Associations of Referral and Discharge Services with Trajectory of Health in Ontario's Complex Continuing Care Facilities: A Multilevel Approach

David Armstrong

Department of Psychology

Lakehead University, Thunder Bay, Ontario

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Supervisor: Michael Stones, PhD

Internal Examiners: John Jamieson, PhD; Peter Brink, PhD

External Examiner: Margaret Gibson, PhD

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Abstract

Province-wide use of the Minimum Data Set 2.0 allows for the development of placement algorithms based on standardized continuous assessment to balance need for continuing care with the least-restrictive environment. Further knowledge of the predictors of care serves to improve these placement algorithms. Due to increasing regionalization of health care services in Ontario and diversity of ways services interact, analytic techniques are required that embrace the contextual nature of health services. The purpose of the current evaluation was two-fold: (1) to explore the degree to which ratings of a patients' health are dependent on the context in which continuing care takes place (i.e. variation in scores attributable to hospital or region); and (2) understand the influence of both symptoms at admission and throughout hospitalization on subsequent need for continuing care. This evaluation examined 24 231 standardized quarterly health symptoms nested within 15 904 patients over age 50 that were admitted and discharged from Ontario's 124 Complex Continuing Care facilities between April of 2007 and March of 2009. Symptoms associated with the need for continuing care (activities of daily living, cognitive impairment, frailty, and aggression) and resource utilization were employed as dependent variables in multilevel modeling analyses. With respect to the first research question, as much as one-third of the variance in patient symptoms and resource utilization were associated with the hospital attended (i.e. occurred between-hospitals rather than solely within). This variation was only minimally accounted for by differences in the average age, sex, and length of stays between hospitals. With respect to the second research question, individuals referred from acute care and private homes were similar in symptom profiles but dissimilar in resource-intensity, while individuals from long-term care homes (LTCH) displayed higher levels of cognitive impairment and aggression. Over time, patients from acute care showed greater declines in symptoms, frailty, and resource utilization than other groups. Individuals discharged to LTCH were rated highest in queried symptoms (activities of daily living, cognitive impairment, aggression) and frailty, while those discharged to private homes were higher in resource intensity. Individuals discharged to acute care also experienced steeper declines in resource utilization on average than those discharged to acute care facilities. Future focused research into predictors of between hospital variability in outcomes and the surprising resource-intensity findings for those discharged to health care are suggested.

Associations of Referral and Discharge Services with Trajectory of Health in Ontario's Complex Continuing Care Facilities: A Multilevel Approach

While the conception of the aging process as frequently associated with poor health has lost favour, there is nevertheless an increased risk for functional decline particularly in adults over 85 years of age (e.g. Ferraro, 2006). This risk can be due to physical decline or frailty, increased stressors and mental health problems, declining support systems, and various interactions among these factors (Aldwin, Spiro & Park, 2006). Health status is a major determinant of objective quality of life and is the strongest single predictor of subjective well-being, while also mediating the effects of demographic and socio-economic status on quality of life (George, 2006). As such, fully meeting the health care needs of seniors is of crucial importance for ensuring optimal physical and mental health through-out the aging process.

Towards this end, seniors use proportionally more ambulatory care, home care, complex continuing care, or long-term care services than any other age group (e.g., CIHI, 2004, 2005; Smith et al., 2005). In the past 100 years, there have been dramatic changes in service delivery to this sector of the population, culminating in the diverse set of services currently offered today. These changes have no doubt been shaped by an average life expectancy increase of approximately 29 years and a shift in the cause of death from acute to chronic illnesses (Aldwin et al., 2006). While heart disease remains the leading cause of death, the rates have halved since the 1950s. Other causes of death, in order of prevalence, include malignant neoplasms, cerebrovascular diseases, influenza and pneumonia, and chronic lower respiratory diseases (Aldwin et al., 2006).

Physical disease is only a coarse predictor of functional decline and death. For example, Mokdad, Markes, and Gerlerding (2004) estimate the leading antecedents to cause of death in the United States are not pathogens, but rather smoking, poor diet, low physical activity, and alcohol consumption. These health behaviours can impact the onset and course of a variety of chronic illnesses (Aldwin et al., 2006).

Psychosocial factors, such as personality, spirituality, and coping processes, can also affect functioning in old age. For example, increased hostility, anxiety, and depressive symptoms are risk factors for cardiovascular disease (Krantz & McCeney, 2002) and affect immune function (Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002). While older adults appraise events as less stressful than younger adults (Park, Aldwin, Snyder, & Fenster, 2005), and report fewer stressors (Aldwin & Levenson, 2001), there is some evidence to suggest avoidant coping mechanisms are associated with poor health in older adults (Aldwin et al., 2006). Spirituality has also been linked to lower rates of disease and higher quality of life, (George, Ellison, & Larson., 2002) with those who frequently attend religious services having lower mortality rates (Thoresen & Harris, 2002). Given that today's older adults may often survive many of the adverse health events that invariably led to death 100 years ago, health behaviours and psychosocial factors that influence the quality of life in the face of disability or chronic disease processes are increasingly a focus of research. Thus, not only is mental health important in service evaluation, but it is a moderator of the disease process requiring its own specialized supports.

To summarize, increases in longevity and rates of chronic (relative to acute) illness suggest that medicine can delay death in many cases while the support of disability and management of compromised health status has become a growing concern for informal (families, communities) and formal (social and health services) support systems. The risks of providing 'too little' support for the elderly patient can range from present distress and disability to a worsening of condition and decreased longevity (e.g. Bouchardy et al., 2003; Loyd-Jones, Evans, & Levy, 2005; Resnik & Rehm, 2001). 'Too little' support not only influences the identified patient, but can also increase caregiver burden which is associated with increased risk of mortality in the informal care provider (Schultz & Beach, 1999; Sorensen & Pinquart, 2005). There are also risks associated with providing 'too much' support. For example, hospitalization or other institutionalization may result in adverse events (e.g. pressure sores, falls, inappropriate treatment) that can result in irreversible declines in functional status and quality of life (Hoenig et al., 1991). Individuals in long-term care homes also have fewer family members (Wolinsky, Callahan, Fitzgerald, & Johnson, 1992), report increased loneliness (Pinquart & Sorensen, 2001), and are rated as increasingly depressed and anxious (Guildner, Loeb, Morris, Penrod, Bramlett, Johnston, & Schlotzhauer, 2001) when compared to community dwelling elders. Given that psychosocial factors are a moderator of health in the elderly (as stated above), individuals inappropriately placed within residential care are not only at risk for medical problems as a direct result of adverse events, but also indirectly through the influence of institutionalization on overall health and quality of life. It follows then that to be of optimal effectiveness, continuing and acute care must judiciously detect and support disability while providing the least restrictive environment. In order to match changing needs with the appropriate response, sensitive and appropriate evaluation of those patient characteristics associated with future continuing-care need is crucial (as is subsequently elucidated).

The goals of the current investigation are to explore hospital and regional influences on select symptoms and resource-utilization in Ontario's hospital-based continuing care patients as well as understand the influence of both symptoms at admission and throughout hospitalization on the subsequent need for continuing care. These goals therefore reflect an attempt to understand varying needs for care on two different levels. First, at the level of the hospital or region, given that health care in Ontario is managed by regional Local Health Integrated Networks (LHINs) that vary widely in population density and integration needs. Secondly, at the level of the individual patient whose overall level of severity or speed of recovery or decline may differentially indicate future need for continuing care services. While these sorts of research questions are certainly not new, few analyses of continuing care attempt to integrate both levels into the same statistical models.

To inform an analytic strategy towards the research goals, the current literature review will survey the multiple formal healthcare supports in Ontario that are typically also used by continuing care patients to understand how systems are integrated together. Given the goal of detecting health care needs and informing placement, predictors of need at various stages in illness will be reviewed. Furthermore, the status of the literature will be reviewed with regard to standardized comprehensive assessments already in use for complex continuing care (specifically the Minimal Data Set 2.0), and resultant measurement issues. Finally, the influence of hospital and regional context on predictors of care will be reviewed with particular focus on the quantitative assessment of these issues. The purpose of these reviews are to inform research questions aimed at improving assessment and service delivery enabling the provision of the least restrictive care environment.

Current Formal Care for Older Adults

Providers of acute and continuing care within Ontario have traditionally been governed at the provincial level, with recent changes aimed to increase regional integration. A review of regional management of health care follows, leading to a discussion of the specific services that are part of the 'continuum of care'.

Management of Ontario Systems of Care

The need for extended or long-term care emerges from chronic and debilitating medical conditions that occur throughout life (Stone, 2006). Furthermore, people that need long-term care tend to have multiple chronic conditions often requiring primary and acute care when they are sick (Stone, 2006). It then follows that integration of these systems to provide "continuity of care" is essential to manage multiple needs. Significant changes have occurred over the last 15 years within Ontario that have influenced system capacity and process, which may also influence appropriate evaluation of the system.

Following an extensive review of alternative assessment and classification systems, continuing care facilities were mandated in 1996 to use the Resident Assessment Index (RAI) MDS 2.0, a comprehensive assessment tool to assist patient care and service planning (Hirdes, 2006). This period also saw extensive change planned in the hospital system via the *Health Services Restructuring Commission* established under legislation by the government to expedite hospital restructuring in Ontario. Recommendations in the final report (Health Services Restructuring Commission, 2000) specific to continuing care placements included:

- "Admission to chronic care hospitals/units for complex continuing care should be restricted to those whose needs require hospital care" (p. 59)
- "There should be a single and consistent process for assessing needs and determining eligibility. The funding system for LTC (including complex continuing care) should be unified and funding levels determined in relation to the needs of the residents regardless of the venue of care" (p. 59).

Furthermore, an identified barrier to health-care restructuring included "delays in moving to a single (unified) classification system for determining eligibility and placement into LTC facilities (including complex continuing care beds)" (p. 126).

In 1998, the Ministry of Health and Long-Term Care implemented regional Community Care Access Centers (CCAC) to provide access to government-funded home and community services and long-term care homes. By 2002, the RAI-Home Care assessment was mandated for all home care clients (through CCAC) who were expected to be receiving services for 60 days or more (Hirdes, 2006).

In 2006, the Ontario government transferred significant decision-making power to the community level through the Local Health System Integration Act. Local Health Integrated Networks (LHINs) were established with the authority to engage their communities, proactively plan an effective service system, facilitate integration and system transformation, and manage the overall funding of the health system within their devolved authority. Under the LHIN model, local service providers retain their focus on service delivery, their individual corporate identities, and their local Boards.

Implementation of the MDS 2.0 is currently underway for all long-term care facilities in the province (Hirdes, 2006).

Community Care Access Centre. Community Care Access Centres (CCACs) are local organizations recently established by the Ontario Ministry of Health and Long-Term Care to coordinate government-funded home and community services and long-term care homes (Community Care Access Corporations Act, 2001). CCACs were to work with one another, as well as with physicians, hospital teams and other health care providers to enhance access and co-ordination for people who need care in the community. CCACs offer a single point of access to Ontario's home care and long term care services and provide the following: (1) arranging for visiting health and personal support services in people's homes (including nursing, occupational therapy, physiotherapy, speech-language pathology, nutritional counselling, social work, home making or personal support, and medical supplies and equipment); (2) Authorizing services for special needs children in schools; (3) Managing admissions to long-term care facilities; and (4) Providing information and referrals to the public about other community agencies and services.

Integration of CCAC with other organizations has been examined before. Brown and colleagues (2003) surveyed the number of hospitals in Ontario making efforts towards varying levels of integration. This indicator requires that emergency departments (EDs) be involved with CCACs in at least two of the following four activities: working with CCACs to 1) understand why patients were sent to the ED as a back-up for in-home care; 2) develop strategies to prevent ED visits where a breakdown of in-home services might lead to ED visits; 3) ensure appropriate referrals were made to the CCAC intake case managers; and 4) become involved with CCAC staff in the planning and/or evaluation of ED services as they relate to the community and the hospital. The results show that overall, 69.5% of Ontario EDs report being involved in at least two of the four selected activities, with the highest frequencies reported by hospitals in the Greater Toronto Area (Region 3: 83.3%) and the South-central region (Region 4: 90.0%). The most frequently-reported collaborative activity involved ensuring appropriate referrals to CCAC intake coordinators (83.3%). At least 40% of Ontario EDs also reported involvement in the other three activities. In addition, EDs in teaching hospitals reported more involvement with CCACs than community or small hospitals (Brown et al., 2003).

Collaboration with CCACs is vital. Reduction in the number of inpatient beds and lengths of stay make the linkage between hospital and home care services essential to ensuring a smooth transfer between the two. The ED System Integration and Change survey (Brown et al., 2003) explored the challenges faced by EDs in their collaboration with CCACs. The most common challenges reported by EDs included time, financial and staff resource shortages. In addition, hospitals that deal with multiple CCACs reported variations in program practices and resources among the different CCACs with which they collaborate (Brown et al., 2003).

Home care

An increasing older population and the desire to reduce acute health care costs have contributed to the growth of home care services (Smith et al., 2005). In Canada, homecare expenditures in 2001 totalled approximately $3.1 billion, accounting for 3.3% of total health care expenditures (MacAdam, 2004). Despite the recent growth in home health services, data on clinical outcomes and acute health care utilization among older adults receiving homecare services are sparse. Obtaining such data is particularly relevant in Ontario where an increasing number of frail seniors receiving homecare are awaiting placement in long-term care facilities (Smith et al., 2005). The interaction of homecare planning, acute care services, and long-term care is particularly relevant, as preliminary data indicates 50% of the elderly receiving homecare visit the hospital within 200 days of intake (Smith et al., 2005).

In Ontario, elderly people experiencing gradual decreases in functioning are referred to and assessed by CCACs who arrange for the required interventions to facilitate living in the community until eventually they hit a threshold of deficits that require regular nursing care within an institutional setting. Those experiencing sudden decreases in functioning (due to a single disease or converging multiplicative factors) are often treated in acute care hospitals and may then be referred to hospital-based continuing care services (known as Complex Continuing Care in Ontario) or CCAC for supportive services or placement within a Long-term Care Home (LTCH) depending on the requirements of care.

A number of services can be delivered through home-care (Ministry of Health and Long-Term Care, 2002a). *Visiting health professionals* include nurses, physiotherapists, occupational therapists, social workers, speech-language pathologists and dieticians. These professionals provide assessment, care planning and education. *Personal Care and Support* consists of assistance with personal hygiene, transferring or positioning into chairs, vehicles or beds, dressing and undressing, assistance with eating, assistance with toileting and transportation to appointments. *Homemaking services* provide assistance with routine household activities including menu planning and meal preparation, shopping, light housecleaning and laundry, and paying bills or banking. Finally, *community support services* (provided in the home or community) include security, transportation, meal services, congregate dining, caregiver respite and support groups, foot care, social and recreational services, home maintenance and repair, and supportive housing.

Acute Care

Emergency Department. Care within the general hospital setting is perhaps the most salient form of medical care. Ontario's 123 hospital EDs see approximately 4 million patients annually or about one in five Ontarians (Brown et al., 2003). Ontario EDs provide emergent, urgent, and non-urgent care to a high volume of patients of all ages who present with a wide range of clinical conditions and a varied complexity of care needs. The varied and complex functions of the emergency department include rapid assessment, initial triage, confirmed diagnosis, appropriate and timely treatment, and disposition to the appropriate level of care in hospital or the community. In some communities without ready access to family physicians, the ED is the first point of care for patients. Those 65 years of age and older account for 18.4% of total ED visits with approximately 56.6% of this age group visiting an ED over the course of the year (CIHI, 2005). Ten percent of emergency visits are subsequently admitted to the hospital (CIHI, 2005).

Ambulatory Care. Ambulatory Care provides outpatient care for people with conditions (often known as Ambulatory Care Sensitive Conditions: ACSC) that may require continual assessment or treatment services to prevent hospitalization. For

Ambulatory Care Sensitive Conditions (angina, asthma, chronic obstructive pulmonary disease, diabetes, epilepsy, heart failure and pulmonary edema, and hypertension as defined by CIHI, 2009), those over the age of 65 represent the highest users of acute care services. This group had 1858 hospitalizations per 100 000 in 2006, which is contrasted to a rate of 383 per 100 000 for all age groups in 2004-2005 (15 777 in total for 2004-2005 fiscal year) (CIHI, 2006). Location in the province also influences hospitalization rates, with the Northeast and Northwest Local Integration Health Networks having almost twice the rate of hospitalizations than the provincial mean (CIHI, 2006).

Changes. Over the past 10 years, there have been changes internationally in acute health care for the elderly. In an Italian sample (Marengoni & Cossi, 2006), elderly patients (65+) admitted between 2003-2005 (n=1476) were older and more likely female than patients admitted between 1998-2000 (n=858). In a logistic regression equation, adjusting for sex, comorbidity, and cognitive and functional status, elderly patients in 2005-2006 were more often widowed, had shorter lengths of stay, and a higher proportion required a full-time caregiver. The authors suggest that the shorter length of stay is mainly due to national policy requirements aimed at controlling expenditures such as reducing the number of admissions and shortening average length of stay. Shorter hospital stays compared to 10 and 20 years ago are also evident in Canadian hospitals (Canadian Institute for Health Information, 2005b). This is worth noting, as (1) there may be a higher need for extended care (post-acute care) as the acute care system may be less able to offer observation and treatment of transient conditions that decrease level of functioning / increase care; and (2) admissions to acute care may not be as strong of a predictor (flag) of decreasing functioning, as more people may be treated and released at the emergency department rather than being admitted.

Towards the first point, authors reporting on an American sample also note acute hospital stays becoming progressively shorter (Bergmann, Murphy, Kiely, Jones, & Marcantonio, 2005). They identify a need for management of delirious post-acute care patients, as "persistent delirium is no longer a contraindication to hospital discharge but often prevents return home" (Bergmann et al., 2005, p. 1817).

Continuing Care: Complex

In Ontario, facility-based continuing care is provided in both hospital and residential care facilities (long term care homes). Hospital-based Complex Continuing Care (CCC, otherwise known as extended, auxiliary, or complex care), consisting of the most resource-intensive patients within the continuing care system (Stones, Brink, Smith, & Nytko, 2006; Health Services Restructuring Commission, 2000) is provided in Ministry of Health and Long-Term Care (MoHLTC) designated chronic care beds. These beds are either in free-standing complex continuing care and rehabilitation hospitals or in designated beds or units within acute care hospitals. One-hundred and six hospital corporations have designated CCC beds, providing over 2 million cumulative complex continuing care days annually. In 2005-2006, this represented 24 000 patients (CIHI, June 2007). Seventeen percent of these patients were aged 19 to 64, 65% were age 75 and older, and 28% of patients were age 85 and older (CIHI, June 2007). The most common medical diagnoses of these patients include: stroke (22.9%); dementia (22.9%); depression (18.6%); chronic obstructive pulmonary disease (15.2%) and ateriosclerotic heart disease (12.8%) (Perlman & Hirdes, 2008).

As previously noted, CCC patients represent the most medically resource intensive patients outside of acute care. Approximately 45% of CCC patients are within the most intensive Resource Utilization Group (a measure that will be discussed subsequently) of 'special rehabilitation' (CIHI, May 2005) while 21% to 19% of patients 65 to 74 and 75 or greater (respectively) have total dependence in activities of daily living (ADLs; CIHI, June 2007). Half (50.9%) of patients in CCC are rated to be either dependent or totally dependent in ADLs (Perlman & Hirdes, 2008). Discomfort is relatively common of CCC patients, with 48% of patients age 65 to 74, and 43% of residents 75 and older being rated as experiencing pain daily (CIHI, June 2007). Twenty-one percent of patients age 65 to 74 and 18% of patients greater than age 75 had no indication of health instability or frailty (as rated by a 0 on the Changes in Health, End-Stage Disease, Signs and Symptoms scale). The majority of patients also had some cognitive impairment: 12% of patients in both age groups were rated as having very severe cognitive impairment as opposed to 27% and 12% (65 to 74 and 75 or older respectively) of patients who had no cognitive impairment (CIHI, June 2007).

Changes. There is evidence of changes in clients and the process of care over the past 10 years within CCC facilities in addition to acute care. The number of new residents increased from 1999-2000 to 2003-2004 as demonstrated by an increase in the proportion of admission assessments from 37.1% to 49.5% (CIHI, May 2005). Correspondingly, admission length-of-stay (LOS) have reportedly declined over time, in that by 2002–2003, at least 50% of admissions had a LOS of 29 days or less and only 21% of admissions had a LOS of 90 days or greater (CIHI, 2004).

In 2003/04, Ontario hospitals reported a total cost of $798.4 million related to complex continuing care programs, representing an increase in daily cost from $286.17 in 1999-2000 to $379.39 in 2003-2004 (CIHI, May 2005). This increased cost may partially reflect serving patients with higher needs. There has been an increase within the same time period in the proportion of residents in the most intensive Resource Utilization groups: an increase of 38.9% to 45.4% in the most intensive group 'special rehabilitation', as well as an increase from 9.9 to 13.8% for the second most intensive group, 'extensive care' (CIHI, May 2005). The average resource intensiveness of clients (as measured by the mean assessment case mix index) also increased from 0.995 to 1.117 (CIHI, 2004). A downward trend in ADLs of the most independent residents admitted has also been noted (CIHI, May 2005).

The increasing resource intensity of clients reflects the increases in complexity of cases. For example, the proportion of assessed residents receiving more than 10 different medications in the last 7 days has substantially grown between financial years (FYs) 1996–1997 and 2002–2003 (CIHI, 2004). With respect to those medications specifically monitored by the Minimal Data Set (MDS), noticeable increases are observed in the proportion of assessed residents receiving daily antipsychotic, antidepressant, and diuretic medications (CIHI, 2004). Increases have been seen in the rates of admission (by 18%), skin treatments, those receiving dietary supplements between meals (19.7 to 38.7%), scheduled toilet plans (19 to 37.1%), rehabilitation / restorative care interventions from nurses, at least one hospital stay (30.3 to 57.5%) or ER visit (19.7 to 38.3%) in the 90 days previous to admission, and polypharmacy interventions from 1996-1997 and 2002-2003 (CIHI, 2004).

Continuing Care: Residential Services and Long-term Care Homes

Supportive housing (or supportive living) is designed for people who only need minimal to moderate care - such as homemaking or personal care and support – to live independently. Accommodations usually consist of rental units within an apartment building. In a few cases, the accommodation is a small group residence (Ministry of Health and Long-Term Care, 2002b). *Retirement homes* are privately owned rental accommodations for seniors who also require only minimal to moderate support with their daily living activities. CCAC is not involved in placing people within these facilities (Ministry of Health and Long-Term Care, 2002c).

Long-term care homes (LTCHs) are designed for people who require the availability of 24-hour nursing care and supervision within a secure setting (Ministry of Health and Long-Term Care, 2002d). In general, long-term care homes offer higher levels of personal care and support than those typically offered by retirement homes, supportive housing, or home-care but have less-intensive care needs than Complex Continuing Care (Stones et al., 2006). In general, residents of long-term care homes have equivalent activity of daily living ratings to complex continuing care patients (Perlman & Hirdes, 2008) with lower resource intensity needs (Stones et al., 2006) and health instability (Perlman & Hirdes, 2008). There is however a higher proportion of severe cognitive impairment in residents of LTCHs (Perlman & Hirdes 2008).

General Predictors of Continuing Care

Preventative Care

Medically frail patients are prone to suffering additional disability in hospital due to a higher risk of adverse events, defined as an unintended injury caused by medical management. Limiting the possibility of experiencing adverse events, poor recovery, or loss of ability during severe illness may serve to moderate functional decline (e.g. Covinsky et al., 2003). It therefore makes sense to identify people before they have a hospitalization that subsequently requires continuing care. For example, if number of previous emergency department visits is predictive of hospitalization and subsequent priority LTC placement, then perhaps an intervention could be provided to those people with high amounts of emergency department visits to prevent subsequent hospitalization.

Part of the task is to appropriately identify individuals who require increased supports to prevent hospitalization. People may have needed services but not sought help, or have not needed services but are then struck by event(s) (including iatrogenic or interaction of various conditions) that are associated with a sudden decrease in functioning. One way to delay institutionalization is to monitor those people receiving home care services for changes in functioning that may be predictive of a hospital admission (and therefore limiting iatrogenic risk). Another way would be to monitor people in hospital to differentiate those who are experiencing a permanent functional decline from those with transitory disability. Therefore general and specific predictors of extended care (including conditions such as delirium, stroke, pneumonia, and spinal injury) are reviewed.

Predictors of hospital admissions. In a retrospective cohort analysis of community-dwelling individuals aged 70 and older (n=7541) it was found poor self-reported health, living with a non-relative, and those with impairments in ADLs are more likely to be hospitalized. Hospital visits (either admissions or ER visits) for elderly persons receiving home care in Ontario are associated with comorbidity, poor nutrition, and renal disease (Smith et al., 2005). In a pilot study conducted in Hamilton, Ontario (n=123), 30% of seniors in their sample receiving homecare services had an emergency department visit or hospital admission within 100 days of the study commencement, while 50% of the sample had used acute care services within 200 days (Smith et al., 2005). Research using the RAI-HC data in a larger sample (n=1291) found seniors living alone, experiencing economic hardship, having previous hospital admissions, or greater than 4 comorbid diagnoses were independently associated with hospitalization (Landi et al., 2004).

Identifying needs within hospital

In contrast to gradual decreases in functioning that may be appropriately serviced in the least-restrictive environment within the community, sudden decreases in functioning are seen in acute care hospitals. Those experiencing sudden significant decreases in functioning (due to a single disease or converging multiplicative factors) are often treated in acute care hospitals and may then be referred to CCAC for supportive services, CCC, or placement within a LTCH depending on the person's medical needs, functional limitations, and the ability of existing community services to meet these needs. Clients new to CCAC that have single assessment in hospital before going to CCC or LTCH may be below community threshold for care (assessed as unable to be cared for adequately in the community). Unfortunately, this is conceivably when a patient is near their worst, and acute conditions contributing to functional impairment make accurate assessment of abilities difficult.

Predictors of extended hospitalization

Predictors of extended hospitalization are important to review, as it may identify the need for extended care beyond what acute hospitalization may be able to provide. Prolonged hospitalization can also increase chances of adverse events while in hospital that may lower functional status (Hirsch, Sommers, & Olsen, 1996).

Lang and colleagues (2006) prospectively and randomly sampled 1306 patients aged 75 and older that were hospitalized through an emergency department (908 participated). Cognitive impairment (< 25 on the Mini-Mental Status Examination or MMSE) was the only marker for a stay exceeding 30 days (Odds Ratio (OR) =2.6). Walking difficulties (OR=2.6), fall risk (OR=2.5), cognitive impairment (OR=7.1), and malnutrition risk (OR=2.5) were found to be early markers for prolonged stays. Notable was that ADLs were not associated with prolongation.

Zanocchi and colleagues (2003) prospectively sampled 1054 consecutive acute care patients, and found independent predictors of hospitalization length included the ADL index (number of lost ADL functions) and pressure sores, as well as diagnoses of hip fractures, Peripheral Arterial Disease with critical ischemia, and low levels of sodium.

As adverse events such as pressure sores are predictors of hospital length (and therefore extended care needs), Mecocci and colleagues (2005) prospectively sampled 13 729 patients (65 + years) consecutively admitted to acute care. Cognitive impairment, advanced age (85 + years), length of stay (more than 3 weeks) and severe disability independently predicted development of pressure sores, incontinence, and falls during stay in hospital. Similarly, perioperative delirium is also associated with longer lengths of stay, as well as greater cost, complications and poor recovery (Weed et al., 1995; see also Dasgupta & Dumbrell, 2006).

It has been shown that during hospitalization elderly subjects have higher risks of adverse events. These events result in prolongation of hospitalization or disability at discharge compared to those without such events (Brennan et al., 1991). Adverse events are more likely to result in irreversible decline in functional status (Covinsky et al., 2003), and an increased rate of placement in nursing homes after discharge (Lamont et al., 1983). Hospitalization following an acute illness is associated with a loss of independent physical function for 25-60% of older patients (Palmer, 1995).

Interventions aimed at treatment of one problem area may increase risk of other problems. For example, being prescribed new medications in the past 90 days, use of hypnotics and use of antipsychotics are associated with falls in Ontario Continuing Care patients (CIHI, February 2007). Adverse events associated with increased susceptibility to various stresses due to the aging process, often cause an irreversible decline in functional status and a change in quality and style of life after discharge (Hoenig et al., 1991).

Predictors of extended care placement following hospitalization

Results from the Canadian Study of Health and Aging (Hebert, Dubois, Wolfson, Chambers, & Cohen, 2001) suggest that a single universal 'cut-off point' to identify those eligible and not-eligible for long-term care is inappropriate. Predictors of institutionalization in this 5 year longitudinal study involving 326 community-dwelling individuals with dementia included both patient specific factors (Alzheimer's disease: HR (Hazzard Ratio) = 1.83; and severity of disability: $HR_{total\ impairment}$ = 4.02) as well as informal-support factors (caregiver age over 60: HR = 1.83; caregiver not a spouse or child: HR = 1.55; and severe caregiver burden: HR=1.71). Caregiver burden was equally associated with the caregiver's depressive mood (r=.55) and the care-receiver's behavioural disturbance (r=.55). As will be described subsequently, the recipients of care and the quality of care can vary between facilities or regions (e.g. Arling, Lewis, Kane, Mueller and Flood, 2007; CIHI, 2006, 2009; Huizing, Hamers, de Jonge, Candel, & Berger, 2007; Sørbye et al., 2009) and it is easily hypothesized that changes in the composition, funding, and policies of institutions or regions would also effect risk of institutionalization.

Given the emphasis of current standardized assessment in Ontario on individual factors (e.g. Hirdes, 2006), this section will focus specifically on factors within the individual rather than the context (which will be reviewed later). Overall, a meta-analysis of 77 reports from 12 longitudinal community-based data sources in the United States suggests the three strongest predictors of nursing home admission within 1 to 10 years was: (1) three or more daily living dependencies (95% CI OR = 2.56-4.09); (2) cognitive impairment (95% CI OR = 1.44-4.51); and (3) prior nursing home use (95% CI OR = 1.89-6.37) (Gaugler, Duval, Anderson & Kane, 2007). This focus on physical functioning / ADLs and cognitive impairment is consistent with earlier narrative reviews (Stuck, Walthert, Nikolaus, Bula, Hohmann, & Beck, 1999), and Canadian longitudinal studies (e.g. Hebert et al., 2001), and is reflected in the current review of frailty and delirium, dementia, stroke, as well as depression and mood.

Frailty, operationalized as simply the proportion of deficits present in an individual (for example, 3 deficits out of 20 present, 3/20=.15) is related to risk of institutionalization (Rockwood, Mitnitski, Song, Steen & Skoog, 2006). Frailty as defined by the American Medical Association is evidenced by 3 or more of the following symptoms: low physical activity; muscle weakness; slowed performance; fatigue or poor endurance; and unintentional weight loss. Frailty has also been operationalized in the Minimum Data Set 2.0 via the MDS-Changes in Health, End-stage disease and Symptoms and Signs (CHESS) scale, a strong predictor of mortality, physician activity, complex medical procedures, and pain (Hirdes, Frijters, & Teare, 2003). Some form of health instability (CHESS scores above 0) are noted in 40.5% of Ontario LTCH residents and 82% of CCC patients. Similarly, ADLs have been suggested to be inversely proportional to risk of nursing home admission in meta-analytic (OR 95% CI = 2.56-4.09, Gaugler et al., 2007) and other large studies (Hebert et al., 2001). Finally, resource utilization in healthcare can also be used for prognosis, as approximately 95% of patients in the heaviest care categories in the LTCHs remain the same (50% of total) or get worse (45% of total) whereas within the light care categories, 75% of individuals stay the same with 20% percent getting better within 90 days (Stones et al., 2006).

