reference date – 2a). ☐☐☐☐ ☐☐ ☐☐ Year Month Day
5	RAI HC ASSESSMENT	a. Did the client receive a RAI HC assessment within the 90 day tracking period 0. No 1. Yes b. If yes, provide the date of the RAI HC assessment ☐☐☐☐ ☐☐ ☐☐ Year Month Day **Note: If yes, a copy of the de-identified RAI-HC assessment is forwarded to the study researchers (University of Waterloo)**
COMPLETE ITEMS 6 - 8 IF PERSON WAS ADMITTED TO HOME CARE OR WAS AN EXISTING HOME CARE CLIENT.		
6	LIVING ARRANGE-MENT	Living arrangement post ED discharge: 1. Private home / apartment / rented room 2. Board and care 3. Assisted living or semi-independent living 4. Mental health residence —e.g., psychiatric group home 5. Group home for persons with physical disability 6. Setting for persons with intellectual disability 7. Other: Specify_____
7	RECEIPT OF HOME CARE SERVICE	Within the 90 day follow up period did the client receive: **a. Any Nursing Services** 0. No 1. Yes **b. Any Personal Support/Homemaking Services** 0. No 1. Yes **c. Any Social Work** 0. No 1. Yes **d. Any Physio./Speech/Occ./Rehab. Therapy** 0. No 1. Yes
8	DISCHARGE FROM HOME CARE	a. Was the client discharged from home care service within the 90 day tracking period? 0. No 1. Yes b. If yes, provide the date of home care discharge ☐☐☐☐ ☐☐ ☐☐ Year Month Day c. If yes, select the discharge reason 1. Admitted to LTC Home 2. Service Plan Complete 3. Transfer to other home care agency 4. Died in Hospital 5. Hospitalized for extended period (i.e., >14 days) 6. Client Preference 7. Other Community Services 8. Vacation (> 30 days) 9. Death 10. Other: Specify_____

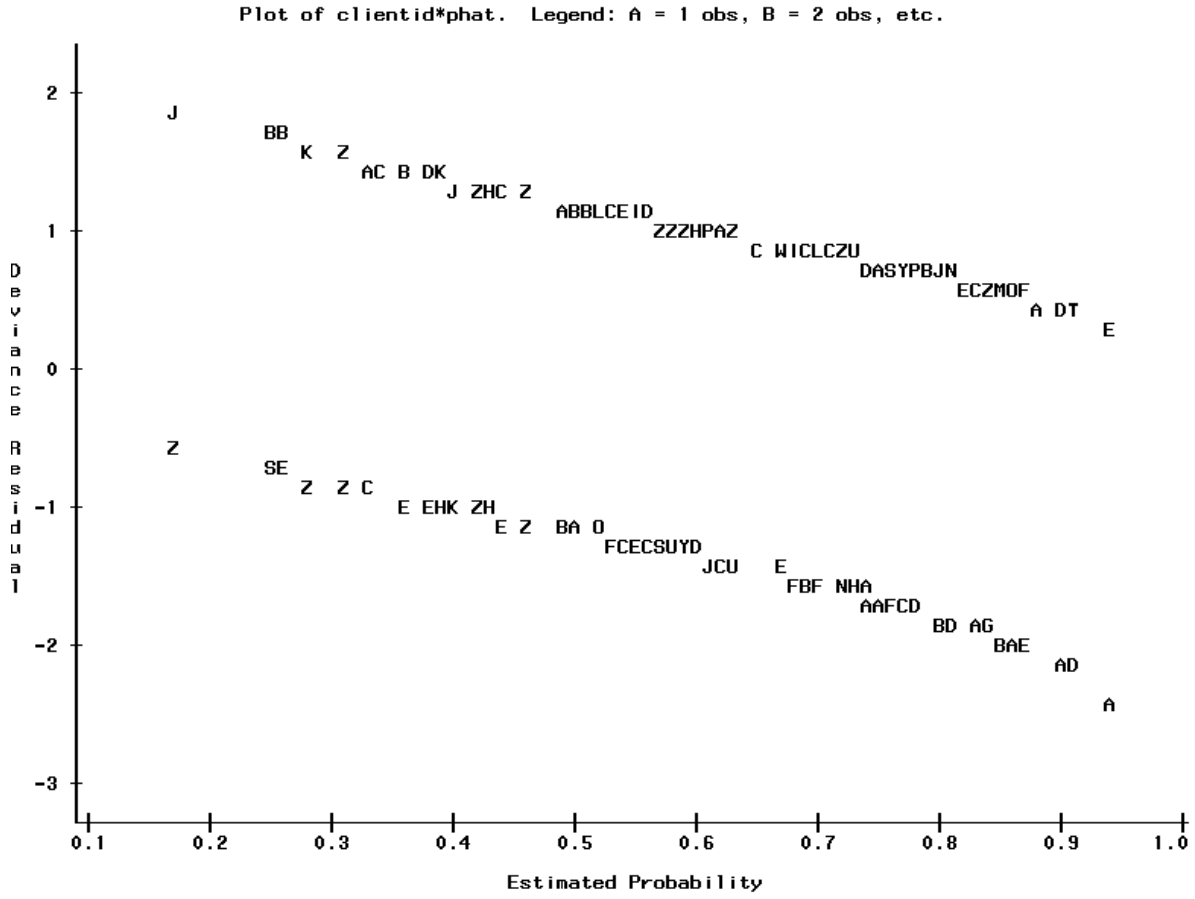
Appendix W: Summary of Results from Best Subset Logistic Procedure, Admission to Acute Care among Non-institutionalized Older Adults in the Emergency Department, MOPED Study, Derivation Sample Partition (N=1,471)