Delirium, defined as a transient cognitive impairment (APA, 2000), is an independent predictor of admission to LTCH (Laurila, 2004; Edlund et al., 1999; Marcantonio et al., 1994), with 43 to 67% of all delirium patients residing in LTCHs (Lurila, 2004). Similarly, 91 to 98% of delirium patients reside in LTCHs or are deceased within two years (Laurila, 2004). Based on a meta-analysis of longitudinal studies, cognitive impairment in general was associated with an increased risk of nursing home admission (OR 95% CI = 1.44-4.51) (Gaugler et al., 2007). While the current author is unaware of data relating to proportions of individuals in varying Ontario health care facilities specifically with delirium, severe cognitive impairment (defined as a score of 5 or 6 on the Cognitive Performance Scale of the MDS 2.0) is evident in 22.3% of Ontario CCC patients and 36.7% of Ontario LTCH residents (Perlman & Hirdes, 2008).

Of patients with delirium, 29% experience symptoms lasting over 24 hours, and 31.6% of patients that are discharged from hospital still experience symptoms sufficient for a diagnosis. Of these, cognitive impairment (inattention, disorientation and memory impairment) are the symptoms most frequently diagnosed. In patients with co-morbid dementia, the course of delirium is longer. After two months, MMSE scores of those with transient and recovered delirium (by discharge) are similar (McCusker, Cole, Dendukuri, Han, & Belzile, 2003).

Predictors of potential delirium (defined by MDS criteria) were cognitive impairment, not having a diagnosis of hemiplegia, presence of an indicator of depression, anxiety, or sad mood in last 30 days, deterioration in ADLs compared to status 90 days previously, renal failure, diagnosed with a terminal illness, increased bowel incontinence, a wound infection, or urinary tract infection. Environmentally, patients with an increased number of daily physician order changes were at higher risk for potential delirium.

In a prospective study examining risk factors of delirium in patients admitted for acute hospitalization (*n*=126), 29% had a prevalent delirium (using the Confusion Assessment Method) either present at admission or developed within 48 hours after admission (Korevaar, van Munster, & de Rooij, 2005). The most important independent risk factors for a prevalent delirium after acute admission were cognitive (MMSE and the Informant Questionnaire on Cognitive Decline, IQCODE) and physical (KATZ-ADL scale) impairment and a high serum urea nitrogen concentration. Of particular interest was that Korevaar and colleagues (2005) found that physical impairment mediated the relationship between age and delirium. In a review of 22 studies, Dasgupta and Dumbrell (2006) found cognitive impairment (r=.27 to .29), increased age (r=.03 to .59), functional dependence (r=.35 to .45), alcohol abuse and electrolyte disturbances increased risk for delirium, which is consistent with clinical prediction rules (Marcantonio et al., 1994). Further correlates of delirium included depression (r=.23 to .56), preoperative psychotropic drug use (r=.20 to .26), presence of psychopathological symptoms (r=.37 to .46), greater comorbidity (r=.15 to .19), and institutional residence (r=.08 to .11) (Dasgupta & Dumbrell, 2006).

Dementia is also significantly associated with long-term care placement, with approximately 75% of people with Alzheimer's disease eventually residing in nursing homes (Welch, Walsh, & Larson, 1992). Both dementia severity (Heyman, Peterson, Fillenbaum, & Pieper, 1997; Scott et al., 1997) and caregiver burden (Lieberman & Kramer, 1991) have been found to predict long-term care placement. Dementia has been reported in 63.1% of sampled Ontario LCTHs (early adopters of the MDS 2.0) and 22.9% of Ontario CCC facilities (Perlman & Hirdes, 2008).

Of *stroke* survivors, approximately 20% live in rest homes or private hospitals (Bonita, Solomon & Broad, 1997), with a worse prognosis for older adults (Macciocchi, Diamond, Alvers, & Mertz, 1998). Data from Ontario indicates approximately 22% of individuals in LTCHs and CCC facilities are diagnosed with stroke (Perlman & Hirdes, 2008). Degree of general cognitive impairment and memory have been found to predict functional outcomes after stroke such as motor impairment, instrumental activities of daily living, and social integration (Fleming, Tooth, Hassell, & Chan, 1999; Goldstein, Levin, Goldman, Clark, & Altonen, 2001; Ozdemir, Birtane, Tabatabaei, Ekukulu, & Kokino, 2001; Robertson, Ridgeway, Greenfield, & Parr, 1997). Location of injury does not necessarily predict impairment (if subcortical structures are undamaged, see Macciocchi et al., 1998) as apraxia and pathological emotional reactions have both been found to predict dependency (in left-hemisphere and right-hemisphere stroke groups respectively, Sundet, Finset, & Reinvang, 1998).

Regarding patients hospitalized for community-acquired *pneumonia*, one study documented 36% developing functional decline at discharge, while 11% had persistent functional impairment at 3 months (Solh, Pineda, Bouquin, & Mankowski, 2006). While Serum TNF-α and comorbidity were independently associated with loss of functionality at the time of hospital discharge, lack of recovery in functional status at 3 months was associated with impaired cognitive ability and preadmission comorbidities (Sohl et al., 2006). Persistent functional impairment at 3 months, impaired cognitive function, and comorbidity was highly predictive of one year hospital readmission or death.

Depression is recognized both as a possible risk factor for dementia and also as a potential prodromal stage of the dementing process (Scwheitzer, Tuckwel, O'Brien & Ames, 2002; Jorm, 2001). Perlman and Hirdes documented diagnoses of depression in 24.4% of Ontario LTCHs (early adopters of the MDS 2.0) and 18.6% of Ontario CCC facilities. There is also evidence that the effects of depressive symptoms on neuropsychological functioning in the elderly are pervasive. For example, bereaved participants performed worse on some neuropsychological tests than non-bereaved individuals despite the fact that there was no greater incidence of affective disorders in the bereaved group (Xanier, Ferraz, Trentini et al., 2002). Depressive symptoms are also predictive of nursing home admission (Harris & Cooper, 2006; St. John & Montgomery, 2006). Harris and Cooper (2006) examined 137 000 people over 65 from the Health Outcomes Survey. Those answering "yes" to the question "In the past year, have you felt sad or depressed much of the time" were twice as likely to be admitted to a nursing home within 3.5 years (Hazard Ratio = 2.43). This relationship remained significant when controlling for demographic and comorbid conditions (HR = 1.38) and was the third greatest predictor of admission (surpassed by heart failure, 1.39, and diabetes mellitus, 1.42). In a Canadian example, St. John and Montgomery (2006) surveyed 1745 people, aged 65 and older at home, using the Center for Epidemiologic Studies Depression Scale as a measure of depressive symptoms. A gradient effect was observed as a function of depression and admission to nursing home, with higher depressive symptoms predicting increased percentage of people admitted to nursing homes within 5 years, in both cognitively impaired (MMSE>23) and unimpaired samples. This association remained significant when controlling for age, sex, education, living arrangement, and social support (AOR = 1.57, when MMSE added AOR = 1.52). Depressive symptoms no longer predicted admission when ADL or IADLs were added to the regression equation. In terms of risk factors for depression in elderly samples, Cole and Dendukuri (2003) conducted a meta-analysis of 20 prospective studies, finding female gender (OR=1.4), disability (OR=2.5), recent bereavement (OR=3.3), sleep disturbance (OR=2.6) and prior depression (OR=2.3) were associated with increased risk for subsequent depressive episodes.

While *challenging behaviour* is not often utilized as a predictor for functional status decline or need for continuing care in large studies, (e.g. Gaugler et al., 2007; Stuck et al., 1999), challenging behaviour such as verbal abuse or agitation significantly impacts care provision (e.g. Black & Almeida, 2004; Cohen-Mansfield, 1986; Cohen-Mansfield & Mintzer, 2005). As such it has been utilized in determining continuing care need in community samples (Fries, Shugarman, Morris, Simon & James, 2002; Hirdes, Poss, & Curtin-Telegdi, 2008). While data from the Canadian Study of Health and Aging does not support that behavioural disturbance is an independent predictor of institutionalization, it accounted for approximately 40% of the variation in caregiver burden which was in turn a risk factor for institutionalization within 5 years (Hebert et al., 2001).

One might also suggest that behavioural disturbance is a predictor of placement via its relationship with cognition. For example, behaviour problems and the Cognitive Performance Scale (CPS) of the MDS 2.0 shared an odds ratio of 12.06 (Stones et al., 2006). Stones and colleagues judged behavioural difficulties to be a redundant predictor of care needs in the context of cognition. However, impairment on the CPS accounted for 95.2% of scores indicative of behaviour problems whereas behaviour problems accounted for only 11.7% of residents with impaired cognition.

Identification, Evaluation and Planning

Standardized Comprehensive Assessments

Standardized comprehensive assessments have been described as particularly relevant in the care of people with multiple care needs. In the past, communication between institutions caring for the elderly has been difficult. Hirdes and colleagues

(2000) refer to the "Tower of Babel" problem: acute care, community care, and long term care all using different assessments to appropriately match services to the needs of elderly patients. Also, Hirdes (2006) identifies standardized comprehensive assessment as essential to address the complex needs of frail elderly people in which symptoms are often ambiguous, threats to health are multifactorial, and trajectories of change and outcomes are highly variable.

One potential solution has been the Resident Assessment Instrument (RAI) series of instruments, which can be combined to form an integrated system of health information linking home care facilities, long term care, acute care, and mental health services. The RAI 2.0 is a comprehensive assessment tool mandated for use in all licensed *nursing homes* in the United States since 1991 and administered with generally high inter-rater reliabilities by trained assessors (Hawes et al., 1995). The use of the RAI 2.0 has spread to over 20 countries since its introduction, with the first mandated Canadian implementation in Ontario complex continuing care facilities in 1996.

MDS for Individual Assessment

Care planning based on the MDS 2.0 links behaviours, symptoms, and problems with subsequent interventions. It differs from medical care planning that aims to link diagnosis with treatment, despite evidence of frequent anomalous combinations in long-term care (e.g., diagnosis without treatment; treatment without diagnosis) (Waintraub, Datto, Streim, & Katz, 2002). In a large-scale meta-analysis of 77 longitudinal reports using community-based samples, diagnosis added little-to-no predictive ability of nursing home admission (Gaugler, Duval, Anderson, & Kane, 2007). Problem areas similar to those purported to be measured by the MDS such as ADLs and cognitive impairment were much better predictors.

The RAI-Home Care (RAI-HC) includes 30 Client Assessment Protocols (CAPs) to flag potential problem areas such as pain, health promotion, social isolation, elder abuse, and falls, with the purpose of indicating whether further assessment is required. CAPs are triggered by clinical algorithms that determine whether various signs of a problem in health, function, or well-being are currently or imminently present. Similarly, the MDS 2.0 (conducted in long-term care) generates Resident Assessment Protocols (RAPs) in 18 domains (e.g. cognition, continence, restraint use, psychotropic drugs, etc.). Items from the RAI have also been used to document clinical severity (frailty) and subsequently predicting death.

Further to the 'binary' RAPS, other scales of health need have been constructed. While these are typically used by researchers and not as a guide to the clinician, they reflect specific health needs in the individual and are therefore also reviewed here.

Mood indicators. The first measure of mood available from RAI items is the seven item MDS Depression Rating Scale (MDS-DRS; Burrows et al., 1995), including the items *negative statements*, *persistent anger*, *unrealistic fears, repetitive health complaints*, *repetitive anxious complaints*, *sad facial expression*, and *tearfulness*. The internal consistency for responses on the Depression Rating Scale exceeded 0.7 in previous research (e.g. Koehler et al. 2005), with its validity established against depressive illness identified with the Hamilton Depression Scale (i.e., sensitivity of 0.94 and specificity of 0.72) and the Cornell Scale (i.e., sensitivity of 0.78 and specificity of 0.77) using the recommended cut-point score of 3 on the Minimum Data Set Depression

Rating Scale (DRS; Koehler et al., 2005). Against psychiatric diagnosis of major depression the sensitivity was 0.91 and the specificity was 0.69. (Borrows et al., 1995). Koehler and colleagues (2005) report poor internal consistency (α=0.58) potentially arising from the small number of items.

A second measure of depression, the simple sum of all symptoms in MDS section E1, is known as E1SUM (Koehler et al., 2005). E1SUM shares strong correlations with the DRS in cognitively impaired (r=0.85) and intact (r=.94) populations, with slightly higher internal consistency (α=.71 for E1SUM vs. α=.58 for DRS), and slightly lower proportion of residents at the floor level than the DRS (24.9% vs. 36.8%) (Koehler et al., 2005).

Gallo, Anthony, and Muthen (1994) suggest that many older people display *depression without sadness*, characterized by anhedonia and somatic complaints rather than by the dysphoric symptoms that are common in younger depressed people. Correspondingly, Stones, Clyburn, Gibson and Woodbury (2006) developed the Anhedonia Index (Stones et al., 2006), which includes two items from the MDS 2.0 on withdrawal (i.e., from *activities of interest*, and *social interaction*) and an item on anhedonia from the mental health version of the Minimum Data Set (i.e., *statements by a resident indicating a general lack of pleasure*). The Anhedonia Index predicts treatment for depression in the elderly but not diagnosis, perhaps reflecting an under-diagnosis due to a lack of dysphoric presentation.

Correlations between MDS indicators and popular self-report measures (e.g. the Geriatric Depression Scale, GDS) are often low or non- significant, while evidence for good reliability of both measures is evident (e.g. Anderson, Buckwalter, Buchanan, Maas

& Imhoff, 2003). Koehler and colleagues (2005) suggest that this may be due to each measure tapping a different construct and reflecting different data collection methods. For example, when MDS items have been converted into a self-report assessment device, it is highly-correlated with the Geriatric Depression Scale (GDS) (r=0.71, Ruckdeschel, Thompsong, Datto, Sreim, & Katz, 2004). For positive MDS depression symptom ratings, residents must visibly act by making negative statements, be easily angered, and display unrealistic fears to trigger MDS symptoms. The GDS asks residents if they are satisfied with their life, feel helpless or worthless, and are often bored. Thus, Koehler and colleagues (2005) suggest the GDS captures a "brooding mental set, reflective of a dysphoric personality trait or adjustment disorder…rather than the presence of major depression" (p. 7).

Cognitive Status Indicators. The Cognitive Performance Scale items include *comatose status*, *short-term memory*, *ability to make one's self understood*, *cognitive skills for daily decision making*, and *independence in eating*. The Cognitive Performance Scale (CPS) uses hierarchical scoring, with its validity established against the MMSE (Morris et al., 1994). Categories are defined by seven groups (0=intact, 1=borderline intact, 2=mild impairment, 3=moderate impairment, 4=moderate/severe impairment, 5=severe impairment, 6=very severe impairment). Existing research demonstrates the CPS provides an accurate and meaningful assessment of cognition among institutionalized populations (Hartmaier et al., 1995). The CPS has an acceptable internal consistency of 0.7 (Gruber-Baldini, Zimmerman, Mortimore, & Magaziner, 2000), and shares approximately 80% of its variance with the MMSE in a sample of long-term care residents (Landi, Tua, Onder, Carrara, Sgadagar, Rinaldi et al., 2000). In acute care, the ability to accurately detect dementia has been reported to be lower, with a moderate correlation (Spearman $\rho = -.60$) and moderate agreement in identification of dementia (K=.53) (Büla & Wietlisbach, 2009). To define severe dementia using the MDS, van der Steen and colleagues (2006) compared the CPS to the Bedford Alzheimer Nursing Severity Scale (BANS-S) in three cross-sectional studies. They found fair agreement between severe cognitive impairment as defined by the CPS (scores of 5 and 6) and the BANS-S scores (17 or higher) (kappa = 0.36), which significantly improved with the inclusion of ADL dependency (i.e. MDS ADL-SF, summing eating, personal hygiene, toileting, and locomotion). Perlman and Hirdes (2008) report some cognitive impairment (Borderline or 1, to Very Severe or 6) in 86% of Ontario LTCHs (Early Adopters of the MDS 2.0) and 76.6% of patients in Ontario CCC facilities. Severe cognitive impairment (scores of 5 or 6) was noted in 36.7% of LTCH residents and 22.3% of CCC patients.

Another proposed method to identify cognitively impaired clients (versus "cognitively-intact" clients) is to differentiate those that are rated as being comatose, and/or with a short-term memory problem and those who only rarely/never make themselves understood (Koehler et al., 2005). This matches a screening rule for the MDS versus GDS depression symptom assessment proposed in the US Centers for Medicare and Medicaid Services' (CMS) working draft of the MDS version 3.0 (as cited in Koehler et al., 2005). The current author is unaware of investigations demonstrating the validity of this technique.

Finally, the MDS Cognition Scale (MDS-COGS) is a nine-item measure asking about memory (two items: one related to short-term and one related to long-term memory); awareness of surroundings (four items: related to current season, location of room, staff faces/voices, and being in a residential care/assisted living facility); decision making and understanding (two items: one related to skills for daily decision making and one to ability to make oneself understood); and dressing performance in the previous 7 days (Hartmaier, Sloane, Guess, & Koch, 1994). Using a cut-off point of 2, the MDS-COGS was found to be highly specific (0.97) but not very sensitive (0.49) for dementia in a sample of long-term care residents without diagnoses subsequently confirmed by a neurologist (Zimmerman et al., 2007).

Physical Functioning Indicators. The MDS-ADL Long Form (ADL-LF) consists of summing seven items (bed mobility, transfer, locomotion, dressing, eating, toilet use, and personal hygiene). The MDS ADL Short Form (ADL-SF) consists of summing four items (eating, personal hygiene, toileting, and locomotion) (Morris et al., 1999). The ADL-SF sums the individual ADL items (ratings of 0 to 4) into a scale running from 0 to 16. Item scores of 8, indicating an activity did not occur, are then converted to 4. Validity and reliability of the ADL-SF has been adequate in earlier studies (Morris et al., 1999; Gerritsen, 2004; Gerritsen et al., 2004).

The Activities of Daily Living-Hierarchy Scale (ADL-H; Morris, Fries, and Morris, 1999) determines the degree of assistance required to perform ADLs. Items used in the ADL-H algorithm include eating ability, personal hygiene, ability to toilet oneself, and locomotion. The ADL-H scale uses 4 items in the MDS 2.0. It includes seven categories (0=independent, 1=Supervision, 2=Limited, 3=Extensive-1, 4=Extensive-2, 5=Dependent, and 6=Total Dependence).

Challenging Behaviour. A 16-item Behavior Profile reported by Gerritsen, Achterberg, Steverink, Pot, Frijters, & Ribbe (2008) displayed good internal consistency when totalled (α=0.83) with the exception of the conflict subscale, all others displayed acceptable internal consistency (α<0.70). The profile consists of 4 subscales: conflict (*repetitive persistent anger with self or others, verbally abusive behaviours, physically abusive behaviours, resisting care, conflict with or repeated criticism of staff*); withdrawal (*withdrawal from activities of interest, reduced social interaction*); agitation (*periods of restlessness, repetitive physical movements, wandering, socially inappropriate / disruptive behaviour*); and attention seeking (*negative statements, repetitive questions, repetitive verbalizations, repetitive health complaints, and repetitive anxious complaints/concerns*).

Perlman and Hirdes (2008) assembled a brief four-item Aggressive Behaviour Scale (ABS), consisting of the following items: verbally abusive behaviour; physical abusive behaviour, socially inappropriate or disruptive behaviour, and resisting care. Scores from Moderate (1 to 2) to Very Severe (6 or more) on the Aggressive Behavior Scale are noted in 54.8% of residents in Ontario LTCHs and 26.6% of Ontario CCC facilities (Perlman & Hirdes 2008). Perlman and Hirdes report acceptable internal consistency (α=.79), and good concurrent validity with the Aggressive Behaviour subscale of the Cohen-Mansfield Agitation Inventory (Cohen-Mansfield, Marx, & Rosenthal, 1989), r=0.72.

Frailty. Hirdes, Frijters and Teare (2003) developed the MDS-Changes in Health, End-stage disease and Symptoms and Signs (MDS-CHESS) scale from items involving vomiting, dehydration, leaving 25% of food uneaten, weight loss, shortness of breath, deterioration in cognition, ADLs, and end-stage disease. When regressed on mortality in chronic hospital patients, the MDS-CHESS score was associated with a hazard ratio of

1.6. In addition, existence of a do-not-resuscitate order (HR=2.0), ADL-LF (HR=1.2) and age (10 year increments, HR=1.14) also predicted mortality (Hirdes et al., 2003).

Overall Severity Indicators

RUG-III. In determining overall severity in long-term care to measure the care requirements of individuals, the RAI 2.0 uses case mix systems comprising of combinations of patient characteristics to identify groups of patients with homogeneous resource requirements. These systems typically describe the relative resource requirements of different groups. The Resource Utilization Groups (RUG-III) explains approximately 55 percent of variance in staffing time resource use, and its utility has been verified by studies in nine countries including Canada (see Hirdes et al., 2000 for a brief review). Heavier resource utilization on the RUG-III index includes categories 1 through 4 (termed Special Rehabilitation, Extensive Services, Special Care, and Clinically Complex respectively), evidenced by 'case-mix index' totals indicating use of resources above that of the average patient (Fries, Schneider, Foley, Gavazzi, Burke, & Cornelius, 1994). A RUG-III classification within Categories 1-4 indicates resource utilization believed to exceed the usual capacity of community resources (Stones et al., 2006) and similarly the Health Services Restructuring Commission (2000) specifies Complex Continuing Care is not appropriate for lower RUG-III scores. Stones and colleagues (2006) present data from Thunder Bay, Ontario in which only 5.1% of all individuals in CCC were in Categories 5 through 7, compared to 21.5% in CCC for 180 days or more (17.7% of which was the RUG category 7). Patients utilizing intensive services in the lightest care categories represent an opportunity for ensuring the least-restrictive environment. This also suggests closer examination of hospital patients with lengths-of-stay greater than 180 days. This is in contrast to 85.5% of LCTH residents, 69.6% of Home Care patients (including those waiting for LTCH and those who are not), and 70.8% of Home Care patients on the waitlist for LCTH (assessed to be within the lighter-care categories on the RUG-III).

Stones and colleagues (2006) examined Resident Assessment Index Health Infomatics Project (RAIHIP) data consisting of three waves of assessments with the RAI in LTCH (306, 306, and 224 assessments respectively). RUG-III ratings showed considerable stability when examining the 'meta-categories' of Heavier Care (Categories 1 through 4) and Lighter Care (Categories 5 through 7). Over 90 days, 78.4% of residents stayed within the same meta-category whereas 76.9% were stable over 180 days. As previously cited however, prognosis varied substantially based on meta-category. Residents in Heavier Care categories required the same (50%) or heavier resources on subsequent 90-day assessment (45.95%), whereas those in Lighter Care required the same (75.39%) or fewer resources (20.24%).

Method for Assigning Priority Levels. While the current author reviewed general predictors of care, use of this information to guide clinical decision-making at the idiographic level has proven extremely challenging. Miller (1997) developed an algorithm to demonstrate that the RAI-HC could be used by CCAC's to identify persons eligible for long term care facility placement. There were difficulties in using this algorithm to account for placement in long-term care given overly vague and overly-inclusive eligibility criteria for LTCHs (Hirdes et al., 2000). Certainly it would be naive to believe that current placement decisions are based off static and universal heuristics regarding clinical severity, which perhaps makes the argument for multilevel modeling more salient. Other home-care algorithms have again proven not to be a good match for Ontario's system (for a brief review, see Hirdes, Poss, & Curtin-Telegdi, 2008) and as such Hirdes and colleagues (2008) recently published the Method for Assigning Priority Levels (MAPLe) to prioritize access to community and facility based services for home care clients. The MAPLe represents a hierarchical analysis of ADL Impairment, the CPS, behaviour, decision making skills and other items to place clients in very high, high, moderate, mild, or low priority, with higher priority indicating increased frailty / higher level of care needed (rather than blanket statements regarding LTCH eligibility). In determining validity, being placed at a higher-level increased the chances of being admitted to a long-term care home within 90 days (14.5% of the 'very high' group, AOR = 11.4), caregiver distress (51% of the 'very high' group, AOR = 26.6), and being rated as 'better off elsewhere' (33% of the 'very high' group, AOR = 7.1). Results were also positively related to mean weekly cost of formal and informal care (Hirdes et al., 2008).

Planning Algorithm for Continuing Care. While the MAPLe has demonstrated concurrent validity, its reliance on RAI-HC items that do not appear on the RAI 2.0 makes it ill-suited for the present purposes. The Planning Algorithm for Continuing Care (PACC 1.0) is an unpublished algorithm used to identify appropriateness for LCTH placement (Stones, Brink, Smith, & Nytko, 2006). Appropriateness for LTCH implied the formal support provided at a given level of the continuing care continuum is unlikely to be accessible at lower levels of that continuum. That is, the individual appropriate for LTCH placement has care needs that would be unlikely to be met by supportive housing, home care, community support services, or congregate housing. The PACC was designed, reflecting the already cited predictive ability of frailty, ADLs and cognition to indicate severity of clinical need, from RAI 2.0 data using scales of frailty (CHESS), clinical intensity (RUGS III), cognition (CPS) and ADL scales (ADL self-performance items utilized in the RUGS III) as well as ratings of 'worsening of condition' to predict higher-care need and appropriateness of care needs with long-term care. Patients are rated as 'low need for LTCHs', 'At-risk for LTCHs', and 'High need for LTCHs' based on their 'triggers' in the above domains. The PACC has fair test-retest stability over a 90-day period (contingency coefficient = 0.68), and shares a positive relationship with continuing care facilities ordered in terms of intensiveness of support (gamma = 0.40) (Stones et al., 2006). Furthermore, the PACC shows good convergent validity with the Fries algorithm (Fries et al., 2002) (rho = 0.58; gamma = 0.97), and moderate relationship with the MAPLe (rho = 0.26; gamma = 0.31), as well as a moderate relationship with mortality at discharge (gamma = 0.35).

Contextual Issues

Consistent with Bronfenbrenner's (1978) ecological model of human development, adults are nested within neighbourhoods, hospitals/facilities, regions, and cultures. While lay explanations of behaviour may automatically take into account the context of another's action, applied quantitative researchers must employ complex statistical techniques to account for contextual relationships. These techniques are employed in situations where health status (for example) may vary widely between households, schools, cities, or regions where the relationship between contextual variables and outcome violate the assumption of independence of errors in many parametric statistical (e.g. Bickel, 2007). Multilevel modeling has the additional benefit of dealing effectively with estimation error and allowing stronger inferences about care quality (Arling et al., 2007). Furthermore, multilevel modeling is currently suited for longitudinal analyses given that assessments of functioning at different times are essentially nested within individuals (e.g. Suveg, Hudson, Brewer, Flannery-Schroeder, Gosch, & Kendall, 2009).

While terms such as 'ecological model', 'multilevel modeling', 'random coefficient regression' and 'hierarchical linear modeling' have been around for some time, the use of contextual variables to reduce error in prediction of care remains sparse. The following is a brief introduction to previous usage of contextual variables in providing supports to elderly individuals. Candidate contextual variables identified by the literature review will then be evaluated empirically for their impact on future outcome variables (e.g. symptoms and resource utilization) (e.g. Lee, 2000).

Institution

Arling, Lewis, Kane, Mueller and Flood (2007) caution that ignoring the multilevel nature of residents nested within health-care facilities of *varying quality* (as indexed by adverse events / nursing home quality measures) can lead to erroneous conclusions, and as Bickel (2007) reviews, may be a violation of the assumptions of traditional analysis techniques. In Ontario CCCs, there is a wide range between facilities for compliance with practices that may improve outcomes (e.g. evidence-based practices, evidence of client-centered care, use of information technology, use of staff skills / competencies) as well as change how health systems interact (e.g. integration of care) (CIHI, 2007). Facilities also differ in outcomes as indexed by performance indicators including improved ADLs (ranging from 4.7 to 48.1% of a facility's CCC patients within a 90 day period in 2007), decrease in ability to walk or wheel self (6.6 to 33.6%), increased anxiety / depression (1.1 to 32.6%), communication decline (1.1 to 28.7%), indwelling catheter (7.8 to 43.3%), patients with new falls (0.0 to 6.3%), physical restraint use (0.0 to 53.9%), antipsychotic drug use without a diagnosis of psychosis (7.6 to 21.9%) and so forth (CIHI, 2007). It is not only empirically, but conceptually astute to view the relationship between health outcomes and their predictors will vary as a function of the quality of a hospital or facility.

There is precedent for hierarchical modeling of patients within facilities in quality assessment literature. While the size of the difference between facilities was not articulated in their papers, Arling and colleagues demonstrated increased accuracy in prediction with a multilevel model at the institution level (Arling, Lewis, et al., 2007) while also examining the relationship between nursing effort and patient outcomes at the unit level (Arlking, Kane, Mueller, Bershadsky, & Degenholtz, 2007). Again using multilevel modeling, Degenholtz, Kane, Kane, Bershadsky and Kling (2006) found approximately nine percent of the total variance in self-reported quality-of-life to be attributable to differences among LTCHs. Forty-nine percent of the variance between LTCHs was accounted for by average physical disability, quality indicators, average social engagement, distressed mood and behavioural problems of the facility, as well as staffing/environmental variables of the facility. Determinants of quality of life proved much more difficult to predict at the individual level, with restraint use, social engagement, stressed mood, and conflict in relationships accounting for only four percent of the variance within facilities. Regarding common quality difficulties that may be of importance for the current investigation, Sørbye and colleagues (2009) found the most frequent care quality problems in home care were: no therapy available for clients with rehabilitation potential (ADLs); inadequate pain control; and no vaccinations against influenza.

Gruneir, Miller, Intrator and Mor (2007) have also briefly explored contextual factors in the hospitalization of nursing home residents with cognitive impairment. Using multilevel modeling, higher prevalence of dementia in a nursing home or presence of a *specialized dementia care unit* decreased the odds of hospitalization. A slight decrease was also noticed in the odds of hospitalization as the rate of cognitive impairment in the nursing home increased. Another multilevel analysis demonstrated higher job autonomy experienced by nursing staff and a higher full-time equivalent ratio on the wards was associated with increased physical restraint use in a psycho-geriatric nursing home ward (Huizing, Hamers, de Jonge, Candel, & Berger, 2007).

Traditionally, analysis is completed on patient-level data (e.g. RAI quality data for that individual) predicting patient outcomes, or on nursing home data (e.g. number of quality issues for the entire home) in predicting overall nursing home outcomes (e.g. level of mortality), with both techniques falling short of developing a statistically-sound model in which individual patients are influenced by larger contextual factors such as facility level of quality. Given facilities vary in the levels of quality of care, complexity, and admission criteria, it is then advisable that future studies examine the dependence between functional variables and institution and permit slopes between predicted and outcome variables to vary across institutions (a technique known as 'random coefficient regression' that is further elucidated in the analysis section).

Region

Sørbye et al. (2009) also found significant variability in the characteristics of adults receiving home-care between *northern and southern regions* in Europe, due to regional variations in availability and eligibility criteria. Northern users of home-care were relatively independent in terms of physical and cognitive function compared to southern regions. This may in turn affect the use of home-care services or availability of out-patient services in predicting hospitalization or entrance to long-term care. Regions also varied with respect to use of antipsychotic medications.