# of Cov.	Covariates	OR	95% CI	AUC	AIC	Chi-Sq Score
1	Impaired locomotion (at admission)	2.90	(2.33 - 3.62)	0.63	1919.3	71.1
2	Impaired locomotion (at admission)	2.73	(2.18 - 3.41)			
	Recent decrease in food and fluids	2.20	(1.72 - 2.81)	0.66	1867.8	107.9
3	Unstable cog., mood, ADL, or beh.	2.13	(1.71 - 2.66)			
	Recent decrease in food and fluids	2.23	(1.74 - 2.86)			
	Decline in locomotion from pre-morbid	3.20	(2.45 - 4.19)	0.69	1807.2	144.8
4	Unstable cog., mood, ADL, or beh.	2.16	(1.73 - 2.71)			
	Recent decrease in food and fluids	2.15	(1.68 - 2.77)			
	Decline in locomotion from pre-morbid	3.10	(2.37 - 4.06)			
	CTAS 1,2, or 3	2.10	(1.59 - 2.78)	0.71	1781.4	165.0
5	Unstable cog., mood, ADL, or beh.	2.17	(1.73 - 2.71)			
	Recent decrease in food and fluids	1.93	(1.50 - 2.50)			
	Decline in locomotion from pre-morbid	3.04	(2.32 - 4.00)			
	Anhedonia	1.58	(1.24 - 2.01)			
	CTAS 1,2, or 3	2.14	(1.62 - 2.84)	0.72	1769.4	178.0
6	Impaired locomotion (at admission)	2.23	(1.75 - 2.85)			
	Unstable cog., mood, ADL, or beh.	2.10	(1.65 - 2.60)			
	Recent decrease in food and fluids	1.89	(1.46 - 2.45)			
	Decline in bathing from pre-morbid	1.87	(1.38 - 2.54)			
	Anhedonia	1.53	(1.20 - 1.95)			
	CTAS 1,2, or 3	2.24	(1.69 - 2.98)	0.73	1748.6	188.7
7	Impaired locomotion (at admission)	2.16	(1.70 - 2.77)			
	Unstable cog., mood, ADL, or beh.	2.00	(1.59 - 2.52)			
	Recent decrease in food and fluids	1.86	(1.43 - 2.42)			
	Decline in cognition from pre-morbid	2.67	(1.33 - 5.37)			
	Decline in bathing from pre-morbid	1.76	(1.29 - 2.40)			