There is some evidence of regional variation in Ontario as well. As previously mentioned, Northeast and Northwest LHINs have almost twice the rate of hospitalizations and Ambulatory Care Sensitive Conditions as the provincial mean (CIHI, 2006; CIHI, 2009). This is in the context of the Northeast and Northwest LHINs having levels of family physicians comparable to the rest of the province, while having significantly fewer specialty physicians (CIHI, 2009). This trend of proportionally poorer health in the northern regions with similar or poorer access to health care professionals is generally consistent across Canada (CIHI, 2009). With regards specifically to Ontario, average ratings in CCC facilities averaged across a LIHN vary on compliance with evidence based practices (ranging from 37.5 to 40.6% compliance in northern LHINs versus 50.9 to 89.9 in all other regions), evidence of client-centered care (45.1 to 48.9% in the northern Ontario versus 53.4 to 87.8 for all other LHINS) and integration of care (23.6 to 29.4 versus 35.5 to 71.8%) (CIHI, 2007).

As is typical with contextual variables, LHINs also overlap with issues of rural and urban settings (as northern settings are much more likely in Ontario to be classified as rural) as well as whether the CCC beds are within a free-standing facility or in a small

CCC unit within an acute care hospital. Those in acute care hospitals are more likely to be younger (CIHI, June 2007), located in small non-urban centers and/or within the Northeast or Northwest LIHN (e.g. CIHI, 2007).

Ontario research in the future then may wish to examine the contextual effects of northern and southern (or similarly, rural and urban) regions on the slopes among predictor and outcome variables and subsequent multilevel analysis. Given that facilities/institutions may also vary with regard to the average level of outcome variable of its patients/residents (level of cognitive impairment, depression), the future analyst with the assistance of intraclass correlation coefficient information, may then choose to accommodate another contextual variable through the use of random coefficients in regression, or attempt to account for the variation with two or three level multilevel modelling.

Other

Regarding residential moves for older adults (including the move to a long-term care facility), Sabia (2008) reported the following contextual effects as increasing the likelihood an elderly person will move from their home: increased property taxes and utility costs, hours of illness from work, presence of physical or nervous conditions that impede work, presence of a persistent physical condition, decreased attachment to the community (indicated by the number of neighbours the respondent reported knowing), and living in smaller cities/towns (especially for those aged 71-85). Attachment to community, perception of problems and health outcomes have also been shown to vary between neighbourhoods in a Canadian city using multilevel modeling procedures, considered by the authors to represent contextual variables (Pampalon, Hamel, Konicnk, & Disant, 2007).

Time

Measuring changes in symptoms over time as a result of interventions, characteristics of the individual (e.g. where they have been referred from) or characteristics of the hospital in which they are being treated is a long-utilized procedure. The most common analysis techniques often involve comparing level of change or end-point score on a measure. These techniques typically do not make full use of data if more than two assessments have been conducted, nor can they be used to estimate the relationship in the case of a missing assessment. In a form of growth modelling, individual patients themselves can be seen as a 'contextual variable' in which multiple assessments are nested, as three assessments from Patient X are likely to be more similar to each other than an assessment from Patient Y even though both may have the same condition, the same treatment, and are in the same hospital. To use the same language as other contextual variables, the relationship in the prediction of health status from time can be allowed to vary between participants.

Methods of Contextual Quantitative Analysis

While conceptually one could identify an infinite number of 'nested' relationships or 'contextual variables' for any given phenomenon, Bickel (2007) offers a practical criterion for empirically testing for the presence of contextual variables: nesting is evident when more than 10% of variance in outcome varies systematically between levels of the contextual variable. This means that if more than 10% of the variability in patient's ADLs was a result of simply which hospital they were treated in, the assumptions of typical ordinary-least-squares (OLS) regression are violated and alternative procedures are utilized (Bickel, 2007). The proportion of variance that occurs between levels of the contextual variable versus within (or between hospitals versus within hospitals) is analyzed utilizing Intraclass Correlation Coefficients (ICCs; Lee, 2000). As will be further explained later, the ICC is the ratio of between group variability to total variability.

A brief adaption of Bickel's (2007) approach to nested data is presented in the remainder of this section and those wishing further explanation are encouraged to consult the original work. It should also be noted that while the examples provided here are often using interval data, Arling, Kane, Mueller, Bershadsky and Degenholtz (2007) describe applications of multilevel modeling with binary outcomes of quality.

Briefly, there are two types of general approaches one could use to correctly analyze nested data: (1) random coefficient regression; and (2) multilevel modeling. In the first approach, '*random coefficient regression*', the use of restricted maximum likelihood estimators (REML) over traditional OLS regression allows a researcher to permit intercepts and slopes to vary across an identified grouping variable. In this application of regression, there is a statistical acknowledgement that the relationship between independent and dependent variables changes (varies) between levels of the grouping variable (e.g. hospital). In predicting ADLs from age, anequation similar to the familiar OLS regression ($Y = a + bX + e$) follows:

$$Y_{IJ} = \beta_{0J} + \beta_{1J}AGE + e_{IJ} \qquad \text{Equation 1}$$

Where β_{0J} represents the intercept (i.e. the predicted value of the ADLs when all independent variables are centered with respect to their grand means), β_{1J} represents the slope of the relationship between age and ADLs which is then multiplied by the individual's age, and e_{IJ} represents residual variance (variance in referral facility not accounted for by age). Note that the regression coefficient beta (β) is used when describing a traditional regression formula, and that a subscript starting with 0 indicates an intercept whereas a subscript from 1 to *J* denotes a slope. With the use of restricted maximum likelihood (REML) indicators - which is a method to provide values for the intercept and slopes that have the greatest likelihood of giving rise to the observed data – a researcher can now specify whether an individual predictor variable is associated with a fixed regression coefficient or a random regression coefficient. A *fixed regression coefficient* does not allow the intercept or slope between predictor and outcome to vary with respect to the grouping variable (e.g. hospital) and is appropriate in instances where there is theoretical or empirical reason to believe that the intercept / slope will not vary substantially (as with OLS regression). Fixed regression coefficients formed the bulk of predictors used in the subsequent analysis.

When the researcher has evidence that the dependent variable (ADL) varies greatly between levels of the grouping variable (hospital), random coefficient regression is used simply as a way to acknowledge variability in the relationship between predictor and outcome variable, which would violate the assumptions of OLS regression. Random coefficient regression includes the use of one or two (rarely more) *random regression coefficients* that have both a fixed component and a random component. The *fixed component* of a random regression coefficient is interpreted as the weighted average (slope or intercept) over all second-level categories (i.e. hospitals). The *random component* of a random regression coefficient is an estimate of the variance of the random regression coefficient (slope and intercept) as it varies from group to group (hospital to hospital). If we were to specify age with a random regression coefficient, the intercept and slope in Equation 1 is further defined in a random coefficient equation:

$$\beta_{0J} = \gamma_{00} + u_{0J} \quad \text{Equation 2}$$

$$\beta_{1J} = \gamma_{10} + u_{1J} \quad \text{Equation 3}$$

In Equations 2 and 3, the random intercept (β_{0J}) is the sum of the average intercept over all patients, γ_{00}, and a measure of hospital-to-hospital variability in the intercept, u_{0J}. Similarly, the random slope, β_{1J}, is the average slope over all patients, γ_{10}, and a measure of hospital-to-hospital variability in the slope, u_{1J}. Note that in random coefficient regression, gamma (γ) is used to specify the fixed component of a random regression coefficient, and u to specify the random component of a random regression coefficient. When Equation 1 is expanded utilizing random coefficients, it can be expressed as:

$$Y_{IJ} = \gamma_{00} + \gamma_{10}AGE + (u_{0J} + u_{1J}AGE + e_{1J}) \quad \text{Equation 4}$$

The random coefficient equation can now be conceptualized as a traditional regression equation with the fixed effects of the common intercept (γ_{00}) and slope (γ_{10}) across institutions and a portion of 'residual' variance in parentheses. However, the variance explained by the contents of the parentheses can be articulated as: (1) hospital-to-hospital variability in the intercept (u_{0J}) and the slope (u_{1J}); and (2) the remaining residual variance (e_{1J}). By further defining the residual variance not predicted by fixed components, one can then create confidence intervals to communicate to what degree the relationship between predictor and outcome vary.

Additional predictors can subsequently be entered as fixed regression coefficients or random regression coefficients. For example, a researcher may have reason to believe the relationship between age and ADLs would vary between hospitals. This may be due to the level of homecare available in a community, or the size of the facility restricting access to only the most severe cases. However, the researcher may suspect the relationship between sex and referral facility would likely not vary between hospitals. If regression coefficients related to age and the intercept are allowed to vary across hospitals but age is not (for reasons of parsimony and lack of theoretical support for the alternative), one could express the equation as follows.

$$Y_{ij} = \gamma_{00} + \gamma_{10}AGE + \gamma_{20}X_{SEX} + (u_{0j} + u_{1j}AGE + e_{1j}) \qquad \text{Equation 5}$$

The fixed regression coefficient associated with age is notated by an X and relevant subscript, and that there is no random component associated with age articulated in the parentheses.

A random coefficient equation is highly appropriate for this type of analysis and is the minimum requirement when more than 10% of the variance in an outcome variable such as referring facility is accounted for by the grouping variable of hospitals (ICC > .10). Rather than simply letting slopes in the variables of interest vary as between hospital or region, researchers also have the option to explain the random component covariances through the use of contextual variables and cross-level interaction terms (i.e. explain why hospitals vary with regard to the proposed relationship between age and functioning). By incorporating what can be more simply described as 'Level 2 predictors' such as quality of each facility, average level of patient age within that hospital, or size of the hospital, the analysis is now termed *multilevel modelling.* The difference then between random coefficient regression and multilevel modeling is the inclusion of contextual variables to decrease uncertainty in prediction or explain why there is variation in relationships between groups. Therefore the equations for the random intercept and slope (see Equations 2 and 3) are now expanded to include the Level 2 predictor of size of the hospital (notated as X_{AGE2}, indicating a fixed regression coefficient at Level 2).

$$\beta_{0J} = \gamma_{00} + \gamma_{01} X_{AGE2} + u_{0J} \quad \text{Equation 6}$$

$$\beta_{1J} = \gamma_{10} + \gamma_{11} X_{AGE2} + u_{1J} \quad \text{Equation 7}$$

Where the random intercept, β_{0J}, is the sum of the average intercept over all patients, γ_{00}, and a measure of hospital-to-hospital variability in the intercept, u_{0J}, *as well as* the predicted value of ADLs given the average age individual (given grand-mean centering). Similarly, the random slope, β_{0J}, is the average slope over all patients, γ_{10}, and a measure of hospital-to-hospital variability in the slope, u_{1J}, *as well as* the slope between average age of a hospital with the ADLs (and not the relationship between patient level age and ADLs). The full multilevel model, consisting of the intercept, 'main effects' of Level 2 and Level 1 predictors, an 'implied cross level interaction term' and the residual component can be articulated as:

Equation 8

$$Y_{IJ} = \gamma_{00} + \gamma_{01} X_{AGE2} + \gamma_{10} AGE1 + (\gamma_{11} X_{AGE2} * AGE1) + (u_{0J} + u_{1J} AGE1 + e_{1J})$$

From right to left, referral facility is predicted by a combination of the *fixed* effects of average intercept (γ_{00}) and slopes of the Level 2 (γ_{01}) and Level 1 (γ_{10}) predictors and outcome variable (across institutions), the slope of an interaction term and outcome variable (γ_{11}), and a portion of 'residual' variance in parentheses consisting of true residual variance (e_{1J}) plus *random* coefficients indicating hospital-to-hospital variability in the intercept (u_{0J}) and the slope (u_{1J}). Bickel (2007) states than whenever a Level 2 predictor is used, the full multilevel model must also include the implied interaction term that results by our choices of fixed and random coefficients. Level 2 predictors (contextual variables) can also be an aggregate Level 1 predictor. For example, instead of average age of each facility, a researcher may hypothesize that the varying relationship between a patient's age score and ADLs between hospitals is due to the size of the facility.

An additional layer of complexity can be added to help understand the factors related to a patient's improvement or decline with time. In this scenario, we wish to predict a patient's health (as indexed in this example by ADL) from the time with which the assessment took place (upon admission, 3, 6, or 12 months after admission). Given that assessments however are nested within patients (with each patient providing up to 4 assessments in a period), random coefficient regression is necessary. This application is also known as 'growth modeling'. The formula at Level 1 in this scenario can be expressed as:

$$Y_{IJ} = \beta_{0J} + \beta_{1J} TIME1 + e_{IJ} \quad \text{Equation 9}$$

Where β_{0J} represents the intercept (i.e. the predicted value of ADL for a patient assessed at admittance if TIME1 is not centered on its grand mean), β_{1J} represents the slope of the relationship between the time at which the individual was assessed and their ADL score, and e_{IJ} represents residual variance (variance in referral facility not accounted for by time). The square of TIME1, also randomized by patient, may also be used at Level 1 if a quadratic relationship is suspected.

The above random coefficient regression analysis would provide a researcher with an understanding of how ADLs of patients change over time within a particular sample.

However, the model can be further improved by using a second level contextual variable, such as the referal facility (notated as the dummy variable X_{REF}), in a multilevel modeling analysis. This analysis would be aimed at understanding how differences in a referral source (such as community physician versus an ER) can influence the rate with which a person may recover or decline in ADL status. Thus, the intercept and slope of Equation 9 can be adjusted with a 2nd level predictor that further articulated in fixed and random components as follows:

$$\beta_{0J} = \gamma_{00} + \gamma_{01}X_{REF} + u_{0J} \qquad \text{Equation 10}$$

$$\beta_{1J} = \gamma_{10} + \gamma_{11}X_{REF} + u_{1J} \qquad \text{Equation 11}$$

Where the random intercept, β_{0J}, is the sum of the average intercept over all patients, γ_{00}, and a measure of variability in the intercept between patients, u_{0J}, *as well as* the predicted value of ADL for the referral facility indicated by a 0 (without grand-mean centering). Similarly, the random slope, β_{0J}, is the average slope over all patients, γ_{10}, and a measure of patient-to-patient variability in the slope, u_{1J}, *as well as* the slope between referring facilities and facility-level ADLs. The full multilevel model, consisting of the intercept, 'main effects' of Level 2 and Level 1 predictors, an 'implied cross level interaction term' and the residual component can be articulated as:

Equation 12

$$Y_{IJ} = \gamma_{00} + \gamma_{01}X_{REF} + \gamma_{10}TIME1 + (\gamma_{11}X_{REF} * TIME1) + (u_{0J} + u_{1J}TIME1 + e_{1J})$$

In this final equation, a patient's ADL score is predicted by a combination of the *fixed* effects of average intercept (γ_{00}) and slopes of the referral facility (γ_{01}) and time of assessment (γ_{10}) predictors and a patient's ADL score, the slope of an interaction term and outcome variable (γ_{11}), and a portion of 'residual' variance in parentheses consisting of true residual variance (e_{1J}) plus *random* coefficients indicating patient-to-patient variability in the intercept (u_{0J}) and the slope (u_{1J}). Note that the 'main' effect of referral facility on ADL will provide the relationship between referral facility and ADLs, but the effect of referral facility on change in ADLs over the course of hospitalization is marked by the significant implied interaction effect of (γ_{11} X_{REF}*TIME1).

While there is a paucity of previous research or pre-existing theory in using facility or district level predictors to account for the variability in the random intercept (i.e. DV means) and slope (i.e. strength of the relationship) between health status and referring facility, the distinct characteristics of differing hospitals as well as diversity within regions regarding resources, population, policies, and training of staff would strongly suggest the applicability of random-coefficient models. Development of multilevel models will be done slowly and acknowledging that the complexity is an invitation to error and misunderstanding (Bickel, 2007).

Current Study

As previously reviewed, there have been dramatic changes within health care supports for the elderly over the past century that reflect changes in the philosophy of aging, changes in life expectancy, and changes in health status profile of the elderly population within our society. Increased admissions and complexity of cases seen within care facilities with decreasing lengths of stay makes accurate assessment of current need and prognosis increasingly difficult. Accurate assessment is essential for the detection of illness and disability and consequently providing the least restrictive environment which optimizes psychosocial well-being and health.

The Ontario government has attempted to coordinate the continuum of care by first establishing a single organization (CCACs) to oversee home-care and long-term care admissions, and secondly implementing the RAI series of instruments for home care, complex continuing care, and soon long-term care. The Health Services Restructuring Commission recommended decreasing the length of stay in patients in CCC and discharging patients to alternate services as medically warranted and possible. This mandate increases the need for sensitive placement of individuals based on data available from standardized assessments.

The current investigation examines 'health' or 'outcome' in three ways. Because appropriate discharge and placement of patients is a significant focus of the current investigation, standardized assessment data serving this purpose were evaluated. First, *symptoms* demonstrated to predict need for continuing care were selected. Limitations in activities of daily living (as indexed by the ADL Hierarchy Scale) and level of impairment in cognition (as indexed by the CPS) were utilized in the current analysis given their inclusion in other placement algorithms (Fries et al., 2002; Hirdes et al., 2008; Stones et al., 2006) and meta-analytic evidence regarding the importance of these symptoms as predictors of admission to continuing care facilities (Gaugler et al., 2007). Despite concerns regarding the redundancy of aggressive behaviour (indexed by the ABS) to predict care needs when the cognition is already taken into account (Stones et al., 2006), it was included in the current analysis for exploratory purposes. Secondly, health instability (termed '*frailty*' for the present purposes) is a strong predictor of mortality, physician activity and complex medical procedures (Hirdes et al., 2003), and hence items of frailty also utilized in the PACC (Stones et al., 2006) were included in the present analysis. Frailty was measured with a widely utilized computed scale (the CHESS scale), as well as change in care needs (indexed by MDS 2.0 item Q2 Change in Care Needs). Finally, *resource intensity* (indexed by the RUG-III) was utilized in the present analysis given its inclusion in previous continuing care algorithms for CCC patients (Stones et al., 2006) and the political directive for using RUG-III results as a tool for determining continuing care eligibility (Health Services Restructuring Commission, 2000).

The present study uses census-level standardized-assessment data towards the following research goals:

1. Explore the degree to which ratings of patients' health are dependent on the context in which continuing care takes place
2. Understand the influence of both symptoms at admission and throughout hospitalization on subsequent need for continuing care

Research Goal 1: Hospital and regional influence on patient health.

In the last 15 years, the Ministry of Health and Long-Term Care in Ontario has attempted to increase sensitivity to regional differences in need and preferences by divesting certain funding and health-management responsibilities to CCACs and later LHINs. It follows that such efforts may increase the heterogeneity of health-service delivery throughout the regions of Ontario, in comparison to a health-system managed provincially with universal policies and procedures. There is evidence that: (1) analysis conducted on residents within differing facilities or regions would conceivably fit the definition of 'nested data' (e.g. Bickel, 2007, Arling, et al. 2007); (2) there are regional differences in health services and outcomes within Ontario (CIHI, 2006, 2009); and (3) facility characteristics (including quality indicators, staffing, and average care needs) can account for large amounts of variance of resident characteristics occurring between facilities (Degenholtz et al., 2006). However, multilevel modeling is rarely used in health-care research to account for regional disparities (Arling et al, 2007). To the current authors knowledge, the extent to which nested data analysis is relevant for the health outcomes of Ontario's complex care has yet to be established.

Given that multi-level analysis is appropriate for the current census-level dataset, meaning that patients' health is dependent on the context in which continuing care takes place, random coefficient regression was utilized in the analysis followed by multilevel demographic predictors.

Research Goal 2. Examine the differences in need between individuals differing in referral source and discharge service.

Analyses were conducted to examine differences in the need for continuing care of patients between the service received immediately prior to CCC admission. Two sets of Multilevel Modeling (MLM) analyses were used to analyze two datasets. The first set of MLM analyses addressed this question by examining only 'admission' assessments (while controlling for variance associated with demographic variables at the assessment and facility level). The second set of analyses examined all assessments, where the patient was used as a random variable (provides the context within which multiple assessments are contributed), while demographic factors and time of assessment were fixed variables.

Another goal of the project is to use current knowledge about service utilization to enable caregivers and policy makers to make more accurate prognoses. Specifically, a set of analyses were conducted to document the interaction of time and referral service. Differences in the trajectory of clinical need based on type of care that preceded admission to CCC can be used to more accurately make prognoses at the individual level or understand how service composition within a region may affect the need for future services at a policy level.

Analyses were conducted to examine differences in patients' need for continuing care dependent upon the type of service they were discharged to. Discharge service analysis is not only important for health planning, but it may also be conceptualized as a broad 'outcome' variable and of bearing to development of algorithms intended to identify need for continuing care. Within the current analyses, it was expected that shallow declines or steeper accelerations on predictors of continuing care relative to LTCH patients would be related to services with lower service intensities.

While one assumes health care professionals obviously take these factors into consideration when recommending discharge locations, the author is unaware of published research examining overall patterns in these decisions. Further knowledge of these relationships are important at the individual level, so that patients and families can make more informed choices based on improved prognosis, as well as the population level, so that policy makers have relevant information about how trajectory of health status and contextual effects can improve estimates of required resources and enhance paths for care (if it is noted that high number of patients receiving one service subsequently require another type of service). This serves to judiciously distribute funding and other resources matched more closely to patient, facility, or community need rather than based on a global base rate (the prior predictive value).

Method

Participants

Quarterly MDS 2.0 assessment data for all Ontario Complex Care facilities was obtained from the Canadian Institute for Health Information through the Graduate Student Data Access Program. This data set was based on all patients admitted and discharged between April 2007 and March 2009. When two assessments were conducted in the same financial year quarter, the later assessment was retained for the data set.

Given various differences between younger and older CCC patients (CIHI, June 2007), the present analysis excluded individuals under age 50. Similarly, due to differences in short and long-term stay patients, those individuals with lengths of stay shorter than 30 days were also excluded. Patients rated as 'comatose' were excluded from analysis, as were patients rated as neither male nor female.

All assessments marked as 'first admission' were selected to examine the influence of hospital and region (LHINs, urban/rural, and north/south) on health and resource utilization. This criteria resulted in the selection of 10 720 assessments nested within 124 Complex Continuing Care centers across Ontario for the first set of MLM analyses. The second set of MLM analyses included all assessments for each individual and episode, resulting in 24 231 assessments.

Measures

Demographics. Sex (male or female, where female was coded as having a higher value) and age (calculated in years from their date of birth) were included as demographic variables given their widespread use in describing health status for individuals over 50. A quadratic effect of age was also entered given there is reason to suspect curvilinearity in the relationship between age and health (e.g. Kunzmann, 2008; Netz, Wu, & Becker, 2005; Schaie, 1994)

Information regarding the complex continuing care facility was requested. Urban / rural status was transformed based on the facility postal code (using the Canada Post Corporation's Postal Code Conversion file based on Statistics Canada's standard geographical areas. Urban is defined as 'urban core', 'urban fringe', 'urban areas outside census metropolitan areas and census agglomerations' and 'secondary urban code'. Rural is defined by exclusion, that is any part of Canada (or in this case, Ontario) not covered by the 'Urban' definition, typically in a town with less than 1000 people. Thirteen of 124 facilities were classified as 'Rural' in the current dataset.

Information was requested regarding each patient's episode of care, including admission date, length of stay (calculated at discharge), as well as the referral services (the location of the client before CCC admission) and discharge service (type of care received immediately after discharge). Assessments were identified by date, as well as whether it was an admission assessment or a non-admission assessment.

Referral and discharge services. These items are 'episode-level' items, in that the same selection appears for each record of an assessment within the episode of care in question (referral is filled out at entry, while discharge is filled out at discharge assessment). Referral and discharge services included the following types: inpatient acute care services, general inpatient rehabilitation services, specialized inpatient rehabilitation services, private home with home care or without home care, residential care services (defined as 24-hour nursing care or board and care as will be further defined), inpatient continuing care service, and 'other/unclassified'. Residential care services were further defined into two categories: those services that provide 24-hour skilled or intermediate nursing care (which will be referred to LTCH for the remainder of this paper); and what was referred to 'board and care', further defined by the RAI MDS 2.0 Manual as 'a non-institutional community residential setting that integrates a shared living environment with varying degrees of supportive services' (which will be referred to as 'supportive living facilities for the remainder of this paper).

Symptoms .The Activities of Daily Living-Hierarchy Scale (ADL-H; Morris, Fries, and Morris, 1999) determines the degree of assistance required to perform ADL. Items used in the ADL-H algorithm include eating ability, personal hygiene, ability to toilet oneself, and locomotion. The ADL-H scale uses 4 items in the MDS 2.0 resulting in seven categories: 0=independent; 1=Supervision; 2=Limited; 3=Extensive-1; 4=Extensive-2; 5=Dependent; and 6=Total Dependence.

The Cognitive Performance Scale (including the items comatose status, short-term memory, ability to make one's self understood, cognitive skills for daily decision making, and independence in eating*)* rates cognitive impairment on a seven point scale: 0=intact; 1=borderline intact; 2=mild impairment; 3=moderate impairment; 4=moderate/severe impairment; 5=severe impairment; and 6=very severe impairment.

The four-item Aggressive Behaviour Scale (ABS) (verbally abusive behaviour; physical abusive behaviour, socially inappropriate or disruptive behaviour, and resting care, see Perlman & Hirdes, 2008) was used as a measure of aggressive behaviour. Scores range from 0 to 12, where anything rated at six and above is generally noted to be 'very severe aggressive behaviour'.

Frailty. Frailty was measured in two ways. The CHESS is based on nine items within the RAI: the scores of six items (vomiting, dehydration, decrease in food or fluid, weight loss, shortness of breath, edema) are summed to a maximum of two (a two indicating the presence of two or more symptoms). The scores associated with three additional items are added: decline in cognition, decline in ADL, and end-stage disease (Hirdes et al., 2003). This resulting CHESS scale has scores ranging between 0 (meaning no instability) to 5 (highly unstable).

The single item 'Q2 Change in Care Needs' was used for the purposes of estimating stability of overall condition, given its inclusion in relevant placement algorithms (e.g. Stones et al., 2005). The scale is a global rating by the respondent of whether the patient's overall level of self-sufficiency has changed significantly as compared to status of 90 days ago (or since last assessment if less than 90 days ago). This item is rated as 0 (no change), 1 (improved, receives fewer supports, needs less restrictive level of care), or 2 (deteriorated; receives more support). To be consistent with the interpretation of the previous items (where high scores indicate impairment), this scale was transformed to an ordinal scale where higher values indicate a worsened condition (i.e. 0 was recoded as a 1; and 1 was recoded as a 0). Within this new scale, 0 is equal to improved and 2 is equal to deteriorated.

Resource usage. The RUG-III assigns facility-based continuing care residents to one of 44 resource utilization groups. The classification is based on a resident's clinical condition, physical functioning and treatment received during the last 14 days. These 44 categories were recoded into the seven major groups as reviewed above. For ease of interpretation the scores were reversed ordered so that higher numbers indicate increased service utilization as follows: (1) Reduced Physical Function (designated in the MDS by a code starting with 'P'); (2) Behaviour Problems (typically coded as 'B'); (3) Impaired Cognition (typically coded as 'I'); (4) Clinically Complex (typically coded as 'C'); (5) Extensive Services (typically coded as SE); (6) Special Care (typically coded as 'SS'); and (7) Special Rehabilitation (typically coded as 'R'). Thus, categories 1 through 3 would be considered 'Lighter Care' whereas categories 4 through 7 would be considered 'Heavier Care'.

Analysis

The present analysis occurred in four stages: (1) providing general descriptive statistics of the dataset; (2) exploring dependence between patient health and candidate contextual variables (i.e. nesting); (3) using admission assessment data in accounting for variance in health scores via patient and facility characteristics as well as referral and discharge services; and finally (4) using longitudinal health scores to evaluate the relationship between patient health over time and the referral and discharge service.

First, the descriptive statistics will provide the context for interpretation of all subsequent analyses. This descriptive analysis also examined the number of assessments contributed by patients within the full dataset and differences between admission and subsequent assessments.

The second analytic step addresses the research goal of exploring the degree to which ratings of a patients' health are dependent on the context in which continuing care takes place (between hospitals or regions). Within the literature review, health care facility and the effects of health care governance (LIHN) as well as geography (northern versus southern LHINs and facilities identified as urban versus rural) were identified as potential contextual variables. The ICC was employed to empirically test for dependence between patient health and grouping variables, as it provides an estimate of the amount of variability that occurs between a levels of a grouping variable as opposed to within (similar to η^2). Unconditional intraclass correlation coefficients (ICC_U) were calculated by dividing between group variability (indexed by the value of the random component of the intercept of the unconditional model, or simply, the variance of the intercept across levels of the contextual variable) into the total variability (random intercept component and all residual variance). This information was then used to determine which regression coefficients should be allowed to vary and which should be fixed. In other words, if symptoms vary substantially between hospitals as evidenced by an ICC_U greater than 0.10, adaptions to the regression equation will be made (via random coefficients) to ensure appropriate analysis.

Thirdly, a contextual analysis on admission data sought to explain symptoms (ADL-H, CPS, ABS), frailty (CHESS, CICN), and resource utilization (RUG-III) when hospital (or 'facility') was identified as a random variable. This series of analysis is subsequently referred to as "MLM Analysis 1: Contextual Analysis and Admission Data". A null-model without predictors provided information regarding the average overall level of symptoms, frailty, or resource utilization across hospitals (the 'fixed component' of the intercept), as well as provide an estimate of how much these outcome variables are expected to vary across facilities (via a confidence interval calculated from the 'random component' of the intercept). Increasingly complex models were evaluated to narrow this confidence interval by accounting for variation in patients' and within hospitals. Patient sex, age (in years), and length of stay (in days) were centered around the hospital mean and used as a Level 1 predictor, accounting for variability in symptoms. Centering predictor variables around the hospital means allows inferences about how a person's demographic status relative to the hospital they are in. It was also hypothesized that the average age, sex, or length of stay within each hospital may account for variations in the health of patients between hospitals and as such this Level 2 predictor was also entered, along with the implied cross-level interaction term between Level 1 and Level 2 (as discussed in the contextual analysis section of the literature review). Given that the type of care received prior to entry of CCC may influence health status, referral service was added in a subsequent model as a fixed variable.

Because of theoretical interest, continuity with the previous analysis, and the complexity of interpretation of binary dependent variables in random coefficient regression models, discharge service was regressed onto outcome scores collected at admission in an effort to document the association between admission health status and where patients were discharged to. The word 'prediction' here may be confusing given we are 'predicting' a past event (admission assessment) from a future event (discharge service). Presently, 'prediction' is simply used as a short-hand to express the minimization of what one might expect health to be at admission given what one knows of the relationship between admission profiles and subsequent discharge facilities. That is, the word 'prediction' in this context does not describe a temporal sequence. It instead describes the minimization of $\sum(Y - \hat{Y})^2$, where Y is the actual score of the patient on the dependent variable, and $\hat{Y}$ represents the estimated score of Y based on the variance it shares with X, the predictor (e.g. Howell, 2007).

Finally, a growth analysis on all assessments within the dataset sought to account for symptoms (ADL-H, CPS, ABS), frailty (CHESS, CICN), and resource utilization (RUG-III) from demographics, time, and referral / discharge service (when the patients were identified as a random variable). This series of analysis is subsequently referred to as "MLM Analysis # 2: Growth Analysis on Health Trajectories". In an effort to build the most parsimonious model and remove variance accounted for by variables quite simple to assess and interpret, demographic predictors of sex, age, and length of stay (which were centered around a their grand-means) were added to reduce errors of prediction. A rating indicating 'first assessment' versus 'later assessment' (the 'time' variable) was then entered into the model that identifies any overall trends in the presence of symptoms, frailty, or resource utilization. The entry of 'referral service' examines the relationship between the type of service previously received versus overall severity of outcome within hospital, whereas the interaction of time and referral facility queries whether individuals from referral service A have steeper declines or increases in health over time. Similarly, entering 'discharge service' into the model will specify severity of symptoms associated with different places of discharge, whereas the interaction between the 'time' variable identifies differences in the 'trajectory' of ADL impairment over time between the discharge service types. In other words, the time-discharge service interaction effect queries whether a person's 'getting better' or 'getting worse' in their health was related to differences in where the patient is discharged.

The use of MLM in health service evaluation is not widespread (as previously reviewed), and hence the current author was unaware of a specific analytic strategy that was commonplace in the field to guide statistical decision making. To spare the reader a lengthy discussion of all choices, interested parties are directed to Appendix B for a detailing of analytic choices that may serve to contextualize findings and assist in replication.

Results

Descriptive Analysis

Demographic Information

To avoid the undue influence of individuals with more assessments, demographic information is presented in Table 2 based on the record relating to each individual's earliest assessment. The average length-of-stay (corrected for distribution skew) approximated 2.5 months, keeping in mind individuals with stays under 30 days have been excluded. While identified in the literature review as potentially important contextual variables, individuals from rural facilities and form the North East and North West LHINs were only a small portion of admissions.

Table 2.

Descriptive Statistics for Demographic Variables

	Value N = 15 904
Age: Mean (SD)	78.41 (10.52)
Sex: Frequency for Female (%)	9 323 (58.60)
Length of stay[a]	
Uncorrected Mean Days (SD_U)	96.14 (86.20)
Corrected Mean Days (SD_C)	74.58 (1.94)
Urban/Rural: Frequency for Rural (%)[b]	471 (3.2)
LIHN : Frequency for Northern (%)[c]	1 340 (8.4)

Note. SD = Standard Deviation.

[a]Length of stay is presented in an uncorrected mean and standard deviation, as well as a mean and standard deviation that have been adjusted for skewness with a logarithmic transformation (values represent the inversed logarithmic mean and standard deviation).

[b]Percentage reflects the removal of 767 individuals rated as 'unknown'.

[c]Northern indicates North East and North West LHINs combined.

Table 3 displays the frequency of individuals 'admitted from' referral services such as private home or acute care facilities, as well as displaying the frequency of subsequent discharge placements. As displayed, the four 'services' or locations with the highest volume of admitted patients include inpatient acute care (84%), inpatient rehabilitation (general, 6%), and private homes with (2%) and without (4%) home care. The most frequent locations to which CCC patients were discharged to include LTCH

(51%), private home with home care (17%) and without home care (9.9%) and inpatient acute care (11%).

Table 3.

Frequency of transfers from referral service and to discharge service

	Referral Service Frequency (%) N = 15 904	Discharge Service Frequency (%) N = 15 904
Inpatient Acute Care	13 408 (84.3)	1 740 (10.9)
Long Term Care Home	162 (1.0)	8 146 (51.2)
Private Home		
With Home Care	362 (2.3)	2 668 (16.8)
Without Home Care	571 (3.6)	1 571 (9.9)
Inpatient Rehabilitation		
General	883 (5.6)	459 (2.9)
Specialized	71 (0.4)	146 (0.9)
Inpatient Continuing Care	60 (0.6)	102 (1.0)
Supportive Living Facility (Residential)	167 (1.1)	859 (5.4)
Inpatient Psychiatry Service	75 (0.5)	35 (0.2)
Ambulatory Care	31 (0.2)	7 (< 0.1)
Other / Unclassified	20 (0.1)	83 (0.5)

Outcome variables for both admission (current analysis) and all assessments (subsequent analysis) are presented in Table 4. As one notes based on a purely visual inspection, patients at admission were on average rated lower on symptom profiles (ADL and cognitive impairment, as well as aggression) when compared to all other assessments, but higher on frailty and resource utilization. This result is counter-intuitive, given that despite increasing symptoms related to further continuing care needs, frailty and resource intensity decrease. This trend will be further elucidated in a subsequent MLM analysis.

Table 4.

Descriptive Statistics of Outcome Variables

	Admission N = 10 720	Other N = 13 308
Symptom Profile		
ADL Mean (SD)	3.65 (1.67)	3.87 (1.67)
CPS Mean (SD)	2.00 (1.75)	2.48 (1.86)
ABS Mean (SD)	0.67 (1.66)	0.95 (2.00)
Frailty		
CHESS Mean (SD)	2.11 (1.37)	1.65 (1.33)
CICN Mean (SD)	1.51 (0.79)	1.27 (0.70)
Resource Usage		
RUGS Mean (SD)	6.02 (1.47)	5.68 (1.75)

Note. ADL = Activities of Daily Living Hierarchy (Range = 0 to 6) . CPS = Cognitive Performance Scale (Range 0 to 6). ABS = Aggressive Behaivour Scale (Range = 0 to 12). CHESS = Changes in Health, End-stage disease and Symptoms and Signs (Range 0 to 5). CICN = Changes in Care Needs (Item Q2 from the MDS 2.0, Range = 0 to 2). RUGS = Resource Utilization Groups (Range = 1 to 7).

Representation of Time

Time is represented in the analysis in two ways. Within the first presented MLM analysis, time will be conceptualized as admission assessments to the facility versus any other assessment that occurs within that facility. Table 5 displays the frequency of these assessments. Investigation 1 thus examines these cases. Despite the dataset having no patients with admission dates nor assessment dates prior to April of 2007, 360 of these admission assessments were not the earliest record (i.e. did not have the earliest date of assessment) in the dataset starting in April of 2007. Likely explanations for this phenomenon include: (1) admission assessment had been endorsed by raters when it was in fact not the true admission assessment or (2) an incorrect date was entered on either facility admission date or assessment date. Given this mistake only occurs within 3.3% of admission assessments, the entire data set was utilized.

Table 5.

Frequency of assessments by facility and appearance in dataset

	Dataset Designation		Total
	1st Assessment	Other	
Facility Designation			
Admission Assessment	10 563	360	10 923
Subsequent Assessment	5 341	7 967	13 308
Total	15 904	8 327	24 231

A second option to evaluate change over time is to examine the person's earliest assessment versus their later assessments. Despite the dataset not having any patients with admission dates or assessment dates prior to April of 2007, approximately one-third of the earliest assessments occurring within the database are not coded as 'admission assessments' (See Table 6). When the source of the data (the Canadian Institute for Health Information) was contacted with regard to this phenomenon, it was traced back to the latest assessment being selected if two (e.g. an admission and a subsequent quarterly assessment) assessments were conducted within the same financial year quarter. Thus, the admission assessment would have been conducted in the previous 89 days for one-third of the sample and thus these set of assessments will be labelled '1st Assessment' rather than 'admission' for the remainder of the paper.

While up to eight assessments were available for analysis (given the two-year period), the number of assessments each individual received demonstrated an extreme positive skew as reported in Table 3. When the record relating to each individual's earliest assessment was examined (to avoid undue influence being given to individuals with more assessments), 50% of patients have lengths-of-stay (LOS) less than to 67 days, 75% have LOS less than 113 days, and 90% have stayed less than 190 days (keeping in mind that individuals with LOS less than 30 days have been excluded from the current analysis). Given that 85% of the sample had two or fewer assessments and that 75% of the sample stays were less than 113 days (which would entail 1 admission assessment and 1 subsequent assessment), the decision was made to simply contrast the first assessment versus later assessments. Later assessments were treated as averaged non-admission assessments which served to decrease excluding further cases and minimizes making faulty interpretations of the slope and curvilinearity of the data based on the relatively few cases with more than 2 assessments.

Table 6.

Number of assessments for new patients

Assessment Number	Number	Percentage	Cumulative Percentage
1	15636	64.5	64.5
2	4891	20.2	84.7
3	1856	7.7	92.4
4	901	3.7	96.1
5	472	1.9	98.0
6	256	1.1	99.1
7	144	.6	99.7
8	75	.3	100.0

Note: New patients were admitted after March 2007 but before March 2009.

Nesting Analysis

Candidate contextual variables (better described here as a 'Level 2 grouping variable') were evaluated empirically for their impact on outcome variables. Intraclass correlation coefficients between health and contextual variables are presented in Table 7.

Table 7.

Variance in Health Accounted for by Contextual Variables

	Facility	Urban vs Rural Facility	LIHN	North vs South LIHN
Symptom Profile				
ADL	0.174*	0.000	0.040	0.011
CPS	0.107*	--[a]	0.020	0.030
ABS	0.071	--[a]	0.016	0.009
Frailty				
CHESS	0.218*	0.005	0.068	0.008
CICN (Q2)	0.321*	0.045	0.098	0.029
Resource Usage				
RUGS	0.334*	--[a]	0.112*	0.006

Note. ADL = Activities of Daily Living Hierarchy. CPS = Cognitive Performance Scale. CHESS = Changes in Health, End-stage disease and Symptoms and Signs. CICN = Changes in Care Needs (Item Q2 from the MDS 2.0). RUGS = Resource Utilization Groups. LIHN = Local Integrated Health Network.

[a] Small numbers prevent accurate analysis.

* $ICC_U > 0.10$.

Examination of the ICC_Us suggest that only that queried symptom profiles (ADL impairment, cognitive impairment, and aggressive behaviour), frailty (CHESS and Change in Care Needs) and resource utilization (RUGS) vary systematically between facilities, but not LHINs, northern or southern Ontario regions (where the Northeast and

Northwest LHINs were defined as 'North' and all others were 'South'), or rural versus urban facilities. Given that facilities account for approximately 7 to 17% of variance in queried symptoms, 16% of variance in resource utilization, and 22 to 32% of the variance in frailty, use of random regression coefficients allowing intercepts and slopes to vary across facilities was warranted.

MLM Analysis 1: Contextual Analysis and Admission Data

Symptom Profiles

ADL Impairment. A mixed-model analysis was conducted on 10 702 admission assessments on patients nested within 124 complex-continuing care facilities to estimate effects of individual and facility-level demographic predictors on functional impairment. Given a substantial component of variance in ADL impairment was accounted for by effects of facility (ICC_U=0.17), maximum likelihood estimators were used as substitutes for OLS estimators to avoid inflation of the standard errors of regression coefficients.

The fixed component for the intercept was statistically significant (t (95.179) = 50.527, $p < .001$) and equal to 3.663 (*Standard Error (SE)* = 0.073) (see Appendix C, Table 8 for additional 'fit' statistics). Since the IV has been grand-mean-centered, the intercept was interpreted as the mean ADL impairment across facilities. In addition, the value of the random component for the intercept was statistically significant (Wald Z = 6.117, $p < .001$) and equal to 0.503 (SE = 0.082). Given this is the variance of the intercept (mean ADL score) as it varies across facilities, the square-root of this intercept variance ($0.503^{1/2}$), multiplied by a standard deviation unit of 1.96 and added-to / subtracted-from the fixed intercept value, provides a 95% confidence interval (Bickel, 2007). This value allows us to express that 95% of all intercept values across facilities fall within the range 2.273 to 5.053 on a scale with a possible range of 0 (meaning 'independent') to 6 ('total dependence').

Given the broad range of potential intercept (mean) values between facilities, increasingly complex models were evaluated to identify contextual variables and cross level-terms that may contribute to explaining both the variances and the covariances that come with use of random coefficients (Bickel, 2007). The conditional 'demographic' model reduced errors in predicting admission ADL impairment by 1.7% (R_1^2) when compared to the null model, resulting in a significantly better fit, χ^2 (10) = 91.431, $p <$ .05. Regarding individual parameters of the demographic model presented in Table 9 (see Appendix C), being female was associated with increased impairments in ADLs, while sex composition of the facility and interaction between Level 1 and 2 predictors did not make a significant contribution. Every year of age older an individual was within a facility (relative to the average age of that facility) predicted a 0.01 increase in ADL impairment. Age Level 2 approached significance ($p = 0.056$), which would be interpreted as each year of age older the average age of patients within the facility, there was a 0.04 decrease in ADL impairment. That is, facilities filled with younger individuals on average have patients with higher functional impairments. The significant interaction between Level 1 and Level 2 of age suggests there are fewer ADL impairments associated with older individuals relative to the average age within facilities with higher average age. As average age within the facility decreases, rates of ADL impairment in older patients increase. While the squared age within each facility was entered given that there is reason to suspect curvilinearity in age and health, no such effect was observed in the present analysis. Finally, those patients with early admission dates relative to their facility's average were rated as having lower ADL impairment. That is, those individuals with increased length of stays had better physical functioning.

In order to account for further variability, referring service was also added to the model as a fixed variable. That is, it would be expected that individuals with higher ADL impairments are referred to complex continuing care from acute care or other inpatient facilities than from ambulatory or other community care. Given this prediction, inpatient acute care hospitals were used as the comparison category. Results from this analysis appear in Appendix C, Table 10. A model in which referral service was added was associated with a 19.5% reduction in errors of prediction (R_1^2) versus the previous demographic model (see model fit data presented in Appendix C, Table 8), accounting for a significant amount of additional variance from the previous model, $\chi^2(10) = 101.535$, $p < .05$. Compared to individuals referred from inpatient acute care settings, those referred from home care, inpatient rehabilitation, inpatient psychiatry service, and from a person's private residence (with no home care) had better physical functioning (Table 10). Compared to acute care hospitals (and in the context of all other variables previously mentioned within the model), referral from an inpatient psychiatry service was associated with a 0.80 average decrease in ADL impairment (on a scale of 0 to 6), a private home was associated with an average 0.58 point decrease, inpatient rehabilitation was associated with a 0.44 point decrease, and home care was associated with a 0.26 decrease in ADL impairment. There were no facilities referring patients with significantly higher ADL impairments than acute care hospitals.

In the final model, the addition of discharge service was associated with a 5.2% reduction in errors of prediction (R_1^2) versus the previous referral model (see model fit data presented in Appendix C, Table 11), accounting for a significant amount of additional variance from the previous model, $\chi^2(10) = 588.294$, $p < .05$. Regarding specific parameters (Table 5), the sex interaction effect remained but in the context of no significant main effects, the meaning of this number was unclear. Age relative to the mean of the facility was associated with decreases in ADL impairment (.05 decrease for every year of age), a change in direction of the relationship from the previous analysis which suggests caution in interpreting the small effects of this predictor. Mean level of the facility shared a relationship with ADL of similar magnitude and direction while age interaction and the quadratic term had small contributions in the prediction of ADLs, as did length of stay. When inpatient acute care was used as comparison category, individuals referred from inpatient rehabilitation, LTCH, inpatient psychiatry, and home care / private home showed lower ADL impairment. Compared to individuals who were discharged to long-term care homes, patients discharged to inpatient acute care and ambulatory care services where not significantly different regarding ADL impairment at entrance to CCC. Those that did have significant differences from patients entering long-term care included: private home without home care (associated with an average 1.02 point decrease of ADL impairment at admission to CCC); inpatient psychiatry services (associated with a 0.88 point decrease); ambulatory care (0.84 point decrease); supported living service (0.75 point decrease) home care services (0.67 point decrease); inpatient rehabilitation (0.41 point decrease); and inpatient continuing care (0.35 point decrease).

Cognitive Impairment. The fixed component for the intercept on cognitive impairment (CPS) was statistically significant ($t\ (97.829) = 33.438$, $p < .001$) and equal to 2.064 (SE=0.062) (see Appendix C, Table 12 for additional 'fit' statistics) indicating a average rating of 'mild' cognitive impairment across CCC hospitals. In addition, the value of the random component for the intercept was statistically significant (Wald $Z = 5.920, p < .001$) and equal to 0.332 ($SE = 0.056$). Correspondingly, 95% of all intercept values across facilities fall within the range of 0.935 to 3.193 on a scale with a possible range of 0 (intact) to 6 (very severe impairment).

Adding demographics in the prediction of cognitive performance (CPS) resulted in statistically significant reduction of errors of 3.7%, χ^2 (10) = 275.801, $p < .05$. Specific parameter estimates within the demographic model are presented in Appendix C, Table 13. In the context of all other demographic variables, being female was associated with a 0.25 decrease in cognitive impairment. Facilities with higher levels of female patients were also associated with decreased cognitive impairment of their patients (estimate = -1.163), and no interaction effect was observed. Age had smaller effects in the prediction of cognitive impairment, as each year of age increased the CPS by 0.02 points (i.e. more cognitive impairment) relative to their facility's mean, whereas each year of the average age of a facility's patients was associated with a 0.06 increase in the CPS. These trends were linear. There was no relationship evident between length-of-stay (indicated by the Admission variable) and CPS scores.

A model in which referral service was added was associated with a 1.4% reduction in errors of prediction (R_1^2) versus the previous demographic model (see model fit data presented in Appendix C, Table 12), accounting for a significant amount of additional variance from the previous model, $\chi^2(10) = 93.496$, p < .05. When admission from an acute care hospital service was used as a comparison (Table 14), the following programs were associated with higher cognitive impairment (CPS) scores at admission:

residential care (those admitted from residential care displayed a 1.04 increase on average in CPS scores); long-term care homes (0.89 increase); other inpatient continuing care (0.85 increase) and inpatient psychiatry services (0.70 increase). There were no significant differences between acute-care services and the programs not mentioned.

The final model, in which discharge service was added, was associated with a 7.4% reduction in errors of prediction (R_1^2) versus the previous referral model (see model fit data presented in Appendix C, Table 12), accounting for a significant amount of additional variance, $\chi^2(10) = 696.115$, $p < .05$. Regarding specific parameters within the final model (Table 15), being female at the individual level was associated with decreased cognitive impairment, but not at the facility level. Every year of age of a patient beyond the average for their facility was associated with a 0.05 increase in cognitive impairment, while every year of age for the facility average was associated with a 0.04 point decrease in cognitive impairment. This change in direction compared to previous analyses resulted in a very small but significant interaction effect, and the quadratic effect was also significant (but small). Length of stay made no difference in cognitive impairment, while patients from residential facilities, long-term care, inpatient continuing care and inpatient psychiatry services were all associated with increased cognitive impairment at admission than those patients referred from acute care hospitals. When one compares cognitive impairment at admission with those individuals who are eventually discharged to long-term care facilities, those future long-term care residents have higher levels of cognitive impairment at admission versus those who are discharged to: private home with no care (1.06 point decrease, on average, in CPS scores); inpatient rehabilitation (0.99 decrease for specialized and 0.97 decrease for general rehabilitation);

private home with home care (0.95 decrease); other residential facilities (board & care; 0.54 decrease); and inpatient acute care (0.45 decrease).

Aggressive Behaviour Scale. While less than 10% of the variance in ABS scores was attributable to differences between facilities (see Table 7), random coefficient regression was used to maintain consistency with all other analyses given all other outcome measures examined had ICC_Us greater than 0.10. The fixed component for the intercept on aggressive behaviour (ABS) was statistically significant (t (90.132) = 14.633, $p < .001$) and equal to 0.725 (SE = 0.050) (see Appendix C, Table 16 for additional 'fit' statistics). This suggests low amounts of aggressive behaviour, on average, across CCC hospitals. In addition, the value of the random component for the intercept was statistically significant (Wald Z = 5.405, $p < .001$) and equal to 0.198 (SE = 0.037). Correspondingly, 95% of all intercept values across facilities fall within the range of 0 to 1.597 on a scale with a possible range of 0 (None) to 12 (Very Severe).

Adding demographic information in the prediction of aggressive behaviour (ABS) resulted in statistically significant reduction of errors of 2.9%, χ^2 (10) = 114.419, $p < .05$. Specific parameter estimates within the demographic model are presented in Appendix C, Table 17. Being male was associated with increased aggressive behaviour (-0.28[1]), while increased males within a facility was associated with increased aggressive behaviour (-1.84). Every year of average age of residents of the facility was associated with a 0.05 point increase in aggressive behaviour.

[1] Numbers presented in parentheses during MLM results presentation indicate regression coefficients or 'estimators'. Consistent with previous interpretation, the number represents the average change in the outcome variable associated with an increase of 1 unit change in the predictor variable in the context of all other variables in the model.

A model in which referral service was added was associated with a 2.3% reduction in errors of prediction (R_1^2) versus the previous demographic model (see model fit data presented in Appendix C, Table 16), accounting for a significant amount of additional variance from the previous model, $\chi^2(10) = 228.808$, $p < .05$. Those individuals referred to CCC from LTCH were significantly more aggressive than those individuals referred from acute care facilities (LTCH residents being 2.11 points higher on the ABS on average at admission). Other referral facilities associated with higher aggressive behaviours at admission were: other/unclassified (1.76 increase); inpatient continuing care (0.92 increase); residential (supportive housing) (0.85 increase); and inpatient psychiatry services (0.73 point increase).

A model in which discharge service was added was associated with a 2.5% reduction in errors of prediction (R_1^2) versus the previous demographic model (see model fit data presented in Appendix C, Table 16), accounting for a significant amount of additional variance from the previous model, $\chi^2(10) = 192.154$, $p < .05$. Within the final model, being male was associated with a 1.53 point increase in ABS scores on average in the context of all other predictors in the model. However, proportion of females within the facility was associated with ABS scores (of a similar magnitude to the males) in the opposite direction: facilities with many females reported higher aggressive behaviour. The interaction effect approached significance. Age had similar apparently conflicting effects but smaller in magnitude, where every year of age (relative to their facility's average) was associated with a 0.04 point increase in ABS, whereas every year of average age for the facility was associated with a drop in 0.04 points on the ABS. Compared to residents from acute care hospitals, at admission the ABS scores were higher for patients from long-term care, other, inpatient continuing care, residential (supportive housing), and inpatient psychiatry services. Patients discharged to an inpatient psychiatric facility (versus a LTCH) had ABS scores 2.10 higher at admission. Conversely, discharge to the following services were associated with lower ABS scores (infrequent aggression) as compared to those individuals who were discharged to LTCH: private home (0.45 points lower on average); inpatient rehabilitation (0.45 points lower); home care (0.44 points lower); inpatient acute care (0.23 points lower); and supportive housing / residential (0.22 points lower).

Frailty

Changes in Health, End-stage disease and Symptoms and Signs. The fixed component for the intercept on Changes in Health, End-stage disease and Symptoms and Signs (CHESS) was statistically significant (t (99.801) = 30.917, $p < .001$) and equal to 2.037 ($SE = 0.066$), indicating on average 'some' instability of health (see Appendix C, Table 20 for additional 'fit' statistics). In addition, the value of the random component for the intercept was statistically significant (Wald $Z = 6.373$, $p <.001$) and equal to 0.420 ($SE = 0.066$). Correspondingly, 95% of all intercept values across facilities fall within the range of 0.767 to 3.307 on a scale with a possible range of 0 (Not at all unstable) to 5 (Highly unstable).

Adding demographic information in the prediction of CHESS scores resulted in small, but statistically significant, reduction of errors of 0.7%, χ^2 (10) = 30.986, $p < .05$. Sex was not a significant predictor, while a patient's age relative to the mean of their facility makes a very small contribution (0.003 pts increase for every year of age, see

Table 21). Length of stay relative to the mean of the facility (noted in the table as 'Admission Level 1') was associated with a very slight decrease in CHESS scores.

Adding referral service information in the prediction of CHESS scores resulted in statistically significant (but similarly small) reduction of errors of 1.4%, χ^2 (10) = 218.79, $p < .05$. When compared to patients referred from acute care hospitals, those individuals coming from long-term care (1.10 points lower CHESS scores on average), inpatient rehabilitation (-0.66 points specialized, and -0.42 points in general rehabilitation), and inpatient psychiatry services (-0.27 points) had lower CHESS scores on average at admission (Table 22). Surprisingly however, individuals arriving at CCC facilities from a private home with (0.45 points) or without (0.35 points) home care had higher CHESS scores (rated as more medically unstable) when compared to patients arriving from acute-care facilities.

The final model (in which discharge service was added) was associated with a 9.3% reduction in errors of prediction (R_1^2) versus the previous demographic model (see model fit data presented in Appendix C, Table 20), accounting for a significant amount of additional variance, $\chi^2(10) = 1194.931$, $p < .05$. There has been little change in the intercept across models (discharge model estimate = 2.27). Higher average lengths of stay per facility were associated with significantly higher CHESS scores (but only an increase of 0.007 pts per unit increase of LOS). As with the previous model, patients referred from LTCH and rehabilitation services were associated with lower CHESS scores than patients from acute care facilities, whereas individuals arriving from private homes (with or without home care) had significantly higher CHESS scores. Finally, patients with higher CHESS scores at admission to CCC were more likely to be discharged to long-term care than almost all other facilities. Specifically, compared to individuals discharged to long-term care facilities, individuals discharged to the following services had lower CHESS scores at admission: private home with no home care (-1.12 points); inpatient psychiatry series (-0.92); inpatient rehabilitation (-0.87 and -0.83); residential (-0.74); other (0.69); and inpatient continuing care (-0.66).

Change in Care Needs. The fixed component for the intercept on aggressive behaviour (ABS) was statistically significant (t (104.29) = 40.998, $p < .001$) and equal to 1.555 (SE = 0.038) (see Appendix C, Table 24 for additional 'fit' statistics). An intercept of this value on 'Change in Care Needs' indicated that overall, patients in CCC are rated almost equally between 'no change' and 'deteriorated'. In addition, the value of the random component for the intercept was statistically significant (Wald Z = 6.681, $p < .001$) and equal to 0.146 (SE = 0.022). Correspondingly, 95% of all intercept values across facilities fall within the range of 0.806 to 2.304 on a scale with a possible range of zero (improved; receives fewer supports, needs less restrictive level of care) to two (deteriorated; receives more supports). A score of one indicates 'no change'.

Adding demographic information in the prediction of change in care needs resulted in statistically significant reduction of errors of 1.5%, χ^2 (10) = 61.819, $p < .05$. Specific parameter estimates within the demographic model are presented in Appendix C, Table 25. Being female was associated with decreased CICN score (-0.028), while every year of age relative to the mean of the facility was associated with a 0.002 increase in CICN score. Length of stay was negatively (and minimally) associated with admission CICN score, while the interaction was also barely significant.

The addition of referral service in the prediction of change in care needs rated at admission to the facility resulted in very small (0.4%) reduction in errors of prediction, χ^2 (10) = 94.923, $p < .05$. When compared to patients referred from acute care hospitals, those individuals coming from long-term care (-0.33 points) and inpatient rehabilitation (-0.33 points specialized, and -0.13 points in general rehabilitation) had lower CHESS scores on average at admission (Table 26). Individuals arriving at CCC facilities from a supported living service (0.14) or private home with (0.09 points) or without (0.08 points) home care had higher CHESS scores (rated as more medically unstable) when compared to patients arriving from acute-care facilities

The addition of discharge service in the prediction of change in care needs rated at admission to the facility resulted in small (2.9%) reduction in errors of prediction, χ^2 (10) = 486.443, $p < .05$ (see model fit data presented in Appendix C, Table 24). Within the final model sex and age effects remained largely null. Very small effects were also found for length of stay, consistent with previous models. As with the previous model and the model predicting CHESS scores, patients referred from LTCH and rehabilitation services were associated with lower CICN scores than patients from acute care facilities, whereas individuals arriving from private homes (without home care) and supportive living facilities had significantly higher CICN scores. Finally, and consistent with the previous CHESS analysis, patients with higher CICN scores at admission to CCC were more likely to be discharged to long-term care than most other facilities. Specifically, compared to individuals discharged to long-term care facilities, individuals discharged to the following services had lower CICN scores at admission: private home with no home care (-0.362 points) or with home care (-0.219 points); inpatient rehabilitation (-0.366 for specialized and -0.182 for general), inpatient continuing care (-0.185 points) and inpatient acute care (-0.133 points).

Resource Utilization

Resource Utilization Groups. The fixed component for the intercept on Resource Utilization Groups (RUGS-III) was statistically significant (t (98.641) = 61.446, $p < .001$) and equal to 5.563 (SE = 0.091) corresponding to the 'Extensive Services' RUG code under the 'Heavier Care' category (see Appendix C, Table 28 for additional 'fit' statistics). In addition, the value of the random component for the intercept was statistically significant (Wald Z = 6.613, p <.001) and equal to 0.833 (SE = 0.128). Correspondingly, 95% of all intercept values across facilities fall within the range of 3.774 to 7.0 on a scale with a possible range of 1 (Reduced Physical Function) to 7 (Special Rehabilitation).

Adding demographic information in the prediction of RUG-III scores resulted in a significant reduction of errors of 1.6%, χ^2 (10) = 31.214, $p < .05$ (see Table 28 for additional fit statistics). Sex did not predict RUG-III scores, nor did age (with the exception of a trivially small curvilinear trend, see Table 29). Very small trends were also noted for length-of-stay (admission), where longer stays were marginally related to reduction in RUGS-III score, while there was also a very small interaction effect.

Adding referral service information in the prediction of RUG-III scores resulted in statistically significant reduction of errors of 1.4%, χ^2 (10) = 103.59, p<.05 (see Table 28 for additional 'fit' statistics). Sex, age and length of stay were not associated with large enough parameter estimates to warrant interpretation (see Table 30). Compared to residents from acute care hospitals, at admission the RUG-III scores were lower for patients from private homes with (-0.62) and without (-0.34) homecare, inpatient psychiatry service (-.59), and specialized inpatient rehabilitation (-0.47).

A model in which discharge service was added was associated with a 6.7% reduction in errors of prediction (R_1^2) versus the previous referral model (see model fit data presented in Appendix C, Table 28), accounting for a significant amount of additional variance from the previous model, $\chi^2(10) = 485.214$, $p < .05$. This full model represents a 9.5% reduction in errors of prediction when compared against the null model. Compared to residents from acute care hospitals, at admission the RUG-III scores were lower for patients from inpatient psychiatry service, and private homes with or without home care and inpatient rehabilitation (indicating less service utilization in these groups versus acute care facility patients). Compared to individuals discharged to long-term care facilities however (see Table 31), individuals discharged to the following services had higher RUG-III scores at admission: inpatient rehabilitation (0.81) specialized and -0.71); inpatient acute care (0.43); private home with (0.64) and without (0.60) home care; and supportive housing (0.39).

MLM Analysis # 2: Growth Analysis on Health Trajectories

Averages for clinical need variables are presented in Table 32. Broadly, impairment in activities of daily-living (ADL-H) at first admission was within the middle of the range of the instrument, whereas cognitive impairment (CPS) and aggression (ABS) were closer to the lower end of a possible range. The average CICN score was between anchor points of 'no change' and 'deteriorated, receives more support (than 90 days ago)'. Resource utilization also fell within the 'Heavier Care' range between 4 and 7, with more than 95% of individuals scoring within this category upon entry. Table 32 also demonstrates the general trend of small increases in symptom ratings with time, and decreases in frailty and resource utilization with time.

Table 32.