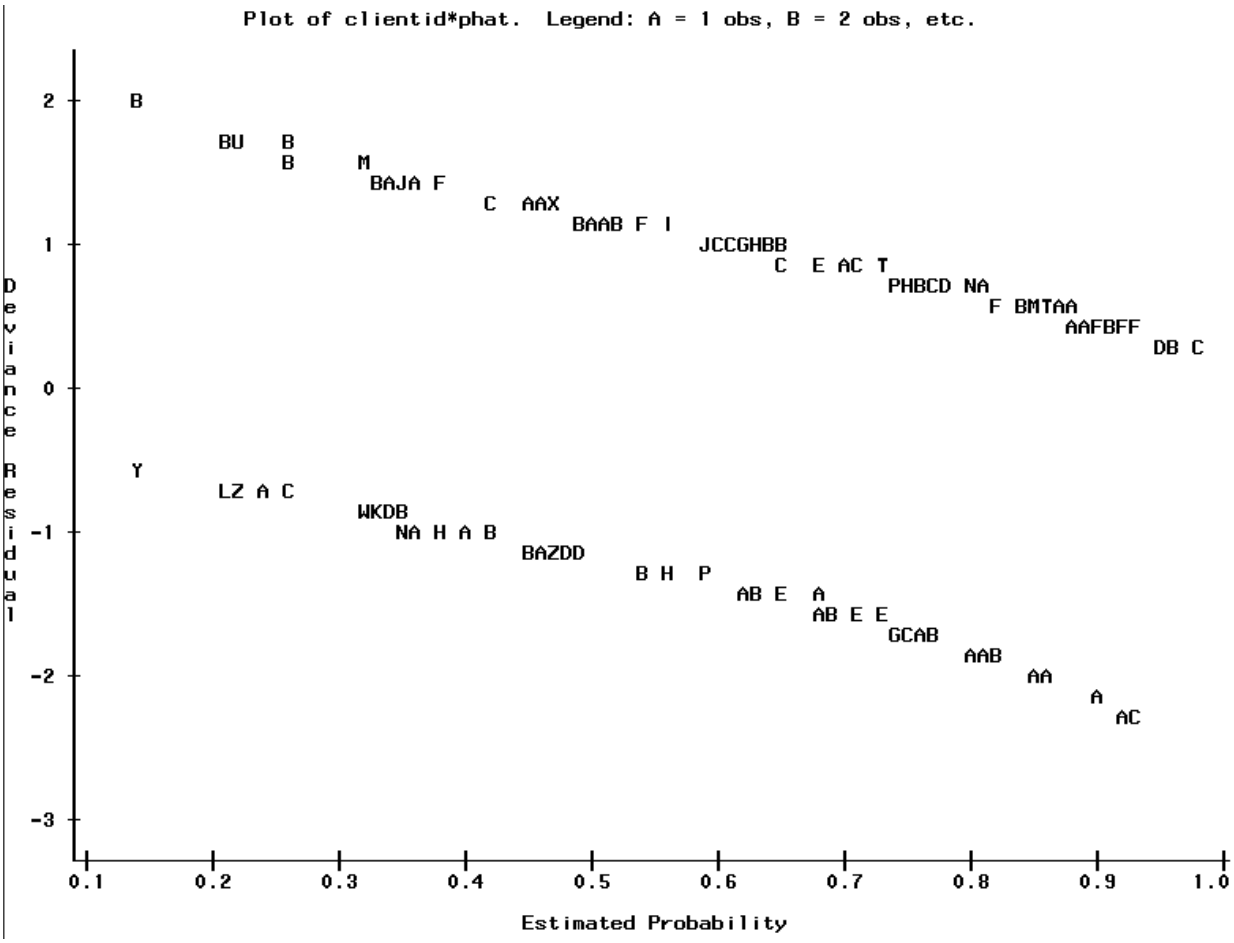
	Anhedonia	1.54	(1.21 - 1.97)			
	CTAS 1,2, or 3	2.22	(1.67 - 2.97)	0.73	1727.1	195.2
8	Impaired locomotion (at admission)	2.14	(1.70 - 2.73)			
	Unstable cog., mood, ADL, or beh.	2.00	(1.60 - 2.50)			
	Recent decrease in food and fluids	1.78	(1.37 - 2.32)			
	Decline in cognition from pre-morbid	2.73	(1.36 - 5.50)			
	Decline in bathing from pre-morbid	1.76	(1.29 - 2.40)			
	Anhedonia	1.47	(1.15 - 1.89)			
	‘ Poor Self-reported Health	1.40	(1.03 - 1.90)			
	CTAS 1,2, or 3	2.21	(1.66 - 2.95)	0.73	1724.5	198.9
9	Impaired locomotion (at admission)	2.18	(1.70 - 2.79)			
	Unstable cog., mood, ADL, or beh.	1.98	(1.57 - 2.50)			
	Recent decrease in food and fluids	1.83	(1.40 - 2.39)			
	Decline in cognition from pre-morbid	2.69	(1.34 - 2.39)			
	Decline in bathing from pre-morbid	1.73	(1.27 - 2.36)			
	* > 2 previous ED visits (last 90 days)	0.75	(0.55 - 1.02)			
	Anhedonia	1.47	(1.14 - 1.88)			
	‘ Poor Self-reported Health	1.44	(1.06 - 1.96)			
	CTAS 1,2, or 3	2.24	(1.68 - 2.99)	0.73	1723.1	203.2
10	Impaired locomotion (at admission)	2.17	(1.69 - 2.78)			
	Unstable cog., mood, ADL, or beh.	1.97	(1.56 - 2.48)			
	Recent decrease in food and fluids	1.80	(1.38 - 2.40)			
	Decline in cognition from pre-morbid	2.73	(1.34 - 5.50)			
	Decline in bathing from pre-morbid	1.72	(1.26 - 2.34)			
	* > 2 previous ED visits (last 90 days)	0.75	(0.56 - 1.02)			
	Anhedonia	1.41	(1.10 - 1.81)			
	‘ Dyspnea at rest	1.42	(1.02 - 1.97)			
	‘ Poor Self-reported Health	1.38	(1.01 - 1.89)			
	CTAS 1,2, or 3	2.18	(1.63 - 2.92)	0.74	1720.8	205.5

OR = Odds Ratio
AUC = receiver operating characteristic (ROC) area under the curve (AUC)
AIC = Akaike Information Criterion
* Not significant (p>0.05)
‘ p>0.01

Appendix X: *Admission Model* Deviance Residual Plot, Admission to Acute Care among Non-institutionalized Older Adults in the Emergency Department, MOPED Study, Derivation Sample Partition (N=1,471)



Appendix Y: *Admission Model* Deviance Residual Plot, Admission to Acute Care among Non-institutionalized Older Adults in the Emergency Department, MOPED Study, Validation Sample Partition (N=630)



Appendix Z: Summary of ED Geriatric Screening Tools

Item No.	ISAR*	TRST**	Runciman***	Rowland****
1	Before the illness or injury that brought you to the ED, did you need someone to help you on a regular basis?	History or evidence of cognitive impairment (poor recall or not oriented)	Has the patient sustained a soft tissue injury?	Does the patient use walking aids or need assistance when walking or transferring (getting up and down from a chair or bed)?
2	Since the illness or injury that brought you to the emergency department, have you needed more help that usual to take care of yourself?	Difficulty walking/transferring or recent falls	Before your accident, were you able to get out and about on your own; for example, could you take a bus into town or visit friends? When you go home, will you be able to go out and about on your own; for example, can you take a bus into town or visit friends?	Does the patient need assistance to dress after treatment?
3	Have you been hospitalized for one or more nights during the past 6 months (excluding a stay in the emergency department)?	Five or more medications	Before your accident, did anybody help you with your shopping, especially your weekly or heavy shopping? If you had to do your own shopping when you go home, would you be able to do your shopping, especially your weekly or heavy shopping?	Has the patient recently relied on someone else to collect his/ her pension?
4	In general, do you see well?	ED use in previous 30 days or hospitalization in previous 90 days	Before your accident, were you able to dress yourself without any assistance; for example, were you able to manage things like buttons,	Has the patient recently relied on someone else to do his/her grocery shopping?

			clips, zips? (if patient only required help with shoe laces tick Yes)	
5	In general, do you have serious problems with your memory?	RN Professional recommendation: Emergency department (ED) nurse (RN) concern for elder abuse/neglect, substance abuse, medication noncompliance, problems meeting instrumental activities of daily living, or other	When you go home, will you be able to dress yourself without assistance. In other words, were you able to manage things like buttons, clips, zips without help? (If patient only required help with shoe laces tick Yes)	Does the patient attend a Day Centre or Day Hospital?
6	Do you take more than three different medications every day?	Lives alone or no available caregiver	Are you on water tablets? Do you have any problems with your 'water works'?	Does the patient receive Meals on Wheels?
7			Have you ever been supplied with and still have equipment such as a walking stick or a high chair? (Include any equipment supplied as a result of attendance at A&E)	Does the patient have a Home Help?
8			Can you remember the address that I gave you at the beginning of these questions? (Tick Yes only if address is given in full without prompting)	

SYMBOLS:

[*] Source: McCusker et al., 2000

[**] Source: Meldon et al., 2003

[***] Source: Runciman et al., 1996

[****] Source: Rowland et al., 1990

Appendix AA: Summary of Predictive Validity Studies using ED Geriatric Screening Tools

Tool	Study	Sample	Proportion Triggered	Outcome(s)	Risk Period	Sen. %	Spec. %	AUC
ISAR	*McCusker et al., 1999	1,122 (86% RR) 65+	≥2 (46%)	Any of: death, functional decline, repeat ED visit, or LTC admission.	6 months	71	57	0.71
	*McCusker et al., 2000 Canada		Multiple Logistic Model	Repeat ED visit	3 months	-	-	0.63
				≥3 Repeat ED visit	6 months	-	-	0.68
	*McCusker et al., 2000 Canada		≥2 (51.3%)	High hospital utilization (Top decile)	6 months	73	51	0.68
	^Dendukuri et al., 2004 Canada		≥2 (46%)	≥2 ED visits	5 months	59	57	0.61
				≥11 hospital days		69	57	0.66
		1,889 65+	≥2 (46%)	≥2 ED visits		71	60	0.68
				≥11 hospital days		70	58	0.68
		508 65+	≥2 (46%)	≥10 community health visits		73	59	-
	Moons et al., 2007 Belgium	314 (73% RR) 65+	≥2	Any Repeat ED visit	Two weeks	100	38	0.70
					1 month	79	37	0.61
					3 months	79	41	0.63
	Salvi et al., 2009 Italy	200 (~90% RR) 65+	≥2 (70.5%)	Death, functional decline, repeat ED visit, or LTC admission.	6 months	-	-	-
	Buurman et al., 2011 Netherlands	381 (75% RR) 65+	≥2	Any of: death, repeat ED visit or hospitalization.	4 months	65	54	0.60
	Graf et al., 2012 Switzerland	345 (81.4% RR)	≥2	Any unplanned repeat ED visit or hospitalization	1 month	92	22	0.61
					3 months	93	26	0.66