Descriptive Statistics for Outcome Variables

	First Assessment N = 15 904	Subsequent Assessments N = 8 327
Symptom Profile		
ADL-H Mean (SD)	3.74 (1.65)	3.84 (1.71)
CPS Mean (SD)	2.11 (1.78)	2.55 (1.88)
ABS Mean (SD)	0.73 (1.74)	1.01 (2.07)
Frailty		
CHESS Mean (SD)	2.06 (1.34)	1.47 (1.32)
CICN Mean (SD)	1.56 (0.68)	1.10 (0.69)
Resource Usage		
RUGS Mean (SD)	5.99 (1.50)	5.54 (1.83)

Note: ADL-H = Activities of Daily Living-Hierarchy (Range = 0 to 6) . CPS = Cognitive Performance Scale (Range 0 to 6). ABS = Aggressive Behaivour Scale (Range = 0 to 12). CHESS = Changes in Health, End-stage disease and Symptoms and Signs (Range 0 to 5). CICN = Changes in Care Needs (Item Q2 from the MDS 2.0, Range = 0 to 2). RUGS = Resource Utilization Groups (Range = 1 to 7).

Symptom Profiles

ADL Impairment. A mixed-model analysis (also known as 'growth model') was conducted on 24 231 assessments nested within 15 904 patients to document the relationship of functional impairment over time and demographic and referral/discharge. The fixed component for the intercept on ADL was statistically significant (t (15 776.978) = 291.173, $p < .001$) and equal to 3.721 ($SE = 0.013$) (see Appendix D, Table 33 for additional 'fit' statistics). In addition, the value of the random component for the intercept was statistically significant (Wald $Z = 63.440$, $p <.001$) and equal to 1.939 ($SE =$ 0.031). Correspondingly, 95% of all intercept values across facilities fall within the range of 0.992 to 6 on a scale with a possible range of 0 (intact) to 6 (very severe impairment).

Adding demographics in the prediction of impairment in activities of daily living (ADL) resulted in statistically significant reduction of errors, χ^2 (4) = 64.902, $p < .05$ (See Appendix C, Table 33 for additional fit statistics). Specific parameter estimates within the demographic model are presented in Appendix C, Table 34. There were no statistically-significant individual estimates.

First assessment versus later assessment was entered into the model to account for change in ADL scores over time and resulted in a statistically significant reduction in error, χ^2 (1) = 32.355, $p < .05$ (See Appendix D, Table 33 for additional fit statistics). Later assessments were associated with a small increase in ADL impairment (estimate = 0.14) (see Appendix D, Table 35).

When referral service was entered into the model, there was a significant reduction in errors compared to the demographic model, χ^2 (10) = 166.679, $p < .05$. When compared to acute care hospitals, individuals referred from ambulatory care had higher ADL impairment at admission (0.60). Private homes (with no home care, -0.36), inpatient rehabilitation (-0.56 general and -0.37 specialized), and inpatient psychiatry services (-0.39) were associated with lower ADL impairment at admission. The interaction between time and referral service was entered in the next model, there was a small but significant reduction in errors compared to the demographic model, χ^2 (10) = 26.032, $p < .05$. In addition to the previous relationships, the positive estimate of the fixed interaction effects between ADL impairment and facilities indicate that individuals from private homes (with home care, estimate = 0.60; without, estimate = 0.27) indicate increased impairment over time relative those referred from acute care (Appendix D, Table 36). Results for the four locations with the highest volume of referrals (for ease of interpretation) are displayed in Figure 1.

The addition of the discharge service to the model resulted in a significant improvement to the model, χ^2 (10) = 985.436, $p < .05$ (See Appendix D, Table 26 for additional fit statistics). When discharge facilities were added to the model, patients eventually discharged to inpatient psychiatry services (-1.09), private home with (-0.72) or without (-0.96) homecare services, supportive living facilities (-0.76), and inpatient rehabilitation units (general = -0.30) had fewer ADL impairments than those discharged to LTCH (Appendix D, Table 38).

The addition of discharge service and time interaction effects to the final model resulted in a statistically significant reduction in error over the previous model, (χ^2 (10) = 44.27, $p <. 05$) which was a 1.2% reduction (pseudo R^2) in level-one residual variance compared to the null discharge model (See Appendix D, Table 33 for additional fit statistics). Based on the fixed effects of the final model (Appendix D, Table 39), 'time' (or the contrast between admission and subsequent assessments) remained a non-significant predictor. Individuals arriving at the CCC from private homes (no home care), inpatient rehabilitation services, and inpatient psychiatric services had significantly lower ADL impairment. Individuals from private homes (with home care; without home care approached significance, $p < .06$) were rated as having lower ADL impairment on their admission assessment than on subsequent assessments (compared to individuals from acute care hospitals), whereas individuals referred from inpatient rehabilitation (general) or 'other' facilities had decreased ADL impairment on subsequent assessments relative to acute care. When discharge facilities were added to the model, patients eventually discharged to inpatient psychiatry services, private home (with or without homecare services), supportive living facilities, and inpatient rehabilitation units (general) had fewer ADL impairments than those discharged to LTCH. Finally, individuals discharged to private home with no home care (0.46) and inpatient rehabilitation (specialized) were rated as having greater increases to ADL impairment after their admission assessment than those discharged to LTCH (see Figure 7).

Cognitive Impairment. The fixed component for the intercept on CPS was statistically significant (t (15 961.675) = 153.780, $p < .001$) and equal to 2.149 (SE = 0.014) (see Appendix D, Table 40 for additional 'fit' statistics). In addition, the value of the random component for the intercept was statistically significant (Wald Z = 74.651, p <.001) and equal to 0.584 (SE = 0.009). Correspondingly, 95% of all intercept values across facilities fall within the range of 0.65 to 3.65 on a scale with a possible range of 0 (intact) to 6 (very severe impairment). Adding demographics in the prediction of cognitive impairment (CPS) resulted in statistically significant reduction of errors, χ^2 (4) = 488.702, p <. 05 (See Appendix D, Table 40 for additional fit statistics). Specific parameter estimates within the demographic model are presented in Appendix D, Table

41. The only significant estimate was sex: being female was associated with a -0.35 CPS point decrease (i.e. less cognitive impairment).

Admission assessment versus later assessment was entered into the model to account for change in CPS scores over time and resulted in a better model fit, χ^2 (1) = 169.673, $p < .05$ (See Appendix D, Table 40 for additional fit statistics). While being female continued to be associated with decreased CPS scores, assessments conducted after the admission assessment were on average associated with a 0.32 increase on CPS scores (see Appendix D, Table 42).

When referral location was entered into the model, there was a significant reduction in errors compared to the demographic model, χ^2 (10) = 247.071, $p < .05$ (see Table 43). When compared to acute care hospitals, individuals referred from inpatient rehabilitation (general) had slightly lower cognitive impairment (estimate = -0.17). Those referral locations that were associated with higher levels of cognitive impairment (higher CPS scores) when compared to acute care facilities included: Supportive Living (residential) facilities (estimate = 1.31); inpatient psychiatry service (1.05); LTCH (1.04); and inpatient continuing care (0.46). Ambulatory care was associated with greater cognitive impairment at admission (0.60) (see Appendix D, Table 43). The interaction between time and referral service was entered in the next model, which did not significantly improve the model fit, χ^2 (10) = 10.385, $p > .05$ (Appendix D, Table 40, 44, see also Figure 2).

The addition of the discharge service to the model resulted in a significant improvement to the model, χ^2 (10) = 1 203.506, $p < .05$ (See Appendix D, Table 40 for additional fit statistics). When discharge facilities were added to the model, patients eventually discharged to private home with (-0.93) or without (-0.98) home care, inpatient rehabilitation (general = -0.87, specialized = -0.68), supportive living (-0.39) or acute care (-0.40) had decreased cognitive impairment than those individuals discharged to LTCH (Appendix D, Table 35).

Finally, the interaction between the 'time' variable and discharge service was added to the model to investigate whether there were differences in the 'trajectory' of cognitive impairment over time between the discharge service types. The addition of discharge service to the model resulted in a statistically significant reduction in error over the previous model, χ^2 (10) = 15.31, $p > .05$ (See Appendix D, Table 40). In fact, when using pseudo R^2 as a fit tool, no stage of the current model resulted in a reduction in Level 1 residual variance, suggesting that the variance observed in the CPS score was not accounted for in any significant way by demographics, a 3 month period of time, or where individuals are referred from or discharged to.

Based on the fixed effects of the final model (Appendix D, Table 46), there was an overall small increase in cognitive impairment from admission assessment to subsequent assessments (estimate = 0.18), while females were rated as slightly less cognitively impaired (-0.29) than males. With additional predictors, age also had a very small and linear positive relationship with CPS scores (0.03). Those individuals referred to CCC from LTCH, inpatient psychiatry service, supportive care housing or inpatient continuing care had higher CPS scores (more impairment) than those referred from acute care facilities. Conversely, those individuals referred from private home with home care or inpatient rehabilitation services had lower CPS scores than those from acute care facilities (see Table 46 for specific parameter estimates and standard errors). Regarding prognosis, individuals referred from home care were not only lower in CPS scores than those referred from acute care, but also had slightly lower 'growth' scores (coefficient = -0.03, see Figure 8). This suggests that while those referred from acute care facilities were rated as slightly higher in cognitive impairment on assessments subsequent to admission, those from home care remained relatively stable.

As displayed in Figure 8, individuals discharged to LTCH were one of the groups rated highest in cognitive impairment. In contrast, individuals discharged to other services were, on average, rated lower on the CPS, including individuals discharged to private homes (with or without home care), inpatient rehabilitation services, supportive living facilities, and inpatient acute care. Those individuals discharged to private homes (with no home care) were noted already to be lower than inpatient acute care in CPS scores, but were slightly 'accelerated' in 'growth', meaning that from admission to subsequent assessments, those discharged to acute care facilities increased an average of 0.23 points on the CPS more than those discharged to acute care facilities.

Aggressive Behaviour. The fixed component for the intercept on ABS was statistically significant (t (16 495.712) = 55.274, $p < .001$) and equal to 0.750 (SE = 0.014) (see Appendix D, Table 47 for additional 'fit' statistics). In addition, the value of the random component for the intercept was statistically significant (Wald Z = 61.139, $p < .001$) and equal to 2.035 (SE = 0.033). Correspondingly, 95% of all intercept values across facilities fall within the range of 0 to 3.546 on a scale with a possible range of 0 (none) to 12 (very severe). Note that any score above 5 was noted to be very severe. Thus, as discussed before, there was relatively little disruptive behaviour on average in CCC facilities, but despite this there was a broad range of intercept values across individuals. To account for this variability, adding demographics to the model resulted in statistically significant reduction of errors, χ^2 (4) = 167.172, p<.05 (See Appendix D, Table 47 for additional fit statistics). Specific parameter estimates within the demographic model are presented in Appendix D, Table 48. Being female was associated with an average 0.34 point decrease on the ABS, while length-of-stay was also associated with a very small decrease in aggressive behaviour.

Admission assessment versus later assessment was entered into the model to account for change in ABS scores over time and resulted in a better model fit, χ^2 (1) = 30.997, $p < .05$ (See Appendix D, Table 47 for additional fit statistics). While being female continued to be associated with decreased ABS scores, assessments conducted after the admission assessment were on average associated with a 0.14 increase on ABS scores means (see Appendix D, Table 49).

When referral location was entered into the model, there was a significant reduction in errors compared to the demographic model, χ^2 (10) = 461.338, $p < .05$ (see Table 47). Time and sex continued to be significant predictors of ABS scores within this model (Table 50). When compared to acute care hospitals, individuals referred from inpatient rehabilitation (general) had slightly lower aggressive behaviour (estimate = -0.17). Those referral locations that were associated with higher levels of aggression (higher ABS scores) when compared to acute care facilities included: LTCH (coefficient estimate = 1.94); inpatient psychiatric service (1.88); inpatient continuing care (0.95); and supportive living facilities (0.68). The interaction between time and referral service was entered in the next model, significantly improved the model fit, χ^2 (10) = 32.995, $p < .05$ (Appendix D, Table 47). Specifically, in addition to the above predictors, patients originally referred from an inpatient psychiatric service were not only higher than acute care patients but experienced increased aggressive behaviour 'growth' (coefficient = 1.484) in the time from admission assessment to a subsequent assessment (Table 51, see also Figure 3). Conversely, those patients from LTCH experienced a decline in growth of the ABS score (coefficient = -0.661), suggesting either stable or decreasing disruptive behaviour.

The addition of the discharge service to the model resulted in a significant improvement to the model, χ^2 (10) = 397.478, $p < .05$ (See Appendix D, Table 47 for additional fit statistics). When discharge facilities were added to the model, patients eventually discharged to private home with (-0.53) or without (-0.53) home care, inpatient rehabilitation (general = -0.49, specialized = -0.36), supportive living (-0.18) or acute care (-0.16) had decreased cognitive impairment than those individuals discharged to LTCH (Appendix D, Table 52). Individuals discharged to an inpatient psychiatry service were rated on average as 1.85 points higher on the ABS than those discharged to a LTCH, while those discharged to ambulatory care were associated with a surprising 2.18 points higher than individuals in a LTCH.

Finally, the interaction between the 'time' variable and discharge service was added to the model to investigate whether there were differences in the 'trajectory' of aggressive behaviour over time between the discharge service types. The addition of discharge service to the model did not produce a statistically significant better fitting model, χ^2 (10) = 17.856, $p > .05$ (See Appendix D, Table 47). No stage of the current model resulted in a reduction in Level 1 residual variance (when using pseudo-R^2 as a fit tool), suggesting that the variance observed in the ABS score was not accounted for in any significant way by demographics, a 3 month period of time, or where individuals are referred from or discharged to.

Based on the fixed effects of the final model (Appendix D, Table 53), females were rated as slightly less aggressive (-0.30) than males. With additional predictors, time was no longer a significant predictor of ABS scores, therefore scores can be treated as relatively static (see Figure 3) in the presence of the predictors in the final model. As with the CPS analysis, those individuals referred to CCC from LTCH, inpatient psychiatry service, supportive care housing or inpatient continuing care had higher CPS scores (more impairment) than those referred from acute care facilities. Conversely, those individuals referred from private home with home care or inpatient rehabilitation services had lower ABS scores than those from acute care facilities (see Table 53 for specific parameter estimates and standard errors). As opposed to the static growth of aggressive behaviour of those individuals referred from inpatient acute care, those referred from inpatient psychiatry services became more aggressive with time whereas those from LTCH became less aggressive (see Figure 9). Individuals discharged to ambulatory care or inpatient psychiatry were rated as higher on the ABS than those discharged to LTCH, whereas those discharged to inpatient acute care, inpatient rehabilitation, supportive living, or private homes (with or without home care) were rated lower on the ABS on average. Finally, while the overall model did not prove to be a better fit, individuals discharged to ambulatory care and inpatient acute care were rated as increasing more in ABS growth than the growth observed in LTCH (which was minimal, see Figure 9).

Frailty

Changes in Health, End-stage disease and Symptoms and Signs. The fixed component for the intercept on CHESS was statistically significant (t (15 209.790) = 191.176, $p < .001$) and equal to 1.953 (SE = 0.010) (see Appendix D, Table 54 for additional 'fit' statistics). In addition, the value of the random component for the intercept was statistically significant (Wald Z = 44.776, $p < .001$) and equal to 0.947 (SE = 0.014). Correspondingly, 95% of all intercept values across facilities fall within the range of 0.046 to 3.860 on a scale with a possible range of 0 (Not at all unstable) to 5 (Highly unstable). The addition of demographic information to the model resulted in statistically significant reduction of errors, χ^2 (4) = 56.193, $p < .05$ (See Appendix D, Table 47 for additional fit statistics). Specific parameter estimates within the demographic model are presented in Appendix D, Table 55. For every year increase in age, there was a 0.03 estimated increase in frailty (CHESS score) when all other predictors are set to their means.

First assessment versus later assessment was entered into the model to account for change in ABS scores over time and resulted in a better model fit, χ^2 (1) = 357.098, $p<.05$ (See Appendix D, Table 54 for additional fit statistics). While age continued to be positively associated with frailty, assessments conducted after the admission assessment were on average associated with a 0.37 point decrease on CHESS scores when all other predictors are set to their means (see Appendix D, Table 56).

When referral location was entered into the model, there was a significant reduction in errors compared to the demographic model, χ^2 (10) = 317.118, $p < .05$ (see Table 54). When compared to acute care hospitals, individuals referred from inpatient rehabilitation (estimate for general = -0.57, specialized = -0.55), LTCH (-0.56), and inpatient psychiatry (-0.49) displayed lower CHESS scores than those referred from acute care (Table 57). However, individuals referred from ambulatory care (0.46) or private homes with (0.35) or without (0.282) home care were rated as higher in CHESS scores than those referred from acute care. The interaction between time and referral service was entered in the next model and did not significantly improve the model fit, χ^2 (10) = 15.48, $p > .05$ (Appendix D, Table 47). In addition to the above predictors, patients originally referred to CCC from a general rehabilitation service or private home with home care were associated with small but significant increases in growth as compared to patients referred from acute care facilities (i.e. did not decrease in CHESS scores as rapidly, see Figure 4).

The addition of the discharge service to the model resulted in a significant improvement to the model, χ^2 (10) = 1 378.679, $p < .05$ (See Appendix D, Table 54 for additional fit statistics). When discharge service was added to the model, it was evident that individuals who are discharged to LTCH have the highest CHESS scores (with non-significant differences between ambulatory care and LTCH) (Appendix D, Table 59). Lower CHESS scores are observed in individuals discharged to private homes (without home care estimate = -0.97, with home care estimate = -0.70), inpatient rehabilitation (specialized = -0.71, general = -0.69), inpatient psychiatry services (-0.69), supportive living facilities (-0.64), inpatient acute care (-0.49), and inpatient continuing care (-0.34).

Finally, the interaction between the 'time' variable and discharge service was added to the model to investigate whether there were differences in the 'trajectory' of frailty over time between the discharge service types. The addition of discharge service to the model resulted in a statistically significant reduction in error over the previous model, χ^2 (10) = 98.364, $p < .05$ (See Appendix D, Table 54). Use of pseudo R^2 suggests a reduction in Level 1 residual variance of 0.4%, suggesting that while there are some differences in groups related to the variables testing, frailty was likely to be much more related to other factors not accounted for by this model.

Based on the fixed effects in the final model (Appendix D, Table 60), CHESS scores decrease with time, suggesting people are rated as less medically frail with intervention within CCC (0.66 points decrease in presence of all other predictors in this model when these predictors are set to their means). Increased age also shared a small relationship with frailty (estimate = 0.02) and also had a very small quadratic effect. Individuals referred from private homes (with or without home care) were generally rated with higher CHESS scores than those referred from a hospital setting, which in turn was rated as higher than LTCH, inpatient rehabilitation, and inpatient psychiatry services. Both patients referred from home care (rated as initially higher in CHESS scores than acute care) and LTCH (rated as lower in CHESS scores) did not decrease with the same slope that those referred from acute care facilities did (see Figure 4). Residents discharged to LTCH were statistically higher in CHESS scores than all other discharge services (with the exception of ambulatory care). While residents from LTCH were rated as high on CHESS scores, they experienced steeper declines in these scores relative to patients from private homes (with home care = 0.26, without home care = 0.52), supportive living facilities (0.38), inpatient continuing care (0.49) and inpatient rehabilitation (0.45) facilities, as well as individuals discharged to acute care facilities (0.28) (e.g. see Figure 10).

Change in Care Needs. The fixed component for the intercept on CICN was statistically significant (t (14 223.756) = 285.870, $p < .001$) and equal to 1.438 (SE = 0.005) (see Appendix D, Table 61 for additional 'fit' statistics). In addition, the value of the random component for the intercept was statistically significant (Wald Z = 21.476, p <.001) and equal to 0.116 (SE = 0.005). Correspondingly, 95% of all intercept values across facilities fall within the range of 0.770 to 2 on a scale with a possible range of zero (improved; receives fewer supports, needs less restrictive level of care) to two (deteriorated; receives more supports). A score of one indicates 'no change'. The addition of demographic information to the model resulted in statistically significant reduction of errors, χ^2 (4) = 109.236, $p < .05$ (See Appendix D, Table 61 for additional fit statistics). While cumulatively, the addition of these variables significantly decreased errors of prediction, no individual predictor was of sufficient magnitude to reach statistical significance (See Table 62).

First assessment versus later assessment was entered into the model to account for change in CICN scores over time and resulted in a better model fit, χ^2 (1) = 895.269, $p <$ .05 (See Appendix D, Table 63 for additional fit statistics). There was a predicted decrease of 0.30 points on the CICN from first to subsequent assessment. In contrast to the previous model, accounting for the additional variance noted above also resulted in a significant but small effect for sex (with males being rated higher on CICN), and a significant but negligible effect for length of stay (see Appendix D, Table 63).

When referral location was entered into the model, there was a significant reduction in errors compared to the demographic model, χ^2 (10) = 154.96, $p < .05$ (see Table 61). Individuals coming from acute care hospitals were on average rated higher with regard to CICN than most other referral sources (see Table 64). Patients arriving at CCC from inpatient rehabilitation (estimate for specialized = -0.31, general = -0.21), LTCH (-0.19), private home with (-0.10) or without (-0.06) home care, and inpatient continuing care (-0.09) were rated as lower on the CICN item than individuals from acute care facilities. The interaction between time and referral service was entered in the next model, which significantly improved the model fit, χ^2 (10) = 117.055, $p < .05$ (Appendix D, Table 61). A visual inspection of Figure 5 suggests individuals coming from acute care facilities are rated highly on the CICN item and have a steep decline relative to individuals from other facilities. Individuals from the following locations differed significantly from the steep negative growth evident of those individuals referred from acute care: inpatient continuing care (estimate = 0.38); LTCH (0.37); private home with (0.36) and without (0.29) homecare; supportive care facilities (0.34); and inpatient rehabilitation (general = 0.21) (Table 65).

The addition of the discharge service to the model resulted in a significant improvement to the model, χ^2 (10) = 530.997, $p < .05$ (See Appendix D, Table 61 for additional fit statistics). When discharge service was added to the model, it was evident that individuals who are discharged to LTCH have the highest CICN scores (with non-significant differences between ambulatory care, psychiatry services and LTCH) (Table 66). Lower CICN scores are observed in individuals discharged to private homes (without home care estimate = -0.31, with home care estimate = -0.22), inpatient rehabilitation (specialized = -0.42, general = -0.23), supportive living facilities (-0.14), inpatient acute care (-0.08), and inpatient continuing care (-0.12).

Finally, the interaction between the 'time' variable and discharge service was added to the model to investigate whether there were differences in the 'trajectory' of frailty over time between the discharge service types. The addition of discharge service to the model resulted in a statistically significant reduction in error over the previous model, χ^2 (10) = 49.062, $p < .05$ (See Appendix D, Table 61). Use of pseudo R^2 suggests a reduction in Level 1 residual variance of 0.3%, suggesting that while there are some differences in groups related to the variables entered in the present models, change in care needs was likely to be much more related to other factors not accounted for by this model.

Based on the fixed effects (Appendix D, Table 67), CICN scores decrease with time, suggesting people are rated as more medically stable with intervention within CCC (0.38 point decrease in presence of all other predictors in this model when these predictors are set to their means). Patients from both inpatient settings (general inpatient rehabilitation, continuing care, LTCH) and community settings (private home with and without home care and supportive living facilities) decreased in CICN scores over time at a slower rate than those referred from acute care facilities. Residents discharged to LTCH were statistically higher in CHESS scores than all other discharge services (with the exception of ambulatory care and inpatient psychiatric facilities). And as presented in Figure 11, while all CICN scores decreased with time, the decrease was slowed in patients discharged to acute care (estimate = 0.08), general inpatient rehabilitation (0.14), or private home with no home-care (0.10) as compared to those individuals discharged to LTCHs. However, individuals discharged to a private home with home care services experienced a steeper decline (-0.10) than those discharged to LTCHs.

Resource Utilization

RUG-III. The fixed component for the intercept on RUG-III scores was statistically significant (t (16 405.580) = 496.214, $p < .001$) and equal to 5.892 (SE = 0.012) (see Appendix D, Table 68 for additional 'fit' statistics). In addition, the value of the random component for the intercept was statistically significant (Wald Z = 42.071, $p < .001$) and equal to 1.103 (SE = 0.026). Correspondingly, 95% of all intercept values across facilities fall within the range of 3.83 to 7 on a scale with a possible range of 1 (Reduced Physical Function) to 7 (Special Rehabilitation). The addition of demographic information to the model resulted in statistically significant reduction of errors, χ^2 (4) = 97.598, p<.05 (See Appendix D, Table 68 for additional fit statistics). Females were rated 0.10 points higher on the RUG-III than men (on average), while every year of age was associated with an average increase of 0.05 of the RUG-III (see Table 69). The quadratic effect for age and admission date were also associated with very small increases in RUG-III scores.

First assessment versus later assessment was entered into the model to account for change in RUG-III scores over time and resulted in a better model fit, χ^2 (1) = 146.335, $p < .05$ (See Appendix D, Table 68 for additional fit statistics). There was a predicted decrease of 0.28 points on the RUG-III from first to subsequent assessment in the context of all other predictors. There was no substantive change in the predictors from the previous analysis (see Appendix D, Table 70).

When referral location was entered into the model, there was a significant reduction in errors compared to the demographic model, χ^2 (10) = 125.645, $p < .05$ (see Table 68). Time continued to be negatively associated with RUG-III scores (see

Appendix D, Table 71), while being female and older was associated with higher RUG-III scores. The quadratic effect of age and length-of-stay continued to share a small but significant relationship with RUG-III scores. Patients arriving at CCC from inpatient rehabilitation (estimate for general = 0.19) were rated as requiring more intensive services than those arriving from inpatient acute care. Patients being referred from acute care were in turn rated as having more intensive care needs than those from inpatient psychiatry services (-0.70), private homes with (-0.51) and without (-0.24) home care, LTCH (-0.19), private home with (-0.10) or without (-0.06) home care, and inpatient continuing care (-0.38). The interaction between time and referral service was entered in the next model, significantly improving the model fit, χ^2 (10) = 21.169, p<.05 (Appendix D, Table 68). A visual inspection of Figure 6 suggests the four most frequent locations CCC clients arrive from have largely parallel trajectories. Significant differences in growth were found between patients from inpatient acute care facilities and specialized inpatient rehabilitation (estimate = 0.75, indicating a slower decline in RUG-III scores) and patients from LTCHs (estimate = -0.61, indicating a steeper decline in RUG-III scores) (see Appendix 72).

The addition of the discharge service to the model resulted in a significant improvement to the model, χ^2 (10) = 1 027.197, $p < .05$ (See Appendix D, Table 68 for additional fit statistics). Somewhat surprisingly, individuals discharged to LTCH had overall lower resource intensity needs (RUG-III scores) than those discharged to private homes with (estimate = 0.85) or without (0.89) homecare, specialized (0.63) or general (0.81) rehabilitation, supportive living facilities (0.44), or inpatient acute care hospitals (0.41) (Table 73).

Finally, the interaction between the 'time' variable and discharge service was added to the model to investigate whether there were differences in the 'trajectory' of resource intensity needs over time between the discharge service types. The addition of discharge service to the model did not result in a statistically significant reduction in error over the previous discharge model, χ^2 (10) = 17.835, $p > .05$ (See Appendix D, Table 68). Use of pseudo R^2 suggests a reduction in Level 1 residual variance of 1.1% when compared to the null model.

Based on the fixed effects of the final model (Appendix D, Table 74), CICN scores decrease with time, suggesting people require fewer care resources with time (0.13 point decrease on average between 1st and subsequent assessment). The estimate for sex decreased by half in subsequent models, so that females are only rated, on average, approximately 0.05 points higher on the RUGS-III than males. Greater age was also associated with higher RUG-III scores, and there was a significant but minimal quadratic effect for age. Individuals arriving at the CCC from a private home (with or without homecare) or inpatient psychiatry services were rated as lower in RUG-III scores than acute care facilities, whose patients were rated lower on than patients arriving from inpatient rehabilitation (general). Inpatient continuing care and LTCHs were associated with a more marked decrease in RUG-III scores when compared against acute care facilities, whereas inpatient rehabilitation services were rated as experiencing increased positive growth. Individuals discharged to acute care hospitals, rehabilitation, or community resources such as private homes (with and without home care) or supportive living were associated with greater resource utilization than those discharged to LTCHs.

Finally, inpatient acute care was associated with steeper declines in RUG-III than those discharged to LTCH.

Patients from both inpatient settings (general inpatient rehabilitation, continuing care, LTCH) and community settings (private home with and without home care and supportive living facilities) decreased in CICN scores over time at a slower rate than those referred from acute care facilities. Residents discharged to LTCH were statistically higher in CHESS scores than all other discharge services (with the exception of ambulatory care and inpatient psychiatric facilities). And as presented in Figure 11, while all CICN scores decreased with time, the decrease was slowed in patients discharged to acute care (estimate = 0.08), general inpatient rehabilitation (0.14), or private home with no home-care (0.10) as compared to those individuals discharged to LTCHs. However, individuals discharged to a private home with home care services experienced a steeper decline (-0.10) than those discharged to LTCHs.

Discussion

The purpose of this investigation was two-fold: (1) to examine the extent to which nesting impacts evaluation given an increasing emphasis on the 'regionalization' of health care; and (2) understand the influence of symptoms at admission and throughout hospitalization on subsequent need for continuing care. The current evaluation examined 24 231 total MDS 2.0 assessments nested within 15 904 continuing-care patients. Patients were nested within 124 complex-continuing care facilities that also fall within 14 Local Health Integrated Networks.

Demographic and service usage statistics of patients in CCC were largely consistent with previous reports (e.g. CIHI, May 2005). Mean age of patients in the current dataset was approximately 78 years (at admission), and 59% of the sample was female. While length of stay appears to have decreased dramatically from an uncorrected LOS of 224 days in 1996 to 139 days in 2002 (CIHI, May 2005), and 96 days currently, the current estimate excludes individuals with stays under 30 days.

Initial examination of outcome measures used in the rest of the analysis suggests CCC patients have high resource needs associated with high ADL Impairment. Individuals were rated very high (mean = 6.02) on RUG-III scores, as well as in the high range in Change in Care Needs and mid-range with regard to frailty measured by CHESS score. Very little aggressive behaviour was noted on average, while cognitive impairment and ADL impairment were with-in the low to middle of the possible range on their respective instruments.

Contextual effects on admission assessments

Based on a literature review, CCC facility (alone or designation as urban vs rural) and LHINs (alone or designation as Northern vs Southern) were identified as potentially influencing a patient's clinical status (Research Question #1). This analysis could not adequately test dependence of observations between facilities designated as having urban versus rural postal codes given the small number of CCC facilities designated as rural (only 3.2% of total admission assessments). Of the remaining candidate contextual variables, more than 10% of the variance was observed between facilities, rather than within facilities (with the exception of only 7% of variances in ABS scores occurring between facilities). Neither LHIN nor Northern versus Southern location displayed any substantial nesting-engendered dependence on the chosen outcome variables, with the exception of the effect of LHIN on RUG-III scores (ICC = 0.11). Assessments were particularly dependent upon CCC facilities for the Change in Care Needs (Q2) item and resource intensity (RUG-III), as 30% of the variance occurred between facilities rather than within them. In other words, approximately one-third of the variability in patient's CICN score has to do with the differences between hospitals, rather than the patient's clinical presentation.

Further analysis was completed in an attempt to explain the differences *between* hospitals as well as *within* them. Multi-level modeling was thus used for two reasons: (1) improved model fit by decreasing errors of prediction utilizing random coefficient regression; and (2) using demographic variables to explain both assessment-level variability as well as facility-level variability. The effect of the patient's age, gender, and length-of-stay (assessment-level predictors, or Level 1) as well as the average age, gender composition and average length-of-stay for the facility the patient was treated in (facility-level predictors, or Level 2), and the implied cross-level interaction terms (Level 1 * Level 2) were used to explain variability in patient scores between facilities.