		75+			6 months	-	-	0.66
					12 months	-		0.66
TRST	`Meldon et al., 2003 United States	647 (66% RR) 65+	≥2 (45%)	Any of: ED Visit, Hospitalization, LTC admission.	1 month	64	63	-
					4 months	55	66	0.64
	Fan et al., 2006 Canada	120 (55% RR) 65+	≥2 (40.2%)	Any Repeat ED visit	1 month	~	~	~
					4 months	~	~	~
	Moons et al., 2007 Belgium	314 (73% RR) 65+	≥2	Any Repeat ED visit	Two weeks	71	47	0.53
					1 month	64	47	0.57
					3 months	62	48	0.53
	`Hustey et al., 2007 United States	647 (66% RR) 65+	≥2 (45%)	ADL decline	1 month	63	60	0.64
					4 months	63	60	0.66
	Lee et al., 2008 Canada	788 (49% RR) 65+	≥2	Any: repeat ED visit, or hospitalization	1 month	62	57	0.61
					4 months	56	58	-
					1 year	56	61	-
	Buurman et al., 2011 Netherlands	381 (75% RR) 65+	≥2	Any of: death, repeat ED visit or hospitalization.	4 months	75	33	0.54
	Graf et al., 2012 Switzerland	345 (81.4% RR) 75+	≥2	Any unplanned repeat ED visit or hospitalization	1 month	-	-	0.61
					3 months	-	-	0.62
					6 months	-	-	0.65
					12 months	-	-	0.66
Runciman Screener	Runciman et al., 1996 UK	232 75+	≥3	Repeat ED visit	1 month	50	77	-
	Moons et al., 2007 Belgium	314 (73% RR) 65+	≥4	Repeat ED visit	Two weeks	80	60	0.71
					1 month	67	61	0.70
					3 months	59	64	0.68
	Buurman et al., 2011 Netherlands	381 (75% RR)	≥3	Any of: death, repeat ED visit or hospitalization.	4 months	86	54	0.60

		65+						
Rowland Screener	Rowland et al., 1990 UK	450 (81% RR) 75+	≥4	Repeat ED visit	Two weeks	28	85	-
	Moons et al., 2007 Belgium	314 (73% RR) 65+	≥3	Repeat ED visit	Two weeks	88	72	0.73
					1 month	73	75	0.72
					3 months	56	76	0.63
	Buurman et al., 2011 Netherlands	381 (75% RR) 65+	≥2	Any of: death, repeat ED visit or hospitalization.	4 months	25	83	0.54

SYMBOLS:
* ` Studies share the same sample.
^ Partial sample is shared from previous study.
- Not reported.
~ Not significant.
RR = Response Rate.

Appendix BB: TRST Items' Odds Ratios

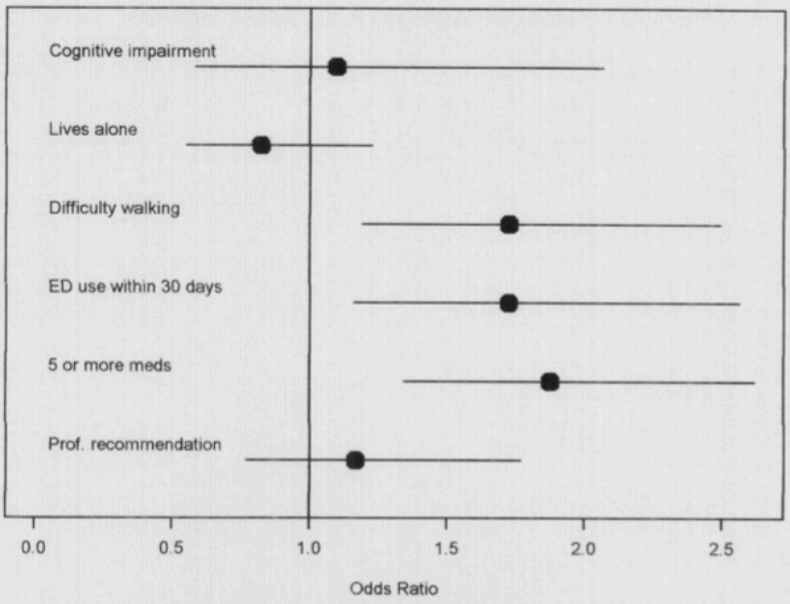
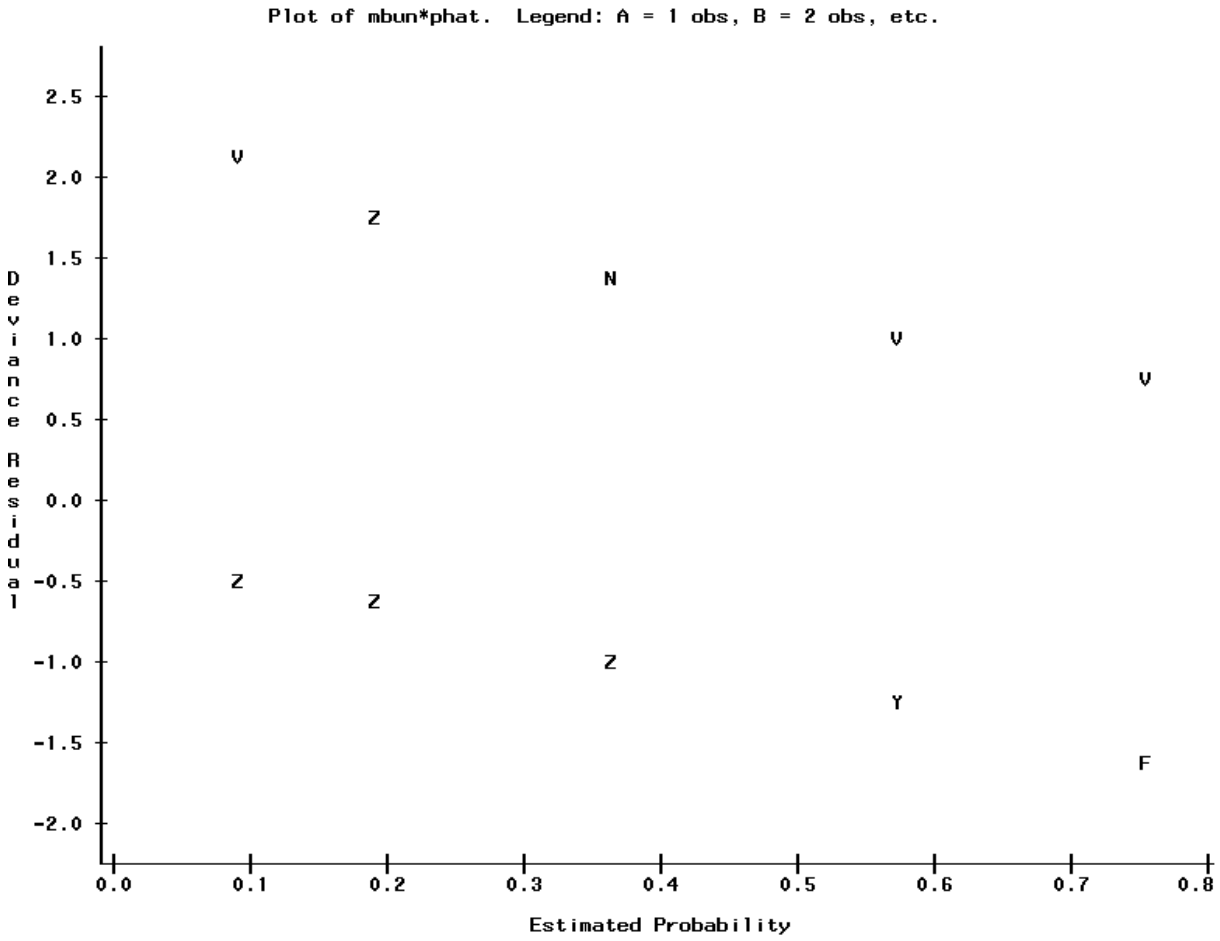


Figure 3. Results of the logistic regression fitting each of the six triage risk screening tool (TRST) items on composite outcome. Odds ratios and 95% confidence intervals are shown for individual items of the TRST for the composite outcome within 120 days. ED = emergency department.

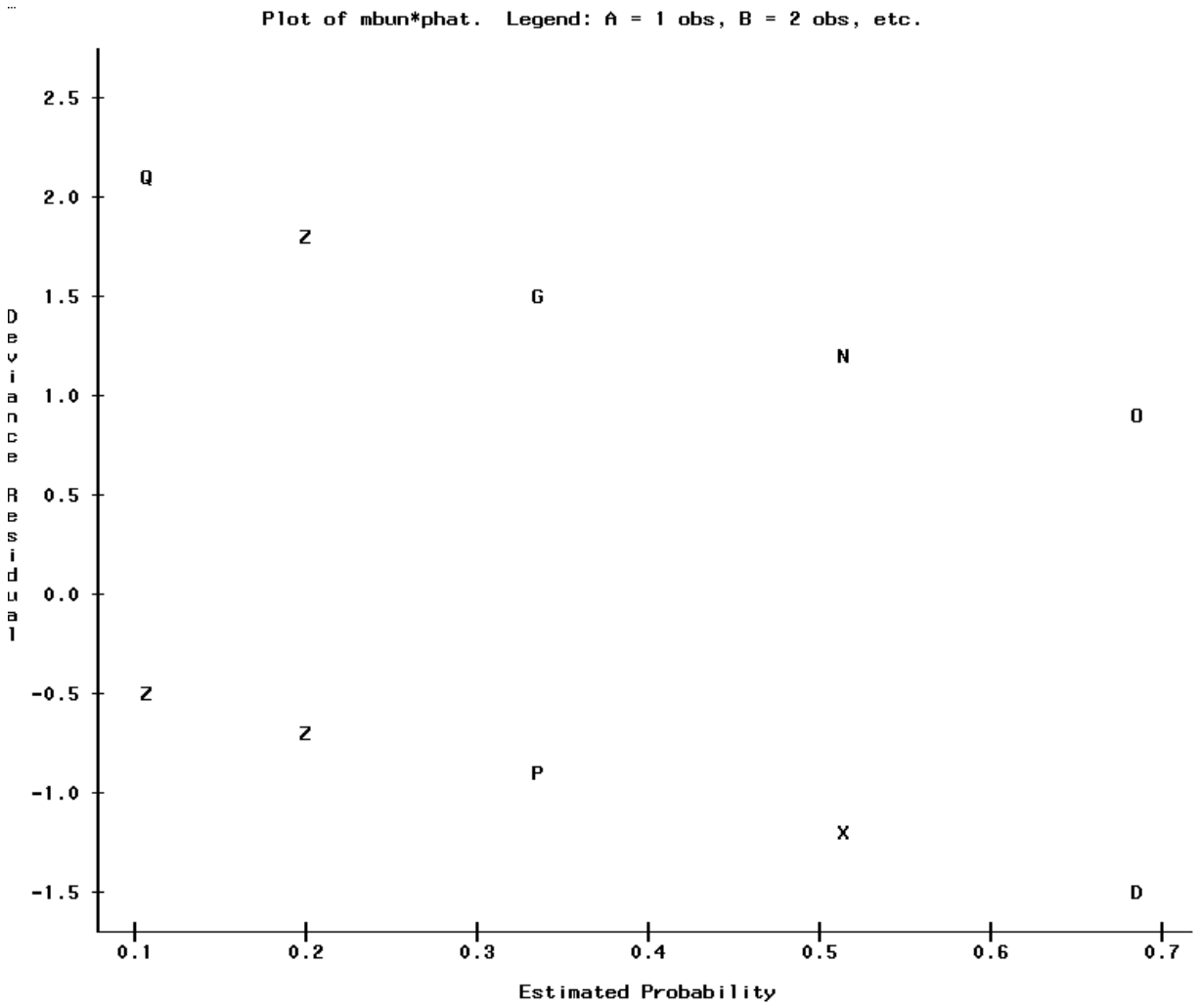
Source: Meldon et al., 2003

Appendix CC: *ALC/LTC Model* Deviance Residual Plot, MOPED Study, Derivation Sample Partition (N=647)



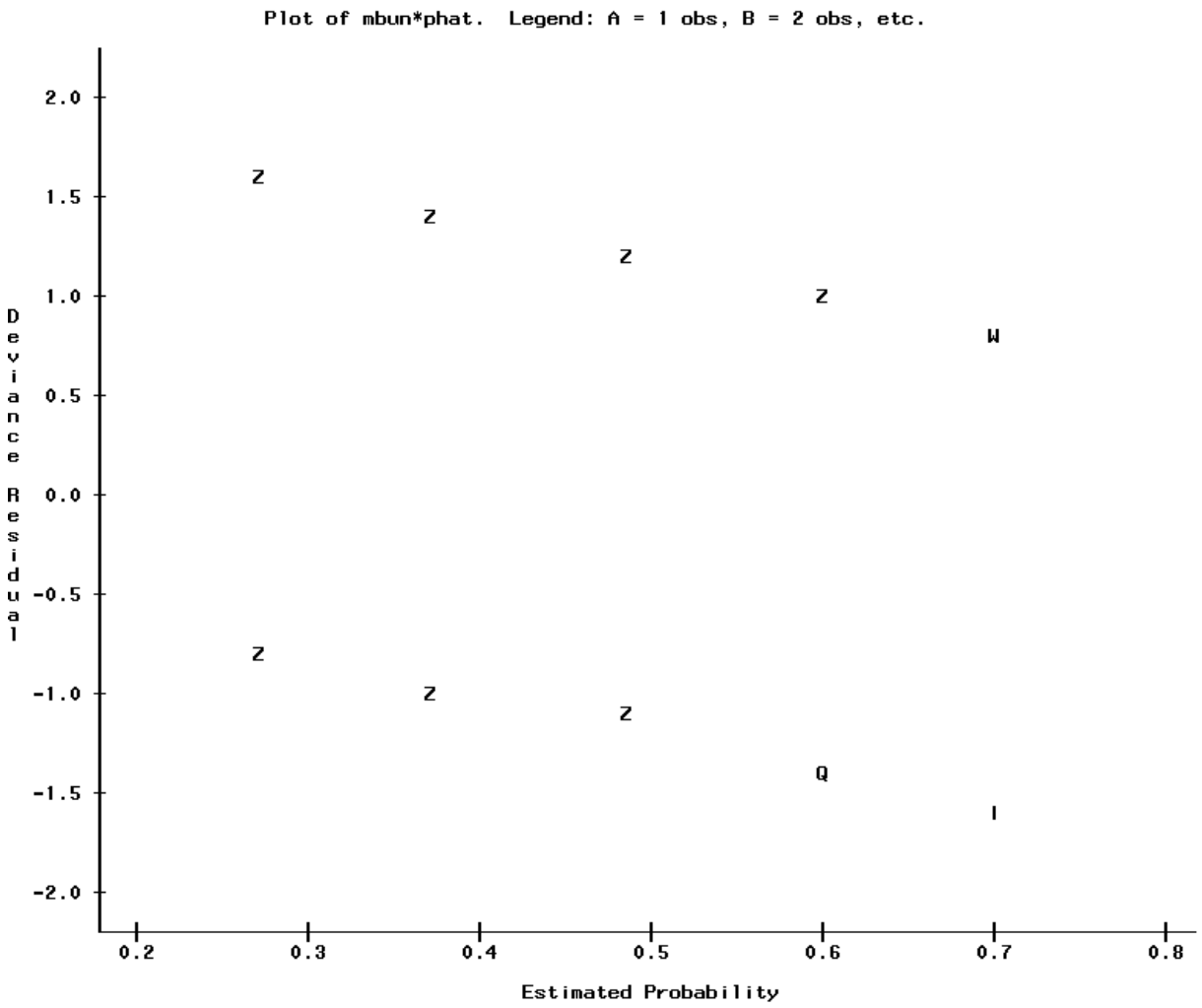
NOTE: 432 obs hidden.