Adding these demographic predictors accounted for slightly more variance in symptoms profiles rather than resource utilization or frailty, resulting in 3.7% reduction in error for CPS (cognitive impairment) scores, followed by a 2.9% reduction in error using the ABS (aggressive behaviour), and a 1.7% reduction in error in ADL-H (activities of daily living impairment) models. Smaller reductions in error were noted for the RUG-III (1.6% decrease for this measure of resource utilization), the CICN (1.5% on change in health status), and the CHESS (0.7% on this frailty measure). Given that these are all relatively small decreases in errors of prediction, variables other than average levels of demographic variables may more likely result in greater error reductions. Variables such as quality or size of the facility should be noted for future work in the area.

Regarding specific predictors, *sex* proved to be a better predictor of symptom profiles (ADL-H, CPS, ABS) than frailty (CHESS, CICN) or resource utilization (RUG-III). Sex was most relevant to the prediction of aggression, where being male was associated with a 0.28 point increase on the ABS (on average; SE=0.03). The fixed estimate for more males within the facility on aggression was -1.84 (SE=0.36) indicating that facilities treating more males are associated with higher levels of aggression. Being male was also associated with increased cognitive impairment, and facilities treating more males had increased cognitive impairment, on average. Being female was associated with small amounts of increased ADL impairment at Level 1, and slightly decreased CICN scores at Level 1.

Age also shared more variance with symptom profile variables than frailty and resource utilization. For every year increase in age of an individual relative to the mean of their facility, there was a 0.1 point increase in the ADL-H and a 0.3 point increase on the CPS (based on only demographics being entered into the model). The mean age of patients within the facility also increased CPS and ABS scores. Given that the Level 1 estimate of ABS was not significant, it is interesting to note that age (relative to facility mean) doesn't necessarily make an individual more aggressive, but facilities with older average ages of patients do share a relationship with aggression in an individual (i.e. it's not a patient's age per se, but the average age of patients within the hospital that can increase aggression). With the addition of the full ADL model (including referral and discharge services), the older one is relative to their facility average was also predictive of ADL impairment. The interaction between Level 1 and Level 2 predictors was significant for the demographic models predicting ADL impairment: when average age within the facility decreases, rates of ADL impairment in older patients increase. Other outcomes were marginally associated with age, but these effects were so weak that they were only noted with the addition of many other predictors and thus aren't of practical significance towards the current discussion.

Length-of-stay, on the other hand, was negatively related to RUG-III scores at Level 1, as well as CICN and CHESS scores. This suggests that the longer a person is in CCC, the less frail or medically unstable they are, and less likely to require intensive resources. Interestingly, interactions between Level 1 and 2 were also significant for each of these clinical need variables. Given positive fixed effects estimates for Level 2, it is suggestive that the average length of stay in a facility moderates the decrease in frailty or resource intensity usually afforded by longer stays relative to others. That is, the more people that have 'longer stays' in the facility, the less likely any one individual's frailty or resource intensity is related to their length of stay.

Time

Eighty-five percent of the current sample had fewer than two assessments (typically spaced 90 days apart), and 75% of the sample had stays less than 113 days. In an attempt to make the presented models generalizable to as many patients as possible, the time contrast included the 1st assessment versus all subsequent assessment(s). While for most patients this represents an approximate span of 90 days, subsequent assessments for longer-stay patients are also incorporated into the analysis and interpretation.

An inspection of Tables 6 and 32 suggests that areas of clinical need change over time, as is also illustrated in Figures 1 through 12. Within the second set of MLM analyses, the addition of a time variable (1st assessment versus later assessment) consistently improved model fit over simply the demographic model, yet accounted for only small amounts of residual variance. This suggests that while time (generally under 90 days) and the interventions that take place during that time are important, there are also many things unrelated to time that influence a patient's presentation. Regarding symptom profiles, patients, on average, increased 0.13 points on the ADL-H (SE = 0.02, scale range=0 to 6), 0.32 on the CPS (SE = 0.02, scale range = 0 to 6), and 0.14 points on the ABS (SE = 0.03, scale range = 0 to 12) from the 1st assessment to subsequent assessments in the dataset. By contrast, patients, on average, decreased by 0.37 points on the CHESS (SE = 0.02; scale range = 0 to 5), 0.30 points on the CICN (SE = 0.01, scale range = 0 to 2), and 0.28 points on the RUG-III (SE = 0.28, scale range = 1 to 7). This corresponds roughly with the direction and size of differences of overall means presented in Table 32 for which demographic variables have not been accounted for.

This small increase in symptoms and decrease in frailty (CICN, CHESS) and resource utilization (RUG-III) seems counter-intuitive given the assumption that supports and overall illness severity would share a positive relationship with symptoms (ADL-H, CPS, ABS). Some possible explanations follow. First, it is not likely an artefact of sampling bias, since individuals that have died (who would initially increase frailty and RUG-III scores) were never included in the analysis, therefore the improvement in frailty and resource utilization is not simply due to attrition in this sense. Also, the attrition of higher-functioning individuals with time (who get better and are discharged) would effectively serve to increase frailty and resource utilization scores over time. Secondly, the explanation that chronic-care patients have long-term high care needs while being medically stable (and thus frailty scores deceasing with time) is not satisfactory, given that RUG-III scores also decrease with time as does frailty.

Thirdly, one could suggest the above phenomenon is simply an artefact of regression towards the mean, given that 45% of CCC patients are within the most Intensive Resource Utilization Group to begin with (CIHI, May 2005), whereas symptoms were rated in general within the mid to low range of the scale (please note however that within health populations these scales would be largely negatively skewed).

Finally, and by process of elimination, a small increase in symptoms may actually be an accurate reflection of disease processes prevalent in CCC facilities that reflect stable or deteriorating health. This suggests that the assumption of a high relationship between symptoms and required supports is not warranted in this case. For example, the most common medical diagnoses within CCC are stroke and dementia (noted in 23% of cases each; CIHI, June 2007). Disease process, affecting the structure (e.g. nervous system) and subsequent function of the body, is not equivalent to functional capacity – restrictions in the performance of the person that is ultimately an interaction between bodily function and accommodations within the environment (World Health Organization, 2002). By altering the environment, through medical (e.g. pharmacotherapy, shunt), occupational or physiotherapy (improving the controls of an electric wheelchair to fit the patient need) or other interventions (accommodations for memory loss, etc), one may then improve stability of care and resource intensity via interventions in the face of stable or increasing symptoms.

Referral service and clinical need

Analyses were undertaken to examine differences of patients' clinical needs for continuing care between the service received immediately prior to CCC admission (Research Question # 2). The first set of MLM analyses examined this question by examining only 'admission' assessments (while first removing the variance accounted for by demographic variables at the assessment and facility level). The second set of analyses examined all assessments with the variance due to assessment level demographic factors as well as time. Differences in clinical needs between referral services were largely consistent across analyses.

Given that approximately 84% of CCC patients had been transferred from an acute care hospital, all other referral services within the analysis were contrasted against acute care in an effort to understand how these services differ from 'the norm'. Regarding *symptom profiles*, individuals arriving at CCC from acute care were among the highest in ADL impairment, but the lowest in cognitive impairment and aggressive behaviour. Individuals from private home settings (private home, home care, encompassing 5.9% of referral services) were not significantly different than those individuals referred from the hospital settings (with the exception of individuals who received no home care, who were significantly lower in ADL impairment). In private homes however, patients referred from ambulatory care services displayed higher levels of ADL impairment than those from acute care hospitals (in the second MLM analysis only). Individuals from residential settings (supportive living facilities and LTCH, encompassing 2.1% of referrals) displayed equivalent ADL impairment to residents referred from acute care, with much higher levels of average cognitive impairment (coefficients above 1.0) as well as aggression (LTCH associated with a coefficient of approximately 2.0). Of the other inpatient medical facilities (rehabilitation and continuing care, encompassing 6.5% of referral) patients from inpatient rehabilitation were associated with lower rates of ADL impairment and aggression, whereas continuing care patients were rated as having higher levels of aggression and cognitive impairment (similar to LTCH and supportive living facilities). Finally, those individuals from inpatient psychiatry services (0.5% of referrals) were associated with lower ADL impairment with higher rates of cognitive impairment and aggression. Thus, when assessing symptoms related to need for continuing care, individuals from acute care facilities and private homes have similar profiles, whereas those from LTCH, continuing care, supportive living and psychiatric facilities are generally associated with increased cognitive impairment and aggression.

With respect to the *other predictors* used, individuals from acute care were among the most resource-heavy patients (RUG-III), and were neither the highest nor lowest with respect to frailty (CHESS, CICN). Individuals from private home settings were rated as lower on the RUG-III (coefficients ranging from 0.06 to 0.66), but higher than individuals from acute care with regard to changes in condition or medical severity (coefficients ranging from 0.06 to 0.10 for CICN scores and 0.28 to 0.45 for CHESS scores). Elevated frailty scores in this context are not unexpected, given the sudden decline in health is what has prompted the move from independent / semi-independent living to requiring CCC intervention. Regarding residential settings, LTCH referrals had lower CHESS and CICN scores (whereas supported living was associated with increased CICN scores), with no difference in RUG-III scores. Differentiated results for inpatient medical settings (excluding psychiatric) were again noted: while patients from continuing care facilities were not different on specified clinical need than those from acute care facilities, patients coming from inpatient rehabilitation units were rated as being more frail (CHESS and CICN scores). Those coming from general rehabilitation units were rated to be higher on the RUG-III. Patients from psychiatric services were rated to similar to patients from acute care facilities on the selected clinical need variables.

Time interaction effects. An admittedly ambitious goal of the current project is using current knowledge about service utilization to make more accurate prognoses for use by patients, families, and policy-makers. Specifically, a set of analyses were conducted to document the interaction of time and referral service. Differences in the trajectory of clinical need based on type of care that preceded admission to CCC can be used to more accurately make prognoses at the individual level or understand how service composition within a region may affect the need for future services at a policy level. It should be noted that these are differences existing beyond that expected by any difference in the age, sex, or length of stay composition between referral services.

Overall, the addition of interaction effects of time and referral service did not reduce errors in prediction by any large amounts even though an inspection of Figures 1 through 6 may provide the impression of dramatic differences. Acute care was associated with steeper declines in CICN over time than many other referral services (including private homes, supportive living, inpatient rehabilitation and continuing care, and long-term care). Individuals coming to CCC from private homes experience steeper increases in ADL impairment and experienced shallower declines in CHESS and CICN scores (meaning they were more likely in the future to be rated with higher ADL impairment and CHESS/CICN scores than those in acute care facilities). This may suggest that individuals from private homes (with or without home care) are less responsive to the CCC intervention on average than many other referral services. It is of note that while these are significant differences, they are often small in nature for the average individual.

While individuals arriving from LTCHs had higher overall levels of aggressive behaviour than those from other referral services, previous LTCH residents were rated as declining in ABS scores relative to acute care over time. Patients from LTCHs and supportive-living facilities experienced stability in CICN scores and a decrease in growth for RUG-III scores. Individuals from psychiatric facilities experienced 'growth' in aggressive behaviour relative to acute care services. Patients from general rehabilitation services experienced a small but significant growth in CHESS scores over time relative to acute care facilities, while individuals from specialized rehabilitation services experienced a slower decline in RUG-III scores compared with patients from acute care facilities.

It is of note that observed differences in trajectory of care between referral services is not the same as saying that the type of care received prior to admission to CCC *caused* a particular trajectory of symptoms. While this analysis cannot speak to causal connections between variables, it seems likely that 'referral service' in the majority of cases is simply an index of several types of variables that may be more 'causal' of a course of symptoms over time. This may include sudden onset versus gradual onset of a set of symptoms, quality or quantity of symptoms themselves, or even an index of health behaviours of the individual. For example, a person may consult a physician or present to CCAC at the first sign of difficulty versus an individual who may resist doing so until rapid functional decline.

Discharge service and clinical need

Analyses were undertaken to examine differences of patients' clinical needs for continuing care between the type of service they were discharged to, which may be conceptualized as a broad 'outcome' variable, and of bearing to measures intended to document need for continuing care (Research Question #2). Because of theoretical interest, continuity with the previous analysis, and the complexity of interpretation of binary dependent variables in random coefficient regression models, discharge service was regressed onto ADL impairment scores collected at admission in an effort to document the association between admission health status and where patients were discharged to. As discussed previously, 'prediction' is used to describe the minimization of an expected value of a health score at admission based on the relationship between admission profiles and subsequent discharge facilities. Thus, 'prediction' in this case should not be interpreted as 'temporal' in nature. Differences in clinical need between referral services were largely consistent across first and second MLM analyses.

Given that approximately 51% of CCC patients had been discharged to LTCHs, all other discharge services within the analysis were contrasted against LTCH in an effort to understand how these services differ from 'the norm'. Regarding *symptom profiles*, individuals discharged to LTCH were among the highest in ADL impairment at admission (with the exception of ambulatory care and inpatient acute care), cognitive impairment (with the exception of ambulatory care, inpatient continuing care and inpatient psychiatric service), and aggressive behaviour (with the exception of ambulatory care, inpatient continuing care, and inpatient rehabilitation). This is highly consistent with the use of these symptoms by others (Fries et al., 2002; Hirdes et al., 2008; Stones et al., 2006) to indicate need for continuing care as those that were not different in symptom profiles were also largely inpatient facilities.

With regard to the *other predictors* of clinical need, residents discharged to LTCH were among the highest at admission in CHESS scores (with the exception of ambulatory care) as well as CICN (with the exception of ambulatory care, inpatient continuing care and inpatient psychiatric services). It is interesting therefore that even based simply on admission assessment, the variables included in the PACC (Stones et al., 2006) appear quite relevant to the identification of need for continuing-care services. Differences between discharge services in average levels of symptoms and resource utilization measured at admission to CCC were replicated results were reanalyzed with 13 511 additional assessments in the second MLM analysis.

One particularly interesting finding emerged that calls for further analysis by subsequent focused evaluations. It is of no surprise that RUG-III scores were noted to be higher than those discharged to LTCH for inpatient acute care and inpatient rehabilitation, given the medical nature of these inpatient facilities that would be able to provide high levels of resources. However, within both first and second MLM analyses, those discharged to private homes with (coefficient = 0.64, *SE* = 0.03) and without (coefficient = 0.60, *SE* = 0.04) homecare, or those discharged to supported living facilities (designed as residential faculties without 24-hour nursing support, coefficient = 0.39, *SE* = 0.06) had *higher* RUG-III scores than those discharged to LTCH as well as ambulatory care and inpatient continuing care (also see Figure 12 for a graphic depiction). The current author (after checking several times that the scoring syntax used is indeed correct) is at a loss to explain this finding given that high levels on the RUG-III are meant to indicate a level of support needed beyond what is available in the community (e.g. Health Services Restructuring Commission, 2000; Stones et al., 2006). Subsequent investigations should be conducted to further evaluate this specific issue.

Time interaction effects. Usefulness of the 'growth' or 'trajectory' of health symptoms in predicting subsequent placement decisions were explored within the current analysis. Specifically, it was expected that shallow declines or steeper accelerations on predictors of continuing care relative to LTCH patients would be related to services with lower service intensities. Overall, the addition of interaction effects of time and discharge service did not reduce errors in prediction by any large amounts. However, an inspection of Figures 7 through 12 suggests that while these are generally small differences, the difference in health and discharge service can appear dramatic. The reader should also be reminded that the presented differences are beyond that expected by any difference in the age, sex, or length of stay composition between discharge services.

In general, individuals discharged to private homes were rated with less impairment than those discharged to LTCH. Individuals without home care experienced an increase in ADL-H and CPS scores over time relative to individuals discharged to LTCHs. Those with home care demonstrated a steep decline on CICN scores over time whereas individuals discharged to private homes without home care were associated with shallower, moderated declines in CICN scores over time (see Figure 11). Individuals in both situations showed slower declines in CHESS scores over time. There were no interaction effects with time and the RUG-III.

Being discharged to acute care was associated with a small increase in ABS scores over time relative to the largely stable effect for those discharged to LTCHs. Expectedly, individuals discharged to acute care experienced a shallower decline in CHESS and steeper decline in CICN scores relative to those discharged to LTCHs, while still being rated lower overall in these scores versus future LTCH residents. Strangely enough however, those discharged to inpatient acute care facilities are associated with a steeper decline in RUGS-III scores (when one would expect stability or positive acceleration in RUG-III scores prior to being transferred to a medically intensive facility). LTCH patients demonstrated a relatively steeper decline in CHESS and CICN scores than patients discharged to general inpatient rehabilitation services.

Summary

The current analysis was limited to those patients over 50 years of age with lengths of stay greater than 30 days, were admitted and discharged between April of 2007 and March of 2009, were not rated as comatose, and who were also rated as male or female. As such, conclusions based on this data are limited to this population of individuals, which included 15 904 patients. There are no concerns of sampling error or Type I / II errors in the interpretation of the current data in the context of current Ontario continuing care clients given that the present analysis reflects population (or census) level records.

Despite the increasing regionalization of health care services in Ontario and evidence of differences in some demographic and system variables between regions, neither the LHIN nor northern-versus-southern location influenced selected patient health ratings. Nesting within these levels poses no threat to OLS regression analyses involving the variables examined in this analysis. However, 7 to 30% of variance in health outcomes was dependent on which CCC facility a patient was admitted to.

In an attempt to explain this slightly unsettling finding, easily obtainable demographic information at the patient and facility level was added. Being male was associated with increased rates of cognitive impairment and aggression, and facilities with a higher number of males had increased aggression. Older individuals (relative to the average age of individuals within their facility) had higher levels of ADL impairment and cognitive impairment, while facilities with older average ages in general were predictive of increased cognitive impairment and aggressive behaviour at the individual level. This phenomenon is limited however to only one of four queried contextual variables. The following interaction effects were also noted: (1) when average age within the facility decreases, rates of ADL impairment in older patients increase; (2) the average length of stay in a facility moderates the decrease in frailty or resource intensity usually afforded by longer stays relative to others – or the more people that have 'longer stays' in the facility, the less likely any one individual's frailty or resource intensity is related to their length of stay. Much of the variance between facilities however remained unexplained, providing a focus for future investigations.

Time. Over time, individuals within CCC facilities experience small increases in symptoms typically predictive of continuing care need, such as ADL impairment, cognitive impairment, and aggression. However, patients are also rated as having decreases in changes in care needs and medical frailty, as well as the resources needed to care for and treat the individual. The author suggests that these somewhat conflicting findings may be due to care providers enhancing a person's functioning (through pharmacotherapy, occupational therapy, or environmental accommodations, for example) without necessarily creating a change in overall symptoms.

Referral Services. Individuals arriving at CCC from acute care facilities represent the largest group of patients. These patients were among the groups rated highest in ADL impairment and resource-intensity but lowest in cognitive impairment and aggressive behaviour. Individuals from acute care facilities experienced steeper declines in 'change in care needs' than most other groups, suggesting these patients experienced improvement in overall condition within a relatively short time-span.

Individuals from private homes (with or without home care) were equivalent in activities of daily living, cognition and aggressive behaviour as individuals from acute care facilities (with the exception of decreased ADL impairment for individuals not receiving home care services). Individuals from private homes were also rated to be lower on resource utilization but higher in change in condition / medical stability. Finally, these patients experienced steeper accelerations in ADL impairment and shallower typical declines in frailty items suggesting that these patients experience less improvement in health when compared against those arriving from acute care hospitals.

Individuals from residential services (e.g. LTCH, supportive living) were rated generally higher on cognitive impairment and aggression, lower on frailty or change in care needs, and similar in resource utilization to individuals referred from acute care facilities. Individuals in these residential services were rated to decline in aggression scores (relative to acute care facilities), while being rated as largely stable in changes-in-care as opposed to the steeper declines observed for individuals from acute care facilities.

Discharge services. Approximately half of individuals within the present analysis were discharged to LTCHs, and as such this was used as the 'comparative' facility. Unsurprisingly, individuals discharged to LTCH were rated at admission and throughout the episode of care as having the highest ADL impairment, cognitive impairment, aggressive behaviour, and frailty (those individuals discharged to other medical inpatient facilities were also rated highly on these items).

Surprisingly however, those discharged to private homes (with or without home care) or supportive living facilities were rated to require higher resources than those discharged to LTCH or other residential / inpatient care facilities. These patients also experienced an increase in ADL and cognitive impairment over time relative to LTCH residents and slower declines in frailty (keeping in mind that on these items, patients were consistently rated lower than individuals discharged to LTCHs.

Those individuals discharged to acute care showed ADL impairments and resource utilization similar to those discharged to LTCH, but lower levels of cognitive impairment, aggressive behaviour and frailty. Individuals discharged to acute care also show steeper declines in change in condition and resource utilization scores relative to those discharged to LTCH, when one may expect stability or an increase in change in condition or the amount of resources required to treat the individual prior to a discharge to an intensive medical setting.

Future research. It will be important in future research to identify the source of the variation between CCC facilities in frailty and service utilization variables (perhaps looking at factors such as facility size or quality of the facility). Future research is also highly recommended to investigate the reasons that 1 571 individuals over age 65 examined in this data-set that were discharged to the community without home-care services had aggregate average ratings for resource need higher than the averages of those discharged to inpatient or residential facilities. Current findings lend further support for using the items in the PACC for identifying need for continuing care and identify notable trends in these PACC variables as they relate to previous and future care provision.

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Appendix A

Table 1.

Psychosocial and Demographic Predictors of Care.

Predictor	Hospitalization	Extended Hosp	Extended Care
Self-reported health	1		
Living with non-relative	1		6
Living alone	2		
Comorbidity	1, 2		6, 8
Poor nutrition	1	3	
ADL impairment	1	4	6
Economic hardship	2		
Previous hospital admissions	2		
Cognitive impairment		3, 4	6, 7, 8
Walking difficulties/physical impairment		3	7
Fall risk		3	
> 85 yrs old		4	
Alcohol abuse			6
Depression			6, 9, 10
Psychopathology / psychotropic drug use			6

Note. Numbers indicate references: 1 = Smith et al., 2005; 2 = Landi et al., 2004; 3 = Lang et al., 2006; 4 = Zanocchi et al., 2003; 5 = Mecocci et al., 2005; 6 = Dasgupta &

Dumbrell, 2006; 7 = Korevaar, van Munster, & de Rooij, 2005; 8 = Sohl et al., 2006; 9 = Harris & Cooper, 2006; 10 = St. John & Montgomery, 2006.

Appendix B

Multilevel Modeling Analytic Decisions

All predictor variables were centered on their means across grouping variables (grand-mean centering) to avoid subsequent problems with shrinkage (i.e. group-specific estimates in the multilevel analysis being pulled or shrunk towards an overall average; for a further discussion see Hox, 2002).

The relative improvement made by adding additional predictors (or 'model fit') was determined in two ways. First, model fit can be assessed via significance testing (specifically, χ^2) that evaluates whether a slight reduction in errors of prediction is appreciably different than what can be attributable to chance. First, the 'deviation difference' is obtained by calculated by subtracting the deviance values (-2 log likelihood values) for the conditional and previous models (Bickel, 2007). One then compares the obtained value to the chi-square critical value based on a predetermined alpha value (0.05 will be used for the present purposes), and the degrees of freedom calculated by subtracting the number of parameters used to estimate the null model from the number of parameters used to estimate the conditional model. While improved fit of the model is tested through use of chi-square statistics, non-significant predictors will also be retained in future models to allow better comparison between final models and outcomes as the same number of variables will be entered in each.

The second method of determining model fit is more analogous to 'effect size' than significance testing per se, and the calculation varies depending on whether the procedure utilizes growth modeling. To obtain the proportional reduction in errors of prediction (R_1^2) used in models without growth modeling, the sum of the residul and intercept estimate for the current demographic (conditional) model is divided by the sum of the residual and intercept estimate for the null model, subtracting by one and multiplying by 100 (Bickel, 2007). This provides one with the proportion of reduction of errors in prediction. Pseudo-R^2 is used as a summary statistic in growth models, in which one divides the residual variance from the unconditional model by the residual variance for the conditional model, subtract the result by 1 and multiply by 100 (Singer & Willett, 2003). This summary statistic is occasionally unstable and open for misinterpretation, as a significant reduction in error is not always reflected in the statistic. This can be the result of underestimation of the residual variance component and overestimation of the level two variance component (Hox, 2002). Therefore, Pseudo-R^2 will be used to compare the full versus null model, rather than at each step of model building.

The advantage of REML over maximum likelihood (ML) estimators is diminished bias in estimates of the random components of random regression coefficients for small samples (Bickel, 2007) is unimportant in this analysis given the use of census-level data, and therefore ML estimators are used to facilitate calculation of pseudo-R^2 for growth model comparisons.

Finally, analysts must also choose a covariance structure which defines the nature of the relationships that are permitted to exist among random components (Bickel, 2007). While choice of covariance structure has little effect on fixed component estimates (which will be the bulk of the following analysis), they may yield more accurate estimates of their standard errors (Bickel, 2007). The default option in SPSS is 'variance components', permitting the variances of random components to vary. In this analysis, the authors specify that the random components do not vary together (an 'unstructured approach' to covariance structure). In using the unstructured approach to covariance structure, we permit the random intercept (i.e. the value of the predicted variable when all predictors are set to 0) and all random slopes (the rate of change in the predicted variable as a function of the predictor) to vary together, and also acknowledge that the variances and covariances of random components may differ from level to level of the independent variables used in the analysis. This covers all bases, providing a measure of assurance we have not missed anything important. However, this approach requires more parameters to estimate a model which used up degrees of freedom and may yield misleading information about the model fit when applying the deviance difference statistic. For growth models, the scaled identity option was used for level-one residuals, which constrains residuals to have a homogeneous variance and be uncorrelated (i.e. makes no assumptions of the relationships between variables) (Bickel, 2007).

Appendix C

Table 8.

Summary of model fit statistics predicting ADL impairment

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	40 022.837	0.503 (0.082)	2.385 (0.033)
Demographic model	13	39 931.406	0.473 (0.077)	2.367 (0.033)
Referral service model	23	39 829.871	0.483 (0.078)	2.344 (0.032)
Discharge service model	33	39 241.577	0.461 (0.075)	2.219 (0.030)

Note. Each model contains all predictors of each previous model. SE= Standard Error.

Appendix C

Table 9.

Parameter estimates of fixed effects for the demographic model

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	3.683	0.073	102.521	50.527**
Sex				
Sex Level 1	0.064	0.031	10604.961	2.078*
Sex Level 2	-0.072	0.510	174.982	-0.141
Sex Interaction	-0.853	0.473	10604.941	-1.804
Age				
Age Level 1	0.011	0.002	10610.599	6.497**
Age Level 2	-0.042	0.023	145.706	-1.922
Age Interaction	-0.002	0.001	10605.269	-2.481*
Age Level 1^2	< 0.001	< 0.001	10631.193	0.360
Admission (LOS)				
Admission Level 1	-0.001	<0.001	10604.940	-2.782**
Admission Level 2	0.005	0.003	168.617	1.857
Admission Interaction	< -0.001	< 0.001	10604.936	-0.536

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error.

$*p < .05$. $**p < .01$.

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Table 10.

Parameter estimates of fixed effects for the referral service model on ADL impairment

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	3.733	0.074	104.024	50.625***
Sex				
Sex Level 1	0.060	0.031	10605.115	1.927
Sex Level 2	-0.147	0.512	176.287	-0.288
Sex Interaction	-0.876	0.471	10605.069	-1.858
Age				
Age Level 1	0.010	0.002	10610.477	6.155***
Age Level 2	-0.047	0.022	146.612	-2.113*
Age Interaction	-0.002	0.001	10605.921	-2.653**
Age Level 1^2	<0.001	<0.001	10630.252	0.333
Admission (LOS)				
Admission Level 1	-0.001	<0.001	10605.221	-2.960**
Admission Level 2	0.006	0.003	168.628	1.903
Admission Interaction	<0.001	<0.001	10605.640	-0.851
Referral service				
Ambulatory care	-0.010	0.316	10658.564	-0.031
Inpt rehab (general)	-0.436	0.071	10681.132	-6.166***
Inpt continuing care	0.063	.205	10695.675	0.307

Residential care (LTCH)	-0.249	0.158	10686.985	-1.576
Inpt psychiatry service	-0.802	0.239	10638.060	-3.355**
Other / Unclassified	-0.762	0.491	10620.535	-1.554
Inpt Rehab (Specialized)	-0.343	0.283	10636.676	-1.210
Home care	-0.261	0.097	10707.898	-2.680**
Residential (board & care)	0.093	0.147	10705.801	0.630
Private home, no home care	-0.575	0.083	10710.059	-6.898***
Inpatient Acute Care (reference category)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home.

*$p < .05$. **$p < .01$ ***$p < .001$

Appendix C

Table 11.

Parameter estimates of fixed effects for the discharge service model on ADL impairment

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	3.814	0.122	803.001	31.181***
Sex				
Sex Level 1	0.047	0.500	175.799	0.093
Sex Level 2	0.229	0.507	183.750	0.453
Sex Interaction	0.918	0.438	8593.666	2.096*
Age				
Age Level 1	-0.052	0.022	146.929	-2.412*
Age Level 2	0.058	0.022	147.943	2.699**
Age Interaction	-0.002	0.001	10606.548	-3.115**
Age Level 1^2	0.002	0.001	10606.184	3.019**
Admission (LOS)				
Admission Level 1	0.006	0.003	167.513	2.140*
Admission Level 2	-0.007	0.003	169.763	-2.306*
Admission Interaction	<0.001	<0.001	10652.271	-0.938
Referral service				
Ambulatory care	-0.102	0.310	10657.724	-0.328

Inpt rehab (general)	-0.434	0.069	10681.088	-6.305***
Inpt continuing care	-0.032	0.199	10692.093	-0.162
Residential care (LTCH)	-0.320	0.154	10686.235	-2.081*
Inpt psychiatry service	-0.801	0.234	10635.931	-3.432**
Other / Unclassified	-0.780	0.477	10621.621	-1.635
Inpt Rehab (Specialized)	-0.487	0.276	10636.425	-1.765
Home care	-0.348	0.095	10707.382	-3.666**
Residential (board & care)	0.144	0.144	10701.247	0.998
Private home, no home care	-0.583	0.081	10708.919	-7.180**
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	-0.842	1.057	10609.278	-0.797
Inpatient acute care	-0.062	0.054	10696.886	-1.145
Inpt rehab (general)	-0.223	0.085	10665.210	-2.626**
Inpt continuing care	-0.353	0.157	10719.446	-2.255*
Inpt psychiatry service	-0.875	0.315	10620.549	-2.781**
Other / Unclassified	-0.797	0.210	10656.112	-3.789***
Inpt Rehab (Specialized)	-0.412	0.150	10643.340	-2.751**
Home care	-0.660	0.041	10710.992	-16.005***
Residential (board & care)	-0.752	0.066	10681.058	-11.448***
Private home, no home care	-1.020	0.053	10704.442	-19.187***

Residential care (LTCH)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home.

*$p < .05$. **$p < .01$ ***$p < .001$

Appendix C

Table 12.

Summary of model fit statistics predicting Cognitive Performance Scale

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	41 648.820	0.332 (0.561)	2.782 (0.038)
Demographic model	13	41 373.019	0.277 (0.048)	2.723 (0.037)
Referral service model	23	41 279.523	0.258 (0.045)	2.701 (0.037)
Discharge service model	33	40 583.408	0.205 (0.037)	2.534 (0.035)

Note. Each model contains all predictors of each previous model. SE= Standard Error.

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Table 13.

Parameter estimates of fixed effects for the demographic model on CPS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.034	0.059	106.574	34.409***
Sex				
Sex Level 1	-0.252	0.033	10613.185	-7.564***
Sex Level 2	-1.163	0.440	177.929	-2.642**
Sex Interaction	-0.416	0.507	10613.154	-0.819
Age				
Age Level 1	0.021	0.002	10621.584	11.898***
Age Level 2	0.063	0.019	144.153	3.427**
Age Interaction	-0.001	0.001	10613.646	-1.233
Age Level 1^2	<0.001	<0.001	10651.044	-0.359
Admission (LOS)				
Admission Level 1	< -0.001	<0.001	10613.153	-1.050
Admission Level 2	0.002	0.003	187.422	0.819
Admission Interaction	<0.001	<0.001	10613.148	0.131

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error.

$^*p < .05$. $^{**}p<.01$. $^{***}p<.001$.

Appendix C

Table 14.

Parameter estimates of fixed effects for the referral service model on CPS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.010	0.058	107.016	34.798***
Sex				
Sex Level 1	-0.254	0.033	10611.646	-7.671***
Sex Level 2	-1.024	0.431	175.980	-2.376*
Sex Interaction	-0.505	0.506	10611.572	-0.998
Age				
Age Level 1	0.021	0.002	10620.003	11.461***
Age Level 2	0.061	0.018	141.389	3.396**
Age Interaction	-0.001	0.001	10613.086	-1.487
Age Level 1^2	<0.001	<0.001	10650.555	-0.505
Admission (LOS)				
Admission Level 1	<-0.001	<0.001	10611.802	-0.891
Admission Level 2	0.002	0.002	185.455	0.708
Admission Interaction	<0.001	0.001	10612.535	0.298
Referral service				
Ambulatory care	0.059	0.342	10694.974	0.173
Inpt rehab (general)	-0.065	0.076	10718.277	-0.861

Inpt continuing care	0.847	0.219	10719.765	3.868***
Residential care (LTCH)	0.887	0.169	10705.627	5.237***
Inpt psychiatry service	0.698	0.256	10663.814	2.721**
Other / Unclassified	0.888	0.526	10642.734	1.686
Inpt Rehab (Specialized)	-0.098	0.304	10658.298	-0.321
Home care	0.151	0.104	10717.382	1.453
Residential (board & care)	1.042	0.157	10708.333	6.616***
Private home, no home care	-0.001	0.089	10711.012	-0.014
Inpatient Acute Care (reference category)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home.

*$p < .05$. **$p < .01$ ***$p < .001$

Appendix C

Table 15.

Parameter estimates of fixed effects for the discharge service model on CPS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.313	0.116	1631.756	19.895***
Sex				
Sex Level 1	-0.844	0.398	173.237	-2.123*
Sex Level 2	0.709	0.407	190.052	1.742
Sex Interaction	0.392	0.455	6277.173	0.862
Age				
Age Level 1	0.050	0.017	140.301	3.037**
Age Level 2	-0.037	0.017	142.075	-2.205*
Age Interaction	-0.002	0.001	10614.333	-2.483*
Age Level 1^2	0.002	<0.001	10614.109	2.186*
Admission (LOS)				
Admission Level 1	< 0.001	<0.001	10611.804	-0.032
Admission Level 2	0.002	0.002	185.935	1.066
Admission Interaction	<0.001	<0.001	10611.898	0.427
Referral service				
Ambulatory care	-0.092	0.331	10701.532	-0.279
Inpt rehab (general)	-0.082	0.073	10719.875	-1.116

Inpt continuing care	0.680	0.212	10719.961	3.200**
Residential care (LTCH)	0.774	0.164	10709.432	4.714***
Inpt psychiatry service	0.571	0.249	10666.342	2.291*
Other / Unclassified	0.856	0.510	10649.953	1.679
Inpt Rehab (Specialized)	-0.236	0.294	10662.371	-0.800
Home care	-0.005	0.101	10709.818	-0.052
Residential (board & care)	0.983	0.154	10698.726	6.389***
Private home, no home care	-0.059	0.087	10699.146	-0.686
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	0.639	1.129	10622.691	0.566
Inpatient acute care	-0.454	0.057	10718.389	-7.902***
Inpt rehab (general)	-0.970	0.091	10708.957	-10.712***
Inpt continuing care	-0.023	0.167	10664.506	-0.136
Inpt psychiatry service	0.321	0.336	10641.894	0.955
Other / Unclassified	-0.390	0.224	10700.285	-1.739
Inpt Rehab (Specialized)	-0.990	0.160	10682.950	-6.194***
Home care	-0.949	0.044	10677.230	-21.635***
Residential (board & care)	-0.543	0.070	10719.771	-7.758***
Private home, no home care	-1.064	0.057	10692.768	-18.804***
Residential care (LTCH)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home. RC = Reference Category.

$^{*}p < .05$. $^{**}p < .01$ $^{***}p < .001$

Appendix C

Table 16.

Summary of model fit statistics predicting ABS

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	40 831.619	0.198 (0.037)	2.594 (0.036)
Demographic model	13	40 717.200	0.139 (0.027)	2.574 (0.035)
Referral service model	23	40 488.392	0.132 (0.026)	2.520 (0.035)
Discharge service model	33	40 296.238	0.109 (0.023)	2.478 (0.034)

Note. Each model contains all predictors of each previous model. SE= Standard Error.

Appendix C

Table 17.

Parameter estimates of fixed effects for the demographic model on ABS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	0.700	0.045	104.828	15.507***
Sex				
Sex Level 1	-0.275	0.032	10615.334	-8.490***
Sex Level 2	-1.838	0.355	173.874	-5.181***
Sex Interaction	0.807	0.493	10615.286	1.635
Age				
Age Level 1	0.003	0.002	10627.958	1.645
Age Level 2	0.050	0.015	135.136	3.428**
Age Interaction	< -0.001	0.001	10616.034	-0.655
Age Level 1^2	< -0.001	< 0.001	10669.518	-0.356
Admission (LOS)				
Admission Level 1	< 0.001	< 0.001	10615.284	0.296
Admission Level 2	< 0.001	0.002	200.434	0.016
Admission Interaction	< 0.001	< 0.001	10615.277	0.340

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error.

$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Appendix C

Table 18.

Parameter estimates of fixed effects for the referral service model on ABS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	0.671	0.045	105.111	15.020***
Sex				
Sex Level 1	-0.277	0.032	10612.124	-8.649***
Sex Level 2	-1.624	0.350	170.922	-4.647***
Sex Interaction	0.693	0.489	10612.005	1.418
Age				
Age Level 1	0.002	0.002	10624.168	1.070
Age Level 2	0.048	0.014	131.392	3.322**
Age Interaction	< -0.001	0.001	10614.509	-0.595
Age Level 1^2	< -0.001	< 0.001	10667.065	-0.582
Admission (LOS)				
Admission Level 1	< 0.001	<0.001	10612.358	0.609
Admission Level 2	-0.001	0.002	194.798	-0.285
Admission Interaction	< 0.001	< 0.001	10613.456	0.575
Referral service				
Ambulatory care	-0.098	0.330	10716.515	-0.297
Inpt rehab (general)	-0.054	0.073	10689.156	-0.738

Inpt continuing care	0.922	0.211	10705.606	4.369***
Residential care (LTCH)	2.106	0.163	10719.551	12.892***
Inpt psychiatry service	0.730	0.247	10683.270	2.948**
Other / Unclassified	1.763	0.508	10665.630	3.470**
Inpt Rehab (Specialized)	0.024	0.293	10674.551	0.081
Home care	0.076	0.100	10641.059	0.756
Residential (board & care)	0.849	0.152	10518.702	5.601***
Private home, no home care	-0.030	0.086	10601.773	-0.349
Inpatient Acute Care (reference category)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home.

*$p < .05$. **$p < .01$ ***$p < .001$

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Table 19.

Parameter estimates of fixed effects for the discharge facility service on ABS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.028552	0.109	2080.993	9.394***
Sex				
Sex Level 1	-1.535	0.332	171.007	-4.627***
Sex Level 2	1.122	0.343	196.254	3.274**
Sex Interaction	-0.780	0.440	4795.364	-1.774
Age				
Age Level 1	0.039	0.014	133.632	2.908**
Age Level 2	-0.040	0.014	136.070	-2.952**
Age Interaction	-0.001	0.001	10617.741	-0.950
Age Level 1^2	0.001	0.001	10617.578	0.745
Admission (LOS)				
Admission Level 1	< 0.001	< 0.001	10613.752	0.961
Admission Level 2	< 0.001	0.002	197.244	-0.051
Admission Interaction	< 0.001	< 0.001	10613.886	0.705
Referral service				
Ambulatory care	-0.178	0.327	10719.237	-0.546
Inpt rehab (general)	-0.058	0.072	10648.320	-0.800

Inpt continuing care	0.859	0.209	10707.719	4.101***
Residential care (LTCH)	2.036	0.162	10719.766	12.570***
Inpt psychiatry service	0.539	0.246	10686.272	2.187*
Other / Unclassified	1.761	0.504	10676.653	3.495***
Inpt Rehab (Specialized)	-0.038	0.291	10679.740	-0.129
Home care	0.008	0.100	10586.249	0.082
Residential (board & care)	0.814	0.151	10453.562	5.371***
Private home, no home care	-0.057	0.085	10545.623	-0.669
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	-.479	1.117	10633.395	-.429
Inpatient acute care	-.230	.057	10666.882	-4.056***
Inpt rehab (general)	-.453	.089	10719.393	-5.068***
Inpt continuing care	-.297	.164	10489.978	-1.812
Inpt psychiatry service	2.095	.332	10656.505	6.305***
Other / Unclassified	-.341	.222	10719.597	-1.540
Inpt Rehab (Specialized)	-.289	.158	10708.863	-1.832
Home care	-.439	.043	10429.266	-10.156***
Residential (board & care)	-.222	.069	10685.213	-3.219**
Private home, no home care	-.448	.056	10463.554	-8.043***
Residential care (LTCH)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home. RC = Reference Category.

$^{*}p < .05$. $^{**}p < .01$ $^{***}p < .001$

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Table 20.

Summary of model fit statistics predicting CHESS

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	35 122.890	0.420 (0.066)	1.507 (0.021)
Demographic model	13	35 091.904	0.409 (0.063)	1.503 (0.021)
Referral service model	23	34 873.114	0.413 (0.064)	1.472 (0.020)
Discharge service model	33	33 678.183	0.393 (0.062)	1.316 (0.018)

Note. Each model contains all predictors of each previous model. SE= Standard Error.

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Table 21.

Parameter estimates of fixed effects for the demographic model on CHESS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.049	0.066	106.907	30.854***
Sex				
Sex Level 1	-0.017	0.025	10607.934	-0.695
Sex Level 2	0.027	0.449	183.338	0.060
Sex Interaction	-0.488	0.377	10607.918	-1.296
Age				
Age Level 1	0.003	0.001	10612.360	2.052*
Age Level 2	0.002	0.0195	154.338	0.106
Age Interaction	< -0.001	0.001	10608.175	-0.488
Age Level 1^2	< -0.001	< 0.001	10628.723	-1.117
Admission (LOS)				
Admission Level 1	-0.001	<0.001	10607.917	-2.969**
Admission Level 2	0.005	0.003	171.642	1.924
Admission Interaction	< -0.001	< 0.001	10607.915	-1.745

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error.

$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

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Table 22.

Parameter estimates of fixed effects for the referral service model on CHESS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.047	0.069	106.868	30.644***
Sex				
Sex Level 1	-0.015	0.024	10606.710	-0.622
Sex Level 2	-0.029	0.450	182.165	-0.065
Sex Interaction	-0.436	0.373	10606.674	-1.168
Age				
Age Level 1	0.003	0.001	10611.016	2.524*
Age Level 2	0.004	0.020	153.248	0.218
Age Interaction	< -0.001	0.001	10607.329	-0.751
Age Level 1^2	< 0.001	0.001	10626.900	-0.942
Admission (LOS)				
Admission Level 1	-0.001	<0.001	10606.800	-3.040**
Admission Level 2	0.010	0.003	169.635	2.317*
Admission Interaction	< -0.001	< 0.001	10607.113	-1.649
Referral service				
Ambulatory care	0.475	0.253	10647.981	1.881
Inpt rehab (general)	-0.417	0.056	10666.046	-7.436***

Inpt continuing care	0.226	0.162	10681.638	1.391
Residential care (LTCH)	-1.103	0.125	10682.871	-8.798***
Inpt psychiatry service	-0.266	0.189	10632.277	-1.402
Other / Unclassified	0.150	0.389	10617.830	0.385
Inpt Rehab (Specialized)	-0.662	0.224	10631.956	-2.949**
Home care	0.451	0.077	10698.471	5.842***
Residential (board & care)	0.039	0.117	10690.639	0.333
Private home, no home care	0.351	0.066	10697.673	5.306***
Inpatient Acute Care (reference category)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home.

**p* < .05. ***p* < .01 ****p* < .001

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Table 23.

Parameter estimates of fixed effects for the discharge service model on CHESS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.274	0.100	566.825	22.805***
Sex				
Sex Level 1	0.110	0.434	177.275	0.253
Sex Level 2	0.054	0.439	183.445	0.122
Sex Interaction	0.730	0.340	9269.439	2.146*
Age				
Age Level 1	-0.007	0.019	149.844	-0.350
Age Level 2	0.004	0.019	150.654	0.198
Age Interaction	-0.001	0.001	10604.556	-1.884
Age Level 1^2	0.001	0.001	10604.295	1.428
Admission (LOS)				
Admission Level 1	< -0.001	< 0.001	10603.486	-1.912
Admission Level 2	0.007	0.002	163.976	2.637**
Admission Interaction	< -0.001	< 0.001	10603.453	-1.786
Referral service				
Ambulatory care	0.289	0.239	10643.396	1.207
Inpt rehab (general)	-0.426	0.053	10661.772	-8.036***

Inpt continuing care	0.086	0.153	10674.962	0.559
Residential care (LTCH)	-1.210	0.119	10680.273	-10.190***
Inpt psychiatry service	-0.288	0.180	10626.953	-1.603
Other / Unclassified	0.114	0.368	10615.232	0.310
Inpt Rehab (Specialized)	-0.782	0.212	10628.325	-3.682***
Home care	0.301	0.073	10695.644	4.115***
Residential (board & care)	0.031	0.111	10682.096	0.281
Private home, no home care	0.286	0.063	10693.644	4.558***
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	-0.189	0.814	10606.394	-0.232
Inpatient acute care	-0.621	0.042	10680.104	-14.926***
Inpt rehab (general)	-0.827	0.065	10649.809	-12.646***
Inpt continuing care	-0.657	0.121	10710.427	-5.436***
Inpt psychiatry service	-0.920	0.242	10614.980	-3.794***
Other / Unclassified	-0.689	0.162	10642.160	-4.251***
Inpt Rehab (Specialized)	-0.866	0.115	10632.218	-7.506***
Home care	-0.804	0.032	10693.010	-25.299***
Residential (board & care)	-0.736	0.051	10662.908	-14.540***
Private home, no home care	-1.127	0.041	10684.401	-27.517***
Residential care (LTCH)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home. RC = Reference Category.

$^{*}p < .05$. $^{**}p < .01$ $^{***}p < .001$

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Table 24.

Summary of model fit statistics predicting CICN

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	18 170.710	0.146 (0.022)	0.308 (0.004)
Demographic model	13	18 108.891	0.140 (0.021)	0.307 (0.004)
Referral service model	23	18 013.968	0.141 (0.021)	0.304 (0.004)
Discharge service model	33	17 527.525	0.142 (0.021)	0.290 (0.004)

Note. Each model contains all predictors of each previous model. SE= Standard Error.

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Table 25.

Parameter estimates of fixed effects for the demographic model on CICN scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.550	0.036	109.639	40.913***
Sex				
Sex Level 1	-0.028	0.0112	10607.918	-2.489*
Sex Level 2	0.340	0.243	185.281	1.402
Sex Interaction	-0.135	0.170	10607.906	-0.795
Age				
Age Level 1	0.002	0.001	10611.002	3.448**
Age Level 2	0.014	0.011	159.339	1.347
Age Interaction	< -0.001	< 0.001	10608.085	-0.941
Age Level 1^2	< 0.001	0.001	10622.579	0.478
Admission (LOS)				
Admission Level 1	< -0.001	<0.001	10607.906	-4.695***
Admission Level 2	0.002	0.001	169.084	1.467
Admission Interaction	< 0.001	< 0.001	10607.904	-2.957**

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error.

**p* < .05. ***p* < .01. ****p* < .001.

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Table 26.

Parameter estimates of fixed effects for the referral facility service on CICN scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.552	0.038	110.698	40.763***
Sex				
Sex Level 1	-0.026	0.011	10608.261	-2.476*
Sex Level 2	0.318	0.243	186.121	1.307
Sex Interaction	-0.133	0.170	10608.235	-0.782
Age				
Age Level 1	0.002	0.001	10611.285	3.486***
Age Level 2	0.015	0.011	159.980	1.374
Age Interaction	< -0.001	< 0.001	10608.667	-1.332
Age Level 1^2	< 0.001	< 0.001	10622.470	0.538
Admission (LOS)				
Admission Level 1	< -0.001	< 0.001	10608.333	-4.776***
Admission Level 2	0.002	0.001	169.500	1.682
Admission Interaction	< 0.001	< 0.001	10608.523	-2.944**
Referral service				
Ambulatory care	0.059	0.115	10634.563	0.517

Inpt rehab (general)	-0.131	0.025	10646.391	-5.156***
Inpt continuing care	0.045	0.073	10660.140	0.614
Residential care (LTCH)	-0.325	0.057	10677.317	-5.691***
Inpt psychiatry service	-0.030	0.086	10624.750	-0.343
Other / Unclassified	0.280	0.177	10614.790	1.584
Inpt Rehab (Specialized)	-0.333	0.102	10625.264	-3.260**
Home care	0.088	0.035	10684.671	2.500*
Residential (board & care)	0.137	0.053	10667.164	2.584*
Private home, no home care	0.076	0.030	10677.078	2.518*
Inpatient Acute Care (reference category)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home.

*$p < .05$. **$p < .01$ ***$p < .001$

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Table 27.

Parameter estimates of fixed effects for the discharge service model on CICN scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.608	.052	390.255	30.901***
Sex				
Sex Level 1	0.366	0.242	185.128	1.515
Sex Level 2	-0.341	0.244	189.973	-1.398
Sex Interaction	0.216	0.161	9955.228	1.336
Age				
Age Level 1	0.011	0.011	159.690	1.053
Age Level 2	-0.011	0.011	160.308	-1.025
Age Interaction	< -0.001	< 0.001	10608.801	-2.002*
Age Level 1^2	< 0.001	< 0.001	10608.558	1.926
Admission (LOS)				
Admission Level 1	< -0.001	< 0.001	10608.056	-4.195***
Admission Level 2	0.003	0.001	168.274	1.800
Admission Interaction	< -0.001	< 0.001	10607.994	-2.879**
Referral service				
Ambulatory care	0.013	0.112	10632.996	0.112
Inpt rehab (general)	-0.135	0.025	10644.721	-5.423***

Inpt continuing care	0.006	0.072	10656.400	0.085
Residential care (LTCH)	-0.350	0.056	10676.121	-6.285***
Inpt psychiatry service	-0.047	0.085	10622.842	-0.562
Other / Unclassified	0.266	0.173	10615.033	1.540
Inpt Rehab (Specialized)	-0.372	0.100	10624.433	-3.727***
Home care	0.048	0.034	10683.261	1.388
Residential (board & care)	0.126	0.052	10661.391	2.398*
Private home, no home care	0.065	0.029	10674.741	2.211*
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	-0.067	0.382	10609.675	-0.175
Inpatient acute care	-0.133	0.020	10662.187	-6.782***
Inpt rehab (general)	-0.182	0.031	10637.610	-5.933***
Inpt continuing care	-0.185	0.057	10689.993	-3.253**
Inpt psychiatry service	-0.090	0.114	10615.098	-0.789
Other / Unclassified	-0.069	0.076	10632.241	-0.904
Inpt Rehab (Specialized)	-0.366	0.054	10625.862	-6.760***
Home care	-0.219	0.015	10670.190	-14.637***
Residential (board & care)	-0.172	0.024	10646.536	-7.225***
Private home, no home care	-0.362	0.019	10661.718	-18.812***
Residential care (LTCH)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home. RC = Reference Category.

$^{*}p < .05$. $^{**}p < .01$ $^{***}p < .001$

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Table 28.

Summary of model fit statistics predicting RUG-III

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	36 230.300	0.833 (0.128)	1.661 (0.023)
Demographic model	13	36 199.086	0.796 (0.121)	1.658 (0.023)
Referral service model	23	36 095.496	0.778 (0.118)	1.642 (0.023)
Discharge service model	33	35 610.282	0.686 (0.105)	1.571 (0.022)

Note. Each model contains all predictors of each previous model. SE= Standard Error.

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Table 29.

Parameter estimates of fixed effects for the demographic model on RUG-III scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	5.616	0.090	104.052	62.384***
Sex				
Sex Level 1	0.032	0.025	10601.643	1.268
Sex Level 2	0.824	0.573	175.329	1.438
Sex Interaction	0.454	0.395	10601.632	1.147
Age				
Age Level 1	-0.001	0.001	10604.793	-1.060
Age Level 2	-0.047	0.025	151.108	-1.881
Age Interaction	< -0.001	0.001	10601.814	-0.949
Age Level 1^2	< -0.001	< 0.001	10616.628	-2.342*
Admission (LOS)				
Admission Level 1	< -0.001	< 0.001	10601.631	2.978**
Admission Level 2	0.003	0.003	159.849	1.149
Admission Interaction	< 0.001	< 0.001	10601.629	1.984*

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error.

$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

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Table 30.

Parameter estimates of fixed effects for the referral service model on RUG-III scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	5.651	0.089	105.600	63.330***
Sex				
Sex Level 1	0.029	0.025	10602.780	1.130
Sex Level 2	0.822	0.568	177.394	1.446
Sex Interaction	0.451	0.394	10602.754	1.144
Age				
Age Level 1	-0.001	0.001	10605.911	-1.427
Age Level 2	-0.050	0.025	152.598	-2.015*
Age Interaction	< -0.001	< 0.001	10603.200	-1.080
Age Level 1^2	< -0.001	< 0.001	10617.495	-2.455*
Admission (LOS)				
Admission Level 1	< 0.001	< 0.001	10602.855	2.783**
Admission Level 2	0.003	0.003	161.491	1.025
Admission Interaction	< 0.001	< 0.001	10603.051	1.866
Referral service				
Ambulatory care	-0.190	0.266	10629.903	-0.712

Inpt rehab (general)	0.102	0.059	10642.110	1.725
Inpt continuing care	0.182	0.171	10656.416	1.064
Residential care (LTCH)	-0.042	0.132	10674.981	-0.324
Inpt psychiatry service	-0.585	0.200	10619.791	-2.927**
Other / Unclassified	-0.846	0.410	10609.496	-2.061*
Inpt Rehab (Specialized)	-0.470	0.237	10620.346	-1.982*
Home care	-0.660	0.081	10682.429	-8.091***
Residential (board & care)	-0.113	0.123	10663.722	-0.922
Private home, no home care	-0.335	0.069	10674.204	-4.799***
Inpatient Acute Care (reference category)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home.

*$p < .05$. **$p < .01$ ***$p < .001$

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Table 31.

Parameter estimates of fixed effects for the discharge service model on RUG-III scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	5.443	0.117	405.703	46.186***
Sex				
Sex Level 1	0.730	0.540	176.049	1.352
Sex Level 2	-0.771	0.545	180.936	-1.414
Sex Interaction	-0.232	0.374	9790.840	-0.620
Age				
Age Level 1	-0.042	0.023	151.047	-1.785
Age Level 2	0.045	0.023	151.678	1.897
Age Interaction	< -0.001	< 0.001	10602.802	-0.176
Age Level 1^2	< -0.001	< 0.001	10602.543	-0.074
Admission (LOS)				
Admission Level 1	< 0.001	< 0.001	10601.958	2.010*
Admission Level 2	0.003	0.003	160.289	1.047
Admission Interaction	< 0.001	< 0.001	10601.898	1.940
Referral service				
Ambulatory care	-0.081	0.261	10631.050	-0.310
Inpt rehab (general)	0.116	0.057	10644.686	2.006*

Inpt continuing care	0.298	0.167	10657.476	1.777
Residential care (LTCH)	0.032	0.129	10675.073	0.249
Inpt psychiatry service	-0.510	0.196	10619.171	-2.600**
Other / Unclassified	-0.829	0.401	10610.165	-2.064**
Inpt Rehab (Specialized)	-0.398	0.232	10620.845	-1.716
Home care	-0.545	0.080	10684.244	-6.816***
Residential (board & care)	-0.080	0.121	10663.101	-0.657
Private home, no home care	-0.281	0.068	10676.815	-4.106***
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	0.594	0.889	10603.893	0.668
Inpatient acute care	0.431	0.045	10663.385	9.494***
Inpt rehab (general)	0.707	0.071	10636.277	9.902***
Inpt continuing care	0.008	0.132	10693.813	0.061
Inpt psychiatry service	-0.011	0.264	10610.201	-0.043
Other / Unclassified	0.010	0.177	10630.167	0.061
Inpt Rehab (Specialized)	0.808	0.126	10622.755	6.417***
Home care	0.644	0.034	10672.915	18.543***
Residential (board & care)	0.388	0.055	10646.504	7.018***
Private home, no home care	0.595	0.044	10663.874	13.307***
Residential care (LTCH)	--	--	--	--

Note. Level 1 refers to an individual's placement or score relative to the facility mean. Level 2 indicates the facility mean. LOS = Length of Stay. SE= Standard Error. Inpt = Inpatient. LTCH = Long Term Care Home. RC = Reference Category.

*$p < .05$. **$p < .01$ ***$p < .001$

Appendix D

Table 33.

Summary of model fit statistics predicting ADL impairment

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	87 041.586	1.939 (0.031)	0.832 (0.013)
Demographic model	7	86 976.684	1.930 (0.030)	0.832 (0.013)
Time model	8	86 944.329	1.921 (0.030)	0.833 (0.013)
Referral service model	18	86 777.650	1.899 (0.030)	0.830 (0.013)
Referral * Time model	28	86 751.618	1.896 (0.030)	0.831 (0.013)
Discharge service model	38	85 766.182	1.760 (0.029)	0.823 (0.013)
Discharge * Time model	48	85 721.916	1.755 (0.028)	0.822 (0.013)

Note. Each model contains all predictors of each previous model. SE= Standard Error.

Residual is also known as 'repeated' variance.

Appendix D

Table 34.

Parameter estimates of fixed effects for the demographic model on ADL scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	3.719	0.012	15706.300	290.098***
Demographic				
Sex	-0.013	0.014	15881.644	-0.924
Age	< 0.001	< 0.001	15919.310	1.609
Age^2	-0.025	0.026	15794.396	-0.973
Admission (LOS)	< 0.001	< 0.001	20730.240	0.108

Note. LOS = Length of Stay. SE= Standard Error.

$^*p < .05$. $^{**}p<.01$. $^{***}p<.001$.

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Table 35.

Parameter estimates of fixed effects for the time model on ADL scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	3.741	0.013	14868.499	279.870***
Demographic				
Sex	-0.021	0.026	15793.568	-0.800
Age	< 0.001	< 0.001	15909.086	1.505
Age^2	-0.011	0.014	15871.884	-0.812
Admission (LOS)	< 0.001	< 0.001	20926.702	0.576
Time	0.137	0.024	21336.340	5.695***

Note. LOS = Length of Stay. SE= Standard Error.

**p* < .05. ***p* < .01. ****p* < .001.

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Table 36.

Parameter estimates of fixed effects for the referral service model on ADL scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	3.789724	0.014	15610.065	265.968***
Demographic				
Sex	-0.023	0.026	15807.311	-0.922
Age	< 0.001	< 0.001	15903.204	1.580
Age^2	-0.013	0.014	15864.873	-0.938
Admission (LOS)	< 0.001	< 0.001	20907.308	0.620
Time	0.136	0.023	21328.093	5.685***
Referral service				
Ambulatory care	0.594	0.277	20336.589	2.144*
Inpt rehab (general)	-0.560	0.050	21850.256	-11.071***
Inpt continuing care	0.021	0.107	23049.099	0.197
Residential care (LTCH)	-0.042	0.118	19331.929	-0.361
Inpt psychiatry service	-0.391	0.165	20246.449	-2.360*
Other / Unclassified	0.067	0.331	17252.430	0.203
Inpt Rehab (Specialized)	-0.365	0.156	23369.875	-2.326*
Home care	-0.143	0.081	20671.446	-1.761

Residential (board & care)	0.219	0.121	20250.688	1.813
Private home, no home care	-0.355	0.064	19900.157	-5.473***
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

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Table 37.

*Parameter estimates of fixed effects for the referral * time model on ADL scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	3.788	0.014	15581.561	264.715***
Demographic				
Sex	-0.025	0.026	15797.477	-0.959
Age	< 0.001	< 0.001	15903.233	1.575
Age^2	-0.013	0.014	15864.528	-0.930
Admission (LOS)	< 0.001	< 0.001	20888.613	0.546
Time	0.128	0.026	21334.062	4.925***
Referral service				
Ambulatory care	0.662	0.315	20816.510	2.101*
Inpt rehab (general)	-0.589	0.053	21540.320	-11.149***
Inpt continuing care	0.022	0.108	23492.142	0.204
Residential care (LTCH)	-0.039	0.120	18608.923	-0.331
Inpt psychiatry service	-0.407	0.166	19886.264	-2.442*
Other / Unclassified	-0.001	0.332	17380.102	-0.003
Inpt Rehab (Specialized)	-0.337	0.158	23752.833	-2.130*
Home care	0.032	0.098	17963.162	0.328

Residential (board & care)	0.152	0.146	17500.587	1.042
Private home, no home care	-0.306	0.069	19600.307	-4.443***
Inpatient acute care (RC)	--	--	--	--
Referral facility * time				
Ambulatory care int.	0.299	0.604	20734.702	0.496
Inpt rehab (general) int.	-0.197	0.103	21534.714	-1.904
Inpt continuing care int.	-0.034	0.222	23647.129	-0.156
Residential care (LTCH) int.	0.052	0.223	22390.178	0.233
Inpt psychiatry service int.	0.308	0.329	21325.234	0.936
Other / Unclassified int.	1.398	0.675	17511.011	2.072*
Inpt Rehab (Specialized) int.	-0.360	0.323	23939.730	-1.113
Home care int.	0.598	0.186	18733.962	3.215**
Residential (board & care) int.	-0.224	0.278	17858.099	-0.807
Private home, no home care int.	0.273	0.132	20258.581	2.056*
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < 0.001$.

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Table 38.