Appendix DD: *ALC/LTC Model* Deviance Residual Plot, MOPED Study, Validation Sample Partition (N=436)

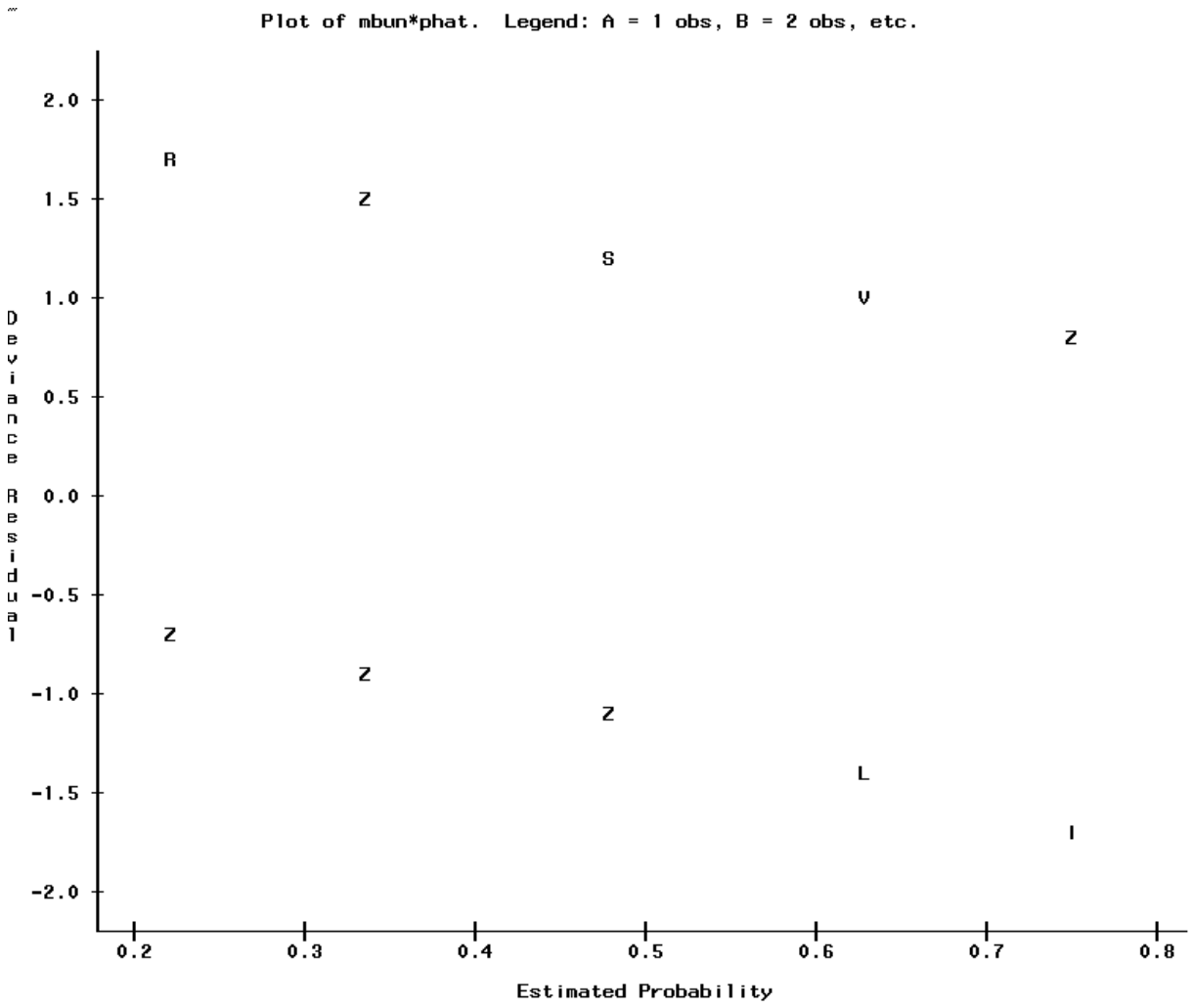


NOTE: 261 obs hidden.

Appendix EE: *ED Revisit Model* Deviance Residual Plot, MOPED Study, Derivation Sample Partition (N=523)



Appendix FF: *ED Revisit Model* Deviance Residual Plot, MOPED Study, Validation Sample Partition (N=352)



NOTE: 142 obs hidden.