Parameter estimates of fixed effects for the discharge model on ADL scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	4.044	0.017	17729.090	230.889***
Demographic				
Sex	0.019	0.025	15829.074	0.768
Age	< 0.001	< 0.001	15909.324	0.331
Age^2	< 0.001	0.013	15866.452	0.018
Admission (LOS)	0.000	< 0.001	20596.067	1.439
Time	0.025	0.025	21091.243	0.978
Referral facility				
Ambulatory care	0.496	0.307	20524.473	1.615
Inpt rehab (general)	-0.573	0.051	20843.834	-11.075***
Inpt continuing care	-0.041	0.106	23093.932	-0.394
Residential care (LTCH)	-0.140	0.117	18329.932	-1.196
Inpt psychiatry service	-0.539	0.162	19477.240	-3.317**
Other / Unclassified	-0.056	0.323	17237.501	-0.173
Inpt Rehab (Specialized)	-0.398	0.155	23453.735	-2.561*
Home care	-0.056	0.096	17746.203	-0.589
Residential (board & care)	0.174	0.143	17455.405	1.217

Private home, no home care	-0.341	0.067	19325.215	-5.062***
Inpatient acute care (RC)	--	--	--	--
Referral facility * time				
Ambulatory care int.	0.301	0.589	20467.857	0.512
Inpt rehab (general) int.	-0.241	0.101	21125.666	-2.387*
Inpt continuing care int.	0.007	0.217	23436.338	0.036
Residential care (LTCH) int.	0.104	0.218	22103.168	0.481
Inpt psychiatry service int.	0.170	0.323	20587.668	0.528
Other / Unclassified int.	1.539	0.656	17420.514	2.343*
Inpt Rehab (Specialized) int.	-0.389	0.316	23786.097	-1.229
Home care int.	0.522	0.181	18511.856	2.883**
Residential (board & care) int.	-0.345	0.271	17639.766	-1.274
Private home, no home care int.	0.278	0.129	19929.520	2.149*
Inpatient acute care (RC)	--	--	--	--
Discharge Service				
Ambulatory care	0.258	0.416	24229.469	0.620
Inpatient acute care	-0.034	0.035	24152.089	-0.996
Inpt rehab (general)	-0.297	0.068	23900.618	-4.355***
Inpt continuing care	-0.080	0.102	23097.281	-0.780
Inpt psychiatry service	-1.091	0.229	23945.225	-4.750***
Other / Unclassified	-0.800	0.152	21742.554	-5.241***

Inpt Rehab (Specialized)	-0.044	0.118	23931.489	-0.381
Home care	-0.721	0.033	20796.075	-21.294***
Residential (board & care)	-0.756	0.054	19790.205	-13.973***
Private home, no home care	-0.957	0.040	21244.703	-23.555***
Residential care (LTCH)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*p < .05. **p < .01. ***p < 0.001.

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Table 39.

*Parameter estimates of fixed effects for the discharge*time model on ADL scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	4.039	0.017	17537.997	229.362***
Demographic				
Sex	0.019	0.025	15815.241	0.754
Age	< 0.001	< 0.001	15908.739	0.250
Age^2	0.001	0.013	15867.503	0.109
Admission (LOS)	< 0.001	< 0.001	20563.487	1.396
Time	-0.035	0.034	18723.503	-1.042
Referral Facility				
Ambulatory care	0.504	0.307	20511.420	1.643
Inpt rehab (general)	-0.567	0.051	20769.361	-10.959***
Inpt continuing care	-0.045	0.106	23050.425	-0.432
Residential care (LTCH)	-0.139	0.117	18315.265	-1.190
Inpt psychiatry service	-0.555	0.162	19221.737	-3.414**
Other / Unclassified	-0.079	0.323	17217.956	-0.246
Inpt Rehab (Specialized)	-0.388	0.155	23397.439	-2.498*
Home care	-0.049	0.095	17737.360	-0.513
Residential (board & care)	0.182	0.143	17415.148	1.275

Private home, no home care	-0.354	0.067	19258.356	-5.251***
Inpatient acute care (RC)	--	--	--	--
Referral Facility * Time				
Ambulatory care int.	0.350	0.588	20453.735	0.596
Inpt rehab (general) int.	-0.239	0.101	21120.016	-2.369*
Inpt continuing care int.	0.004	0.217	23427.261	0.021
Residential care (LTCH) int.	0.118	0.218	22053.165	0.545
Inpt psychiatry service int.	0.188	0.323	20641.015	0.581
Other / Unclassified int.	1.538	0.656	17410.588	2.344*
Inpt Rehab (Specialized) int.	-0.343	0.316	23687.922	-1.083
Home care int.	0.533	0.181	18494.376	2.942**
Residential (board & care) int.	-0.306	0.272	17606.128	-1.123
Private home, no home care int.	0.245	0.129	19848.101	1.890
Inpatient acute care (RC)	--	--	--	--
Discharge Service				
Ambulatory care	-0.219	0.567	20191.198	-0.387
Inpatient acute care	-0.027	0.035	24122.936	-0.782
Inpt rehab (general)	-0.319	0.075	24193.053	-4.211***
Inpt continuing care	-0.073	0.102	23050.844	-0.713
Inpt psychiatry service	-1.154	0.233	24131.939	-4.942***
Other / Unclassified	-0.796	0.153	21918.905	-5.191***

Inpt Rehab (Specialized)	0.110	0.131	23386.353	0.843
Home care	-0.750	0.039	21007.372	-19.051***
Residential (board & care)	-0.754	0.060	18235.290	-12.507***
Private home, no home care	-0.866	0.043	21178.760	-19.754***
Residential care (LTCH)	--	--	--	--
Discharge Service * Time				
Ambulatory care int.	1.566	1.220	19639.075	1.283
Inpatient acute care int.	0.102	0.066	24128.830	1.538
Inpt rehab (general) int.	-0.058	0.145	24201.079	-0.406
Inpt continuing care int.	0.179	0.206	23152.825	0.870
Inpt psychiatry service int.	-0.558	0.458	24193.372	-1.218
Other / Unclassified int.	0.040	0.305	21734.375	0.132
Inpt Rehab (Specialized) int.	0.689	0.249	23829.913	2.768**
Home care int.	-0.043	0.073	21538.898	-0.593
Residential (board & care) int.	0.046	0.115	18793.682	0.402
Private home, no home care int.	0.460	0.083	21327.202	5.487***
Residential care (LTCH) int.	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

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Table 40.

Summary of model fit statistics predicting CPS scores

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	86 889.948	2.636 (0.035)	0.584 (0.009)
Demographic model	7	86 401.246	2.544 (0.034)	0.584 (0.009)
Time model	8	86 231.573	2.505 (0.034)	0.586 (0.009)
Referral service model	18	85 984.502	2.447 (0.033)	0.589 (0.009)
Referral * Time model	28	85 974.117	2.445 (0.033)	0.589 (0.009)
Discharge service model	38	84 870.611	2.259 (0.031)	0.586 (0.009)
Discharge * Time model	48	84 855.230	2.260 (0.031)	0.585 (0.009)

Note. Each model contains all predictors of each previous model. Residual is also known as 'repeated' variance.

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Table 41.

Parameter estimates of fixed effects for the demographic model on CPS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.151	.014	15936.038	155.418***
Demographic				
Sex	-0.351	.028	16009.075	-12.489***
Age	0.002	.015	16301.294	0.155
Age^2	< 0.001	< 0.001	16329.922	1.553
Admission (LOS)	< 0.001	< 0.001	22540.272	-1.598

Note. LOS = Length of Stay. SE= Standard Error.

$*p < .05$. $**p<.01$. $***p<.001$.

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Table 42.

Parameter estimates of fixed effects for the time model on CPS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.207	.014	15897.004	153.209***
Demographic				
Sex	-0.341	.028	15985.617	-12.194***
Age	< 0.001	.000	16292.569	1.323
Age^2	0.006	.015	16264.489	0.408
Admission (LOS)	< 0.001	.000	22608.224	-0.840
Time	0.319	.024	23722.829	13.076***

Note. LOS = Length of Stay. SE= Standard Error.

$*p < .05$. $**p<.01$. $***p<.001$.

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Table 43.

Parameter estimates of fixed effects for the referral service model on CPS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.177	0.015	16697.755	143.345***
Demographic				
Sex	-0.335	0.028	15987.399	-12.087***
Age	0.012	0.015	16237.160	0.765
Age^2	< 0.001	< 0.001	16267.283	0.923
Admission (LOS)	< 0.001	< 0.001	22516.943	-0.673
Time	0.317	0.024	23647.502	13.046***
Referral service				
Ambulatory care	0.448	0.285	21764.025	1.572
Inpt rehab (general)	-0.168	0.051	23684.125	-3.281**
Inpt continuing care	0.458	0.107	24151.671	4.282***
Residential care (LTCH)	1.035	0.122	21637.431	8.488***
Inpt psychiatry service	1.052	0.169	23064.957	6.209***
Other / Unclassified	0.557	0.347	19582.973	1.605
Inpt Rehab (Specialized)	0.013	0.155	24035.200	0.086
Home care	0.001	0.084	22172.611	0.008
Residential (board & care)	1.308	0.125	21553.032	10.480***

Private home, no home care	0.107	0.067	21740.251	1.595
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

$*p < .05$. $**p < .01$. $***p < 0.001$.

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Table 44.

*Parameter estimates of fixed effects for the referral * time model on CPS scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.180	0.015	16783.710	142.867***
Demographic				
Sex	-0.336	0.028	15981.739	-12.094***
Age	0.011	0.015	16241.518	0.751
Age^2	< 0.001	< 0.001	16271.952	0.939
Admission (LOS)	< 0.001	< 0.001	22498.591	-0.670
Time	0.331	0.026	23651.113	12.567***
Referral service				
Ambulatory care	0.724	0.321	23447.705	2.257*
Inpt rehab (general)	-0.179	0.053	23920.983	-3.347**
Inpt continuing care	0.468	0.108	24087.330	4.350***
Residential care (LTCH)	1.005	0.125	21540.190	8.072***
Inpt psychiatry service	1.049	0.171	22009.005	6.121***
Other / Unclassified	0.555	0.349	19152.471	1.589
Inpt Rehab (Specialized)	0.004	0.156	23919.154	0.025
Home care	-0.102	0.103	20569.961	-0.995
Residential (board & care)	1.208	0.154	19701.044	7.856***

Private home, no home care	0.115	0.071	22591.082	1.627
Inpatient acute care (RC)	--	--	--	--
Referral facility * time				
Ambulatory care int.	1.129	0.616	23212.609	1.834
Inpt rehab (general) int.	-0.065	0.105	23792.716	-0.624
Inpt continuing care int.	-0.220	0.220	24083.920	-0.999
Residential care (LTCH) int.	-0.238	0.224	24189.253	-1.060
Inpt psychiatry service int.	< 0.001	0.335	23075.332	0.001
Other / Unclassified int.	-0.033	0.710	18764.311	-0.046
Inpt Rehab (Specialized) int.	0.150	0.318	23813.096	0.472
Home care int.	-0.330	0.193	21306.548	-1.712
Residential (board & care) int.	-0.337	0.291	19988.507	-1.158
Private home, no home care int.	0.044	0.136	22969.903	0.324
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$. .

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Table 45.

Parameter estimates of fixed effects for the discharge model on CPS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.508	0.018	19029.710	137.010***
Demographic				
Sex	-0.292	0.027	16027.743	-10.854***
Age	0.029	0.015	16255.371	1.990
Age^2	0.000	0.000	16290.356	-0.719
Admission (LOS)	0.000	0.000	21958.923	-1.066
Time	0.202	0.026	23279.152	7.769***
Referral service				
Ambulatory care	0.490	0.313	23200.143	1.567
Inpt rehab (general)	-0.210	0.053	23267.885	-4.006***
Inpt continuing care	0.461	0.106	24230.939	4.354***
Residential care (LTCH)	0.914	0.121	21184.477	7.542***
Inpt psychiatry service	0.970	0.167	21314.792	5.800***
Other / Unclassified	0.526	0.339	18955.102	1.553
Inpt Rehab (Specialized)	-0.089	0.154	24173.394	-0.580
Home care	-0.240	0.100	20250.644	-2.402*
Residential (board & care)	1.111	0.150	19587.551	7.423***

Private home, no home care	0.054	0.069	22276.411	0.783
Inpatient acute care (RC)	--	--	--	--
Referral facility * time				
Ambulatory care int.	1.135	0.600	22959.412	1.892
Inpt rehab (general) int.	-0.185	0.103	23471.540	-1.806
Inpt continuing care int.	-0.151	0.215	24199.693	-0.703
Residential care (LTCH) int.	-0.121	0.219	24091.370	-0.552
Inpt psychiatry service int.	0.238	0.330	22387.612	0.720
Other / Unclassified int.	0.144	0.688	18625.973	0.209
Inpt Rehab (Specialized) int.	0.241	0.312	24028.943	0.773
Home care int.	-0.388	0.188	20989.640	-2.071*
Residential (board & care) int.	-0.336	0.283	19633.215	-1.188
Private home, no home care int.	0.115	0.132	22630.443	0.869
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	-0.127	0.401	21538.854	-0.317
Inpatient acute care	-0.395	0.034	23600.772	-11.521***
Inpt rehab (general)	-0.868	0.067	24188.825	-12.906***
Inpt continuing care	-0.001	0.102	24223.254	-0.010
Inpt psychiatry service	0.379	0.226	24122.363	1.677
Other / Unclassified	-0.385	0.154	23621.590	-2.501*

Inpt Rehab (Specialized)	-0.682	0.116	24069.772	-5.872***
Home care	-0.928	0.035	22174.945	-26.799***
Residential (board & care)	-0.391	0.056	21287.339	-7.025***
Private home, no home care	-0.984	0.041	22883.233	-23.821***
Residential care (LTCH)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < 0.001$.

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Table 46.

*Parameter estimates of fixed effects for the discharge*time model on CPS scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.506	.018	19072.566	135.972***
Demographic				
Sex	-0.292	0.027	16011.392	-10.839***
Age	0.029	0.015	16257.842	2.001*
Age^2	0.000	0.000	16291.219	-0.727
Admission (LOS)	0.000	0.000	21925.029	-1.109
Time	0.179	0.036	20630.489	5.031***
Referral service				
Ambulatory care	0.494	0.313	23206.496	1.582
Inpt rehab (general)	-0.209	0.053	23219.178	-3.979***
Inpt continuing care	0.457	0.106	24229.896	4.309***
Residential care (LTCH)	0.919	0.121	21186.465	7.577***
Inpt psychiatry service	0.977	0.168	21075.227	5.814***
Other / Unclassified	0.512	0.339	18939.479	1.511
Inpt Rehab (Specialized)	-0.068	0.154	24197.311	-0.444
Home care	-0.236	0.100	20249.405	-2.367*
Residential (board & care)	1.112	0.150	19564.486	7.424***

Private home, no home care	0.049	0.069	22219.444	0.701
Inpatient acute care (RC)	--	--	--	--
Referral Facility * Time				
Ambulatory care int.	1.152	0.600	22963.044	1.919
Inpt rehab (general) int.	-0.188	0.103	23467.525	-1.836
Inpt continuing care int.	-0.136	0.216	24198.275	-0.631
Residential care (LTCH) int.	-0.112	0.219	24074.292	-0.509
Inpt psychiatry service int.	0.257	0.330	22382.355	0.779
Other / Unclassified int.	0.138	0.688	18620.050	0.200
Inpt Rehab (Specialized) int.	0.296	0.313	24129.974	0.945
Home care int.	-0.384	0.188	20988.601	-2.046*
Residential (board & care) int.	-0.342	0.285	19608.910	-1.199
Private home, no home care int.	0.093	0.133	22554.836	0.700
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	0.038	0.586	20088.280	0.064
Inpatient acute care	-0.393	0.034	23556.759	-11.442***
Inpt rehab (general)	-0.893	0.074	23479.773	-12.098***
Inpt continuing care	-0.001	0.102	24226.822	-0.005
Inpt psychiatry service	0.381	0.228	23842.775	1.669
Other / Unclassified	-0.371	0.155	23848.293	-2.397*

Inpt Rehab (Specialized)	-0.572	0.130	24129.033	-4.405***
Home care	-0.923	0.040	23462.267	-23.100***
Residential (board & care)	-0.372	0.063	21157.959	-5.958***
Private home, no home care	-0.940	0.044	23565.623	-21.158***
Residential care (LTCH)	--	--	--	--
Discharge service * Time				
Ambulatory care int.	-0.476	1.267	19292.625	-0.375
Inpatient acute care int.	-0.049	0.064	22591.990	-0.758
Inpt rehab (general) int.	-0.106	0.141	23362.869	-0.752
Inpt continuing care int.	-0.011	0.206	24230.585	-.056
Inpt psychiatry service int.	0.079	0.447	23520.761	0.177
Other / Unclassified int.	0.373	0.308	23558.620	1.209
Inpt Rehab (Specialized) int.	0.464	0.245	23864.731	1.895
Home care int.	0.034	0.075	23725.616	0.457
Residential (board & care) int.	0.095	0.119	21538.433	0.793
Private home, no home care int.	0.228	0.085	23517.408	2.686**
Residential care (LTCH) int.	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*p < .05. **p < .01. ***p < 0.001.

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Table 47.

Summary of model fit statistics predicting ABS scores

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	91 563.692	2.034 (0.033)	1.136 (0.017)
Demographic model	7	91 396.520	2.001 (0.033)	1.137 (0.017)
Time model	8	91 365.523	1.992 (0.033)	1.139 (0.017)
Referral service model	18	90 904.185	1.895 (0.032)	1.146 (0.017)
Referral * Time model	28	90 871.190	1.886 (0.032)	1.147 (0.017)
Discharge service model	38	90 473.712	1.837 (0.031)	1.138 (0.017)
Discharge * Time model	48	90 455.856	1.836 (0.031)	1.136 (0.017)

Note. Each model contains all predictors of each previous model. Residual is also known as 'repeated' variance.

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Table 48.

Parameter estimates of fixed effects for the demographic model on ABS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	0.757	0.014	16374.381	55.817***
Demographic				
Sex	-0.343	0.028	16471.010	-12.418***
Age	0.005	0.015	16479.275	0.311
Age^2	0.000	0.000	16522.077	0.078
Admission (LOS)	-0.001	0.000	20605.133	-2.408*

Note. LOS = Length of Stay. SE= Standard Error.

$*p < .05$. $**p<.01$. $***p<.001$.

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Table 49.

Parameter estimates of fixed effects for the time model on ABS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	0.778	0.014	15210.047	55.252***
Demographic				
Sex	-0.338	0.028	16466.891	-12.254***
Age	0.006	0.015	16466.330	0.425
Age^2	< 0.001	< 0.001	16508.771	-0.028
Admission (LOS)	< 0.001	< 0.001	20812.217	-1.891
Time	0.144	0.026	20650.376	5.574***

Note. LOS = Length of Stay. SE= Standard Error.

$*p < .05$. $**p<.01$. $***p<.001$.

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Table 50.

Parameter estimates of fixed effects for the referral service model on ABS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	0.736	.015	15805.427	49.501***
Demographic				
Sex	-0.325	.027	16446.863	-11.949***
Age	0.009	.015	16414.351	.597
Age^2	< 0.001	< 0.001	16459.049	-.235
Admission (LOS)	< 0.001	< 0.001	20718.039	-1.463
Time	.128	.025	20476.059	5.015***
Referral service				
Ambulatory care	-0.210	0.294	20355.390	-0.714
Inpt rehab (general)	-0.173	0.054	21240.244	-3.212**
Inpt continuing care	0.951	0.115	21666.714	8.248***
Residential care (LTCH)	1.944	0.125	18835.869	15.570***
Inpt psychiatry service	1.880	0.176	19209.026	10.705***
Other / Unclassified	1.048	0.348	16856.630	3.016**
Inpt Rehab (Specialized)	-0.172	0.168	22135.157	-1.019
Home care	-0.066	0.087	20597.909	-0.756
Residential (board & care)	0.683	0.129	20334.457	5.308***

Private home, no home care	0.104	0.069	19673.133	1.510
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

**p* < .05. ***p* < .01. ****p* < 0.001.

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Table 51.

*Parameter estimates of fixed effects for the referral * time model on ABS scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	0.738	0.015	15690.084	49.451***
Demographic				
Sex	-0.324	0.027	16427.304	-11.956***
Age	0.009	0.015	16402.126	0.579
Age^2	< 0.001	< 0.001	16447.410	-0.217
Admission (LOS)	< 0.001	< 0.001	20691.015	-1.460
Time	0.137	0.028	20455.692	4.973***
Referral service				
Ambulatory care	-0.164	0.334	19771.880	-0.491
Inpt rehab (general)	-0.189	0.056	20383.535	-3.367**
Inpt continuing care	0.934	0.117	22542.710	7.994***
Residential care (LTCH)	1.884	0.127	17834.914	14.883***
Inpt psychiatry service	1.804	0.176	19195.980	10.231***
Other / Unclassified	1.114	0.349	17275.550	3.191**
Inpt Rehab (Specialized)	-0.177	0.171	22902.116	-1.038
Home care	-0.146	0.104	17462.021	-1.408
Residential (board & care)	0.641	0.154	17216.017	4.162***

Private home, no home care	0.115	0.073	18594.846	1.570
Inpatient acute care (RC)	--	--	--	--
Referral service * time				
Ambulatory care int.	0.174	0.641	19859.412	0.272
Inpt rehab (general) int.	-0.107	0.110	20566.907	-0.976
Inpt continuing care int.	0.189	0.239	22887.855	0.790
Residential care (LTCH) int.	-0.661	0.239	21298.212	-2.771**
Inpt psychiatry service int.	1.484	0.351	20680.287	4.232***
Other / Unclassified int.	-1.251	0.709	17674.620	-1.764
Inpt Rehab (Specialized) int.	0.050	0.349	23274.577	0.144
Home care int.	-0.274	0.196	18206.996	-1.396
Residential (board & care) int.	-0.165	0.292	17618.363	-0.565
Private home, no home care int.	0.058	0.141	19339.733	0.411
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*p < .05. **p < .01. ***p < 0.001.

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Table 52.

Parameter estimates of fixed effects for the discharge model on ABS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	0.908	.019	17808.401	48.469***
Demographic				
Sex	-0.297	0.027	16457.990	-11.046***
Age	0.019	0.015	16417.087	1.322
Age^2	< 0.001	< 0.001	16464.903	-1.194
Admission (LOS)	< 0.001	< 0.001	20580.286	-1.113
Time	0.060	0.028	20517.366	2.163*
Referral service				
Ambulatory care	-0.288	0.331	19717.099	-0.868
Inpt rehab (general)	-0.203	0.056	20067.822	-3.637***
Inpt continuing care	0.897	0.116	22344.876	7.739***
Residential care (LTCH)	1.808	0.125	17780.725	14.417***
Inpt psychiatry service	1.736	0.175	19112.945	9.937***
Other / Unclassified	1.074	0.346	17255.945	3.106**
Inpt Rehab (Specialized)	-0.219	0.169	22740.251	-1.292
Home care	-0.213	0.103	17430.359	-2.076*
Residential (board & care)	0.579	0.153	17300.480	3.781***

Private home, no home care	0.073	0.072	18572.425	1.012
Inpatient acute care (RC)	--	--	--	--
Referral service * time				
Ambulatory care int.	0.174	0.635	19806.644	0.274
Inpt rehab (general) int.	-0.183	0.109	20404.834	-1.670
Inpt continuing care int.	0.245	0.237	22800.998	1.032
Residential care (LTCH) int.	-0.592	0.236	21225.274	-2.505*
Inpt psychiatry service int.	1.792	0.349	20205.247	5.134***
Other / Unclassified int.	-1.203	0.702	17664.997	-1.714
Inpt Rehab (Specialized) int.	0.097	0.346	23208.237	0.281
Home care int.	-0.302	0.194	18170.006	-1.557
Residential (board & care) int.	-0.140	0.290	17559.423	-0.484
Private home, no home care int.	0.094	0.139	19250.044	0.673
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	2.180	0.458	23665.208	4.763***
Inpatient acute care	-0.163	0.038	23706.527	-4.246***
Inpt rehab (general)	-0.494	0.075	23598.912	-6.620***
Inpt continuing care	-0.127	0.112	22395.384	-1.133
Inpt psychiatry service	1.854	0.251	23557.137	7.371***
Other / Unclassified	-0.132	0.165	21206.621	-0.801

Inpt Rehab (Specialized)	-0.356	0.129	23525.661	-2.756**
Home care	-0.528	0.037	20795.144	-14.434***
Residential (board & care)	-0.183	0.058	19799.860	-3.139**
Private home, no home care	-0.533	0.044	21026.248	-12.134***
Residential care (LTCH)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < 0.001$.

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Table 53.

*Parameter estimates of fixed effects for the discharge*time model on ABS scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	0.906	0.019	17530.603	48.106***
Demographic				
Sex	-0.297	0.027	16447.219	-11.050***
Age	0.020	0.015	16419.849	1.358
Age^2	< 0.001	< 0.001	16466.049	-1.226
Admission (LOS)	< 0.001	< 0.001	20559.659	-1.038
Time	0.030	0.037	18615.096	0.810
Referral service				
Ambulatory care	-0.286	0.331	19714.482	-0.862
Inpt rehab (general)	-0.206	0.056	20018.162	-3.687***
Inpt continuing care	0.903	0.116	22315.032	7.792***
Residential care (LTCH)	1.800	0.125	17777.184	14.354***
Inpt psychiatry service	1.735	0.175	18915.999	9.917***
Other / Unclassified	1.071	0.346	17245.433	3.097**
Inpt Rehab (Specialized)	-0.220	0.169	22701.691	-1.299
Home care	-0.212	0.103	17431.379	-2.068*
Residential (board & care)	0.578	0.153	17268.765	3.773***

Private home, no home care	0.068	0.072	18528.411	0.945
Inpatient acute care (RC)	--	--	--	--
Referral Facility * Time				
Ambulatory care int.	0.203	0.635	19802.571	0.320
Inpt rehab (general) int.	-0.190	0.109	20415.214	-1.739
Inpt continuing care int.	0.232	0.238	22795.541	0.975
Residential care (LTCH) int.	-0.596	0.237	21192.022	-2.518*
Inpt psychiatry service int.	1.761	0.349	20300.950	5.043***
Other / Unclassified int.	-1.192	0.702	17660.259	-1.698
Inpt Rehab (Specialized) int.	0.098	0.346	23128.013	0.284
Home care int.	-0.296	0.194	18161.360	-1.521
Residential (board & care) int.	-0.159	0.292	17534.479	-0.544
Private home, no home care int.	0.086	0.140	19196.099	0.614
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	1.376	0.613	20580.221	2.244*
Inpatient acute care	-0.157	0.039	23597.488	-4.069***
Inpt rehab (general)	-0.508	0.083	23841.969	-6.112***
Inpt continuing care	-0.121	0.112	22309.458	-1.084
Inpt psychiatry service	1.892	0.256	23735.348	7.387***
Other / Unclassified	-0.098	0.166	21176.496	-0.589

Inpt Rehab (Specialized)	-0.417	0.143	22484.273	-2.911**
Home care	-0.563	0.043	20212.623	-13.242***
Residential (board & care)	-0.157	0.065	17689.318	-2.436*
Private home, no home care	-0.522	0.047	20394.861	-11.014***
Residential care (LTCH)	--	--	--	--
Discharge service * Time				
Ambulatory care int.	2.638	1.316	20241.837	2.005**
Inpatient acute care int.	0.164	0.074	24209.154	2.228**
Inpt rehab (general) int.	-0.032	0.159	23869.376	-0.200
Inpt continuing care int.	0.244	0.225	22489.815	1.086
Inpt psychiatry service int.	0.441	0.504	23863.903	0.875
Other / Unclassified int.	0.555	0.331	21179.243	1.678
Inpt Rehab (Specialized) int.	-0.250	0.272	23112.398	-0.918
Home care int.	-0.087	0.080	20783.033	-1.087
Residential (board & care) int.	0.131	0.124	18306.314	1.059
Private home, no home care int.	0.073	0.091	20661.171	0.800
Residential care (LTCH) int.	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

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Table 54.

Summary of model fit statistics predicting CHESS scores

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	80 969.537	0.947 (0.021)	0.926 (0.014)
Demographic model	7	80 913.344	0.937 (0.021)	0.929 (0.014)
Time model	8	80 556.246	0.887 (0.021)	0.936 (0.014)
Referral service model	18	80 239.128	0.827 (0.021)	0.936 (0.014)
Referral * Time model	28	80 223.648	0.855 (0.021)	0.936 (0.014)
Discharge service model	38	78 844.969	0.746 (0.018)	0.922 (0.014)
Discharge * Time model	48	78 746.605	0.738 (0.019)	0.922 (0.014)

Note. Each model contains all predictors of each previous model. Residual is also known as 'repeated' variance.

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Table 55.

Parameter estimates of fixed effects for the demographic model on CHESS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.951	0.010	14966.406	190.640***
Demographic				
Sex	0.004	0.021	15096.330	0.206
Age	0.028	0.011	14946.151	2.472*
Age^2	< 0.001	< 0.001	15012.712	-1.864
Admission (LOS)	< 0.001	< 0.001	19085.471	0.810

Note. LOS = Length of Stay. SE= Standard Error.

*p < .05. **p<.01. ***p<.001.

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Table 56.

Parameter estimates of fixed effects for the time model on CHESS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.901	0.010	12868.984	182.934***
Demographic				
Sex	-0.008	0.021	14896.947	-0.410
Age	0.023	0.011	14717.338	2.103*
Age^2	< 0.001	< 0.001	14786.702	-1.509
Admission (LOS)	< 0.001	< 0.001	19233.615	-1.231
Time	-0.374	0.020	17765.511	-19.063***

Note. LOS = Length of Stay. SE= Standard Error.

*$p < .05$. **$p < .01$. ***$p < .001$.

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Table 57.

Parameter estimates of fixed effects for the referral service model on CHESS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.929	.011	13556.296	173.909***
Demographic				
Sex	-0.011	.020	14917.657	-0.523
Age	0.020	.011	14710.943	1.809
Age^2	< 0.001	< 0.001	14782.138	-1.175
Admission (LOS)	< 0.001	< 0.001	19221.363	-1.230
Time	-0.365	.020	17738.142	-18.679***
Referral service				
Ambulatory care	0.455	0.226	19221.896	2.011*
Inpt rehab (general)	-0.566	0.042	19016.523	-13.607***
Inpt continuing care	-0.124	0.089	17169.001	-1.396
Residential care (LTCH)	-0.557	0.095	15943.698	-5.879***
Inpt psychiatry service	-0.485	0.133	15349.608	-3.643***
Other / Unclassified	-0.001	0.260	13676.690	-0.005
Inpt Rehab (Specialized)	-0.547	0.130	18189.385	-4.209***
Home care	0.350	0.067	19330.316	5.234***
Residential (board & care)	-0.140	0.099	19261.610	-1.414

Private home, no home care	0.282	0.053	17667.911	5.371***
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

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Table 58.

*Parameter estimates of fixed effects for the referral * time model on CHESS scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.927	0.011	13336.002	173.074***
Demographic				
Sex	-0.011	0.020	14908.686	-0.521
Age	0.020	0.011	14710.081	1.846
Age^2	0.000	0.000	14781.924	-1.216
Admission (LOS)	0.000	0.000	19209.536	-1.217
Time	-0.386	0.021	17725.597	-18.258***
Referral service				
Ambulatory care	0.381	0.255	16544.700	1.496
Inpt rehab (general)	-0.543	0.043	16964.243	-12.628***
Inpt continuing care	-0.126	0.091	19821.461	-1.384
Residential care (LTCH)	-0.534	0.095	14612.830	-5.601***
Inpt psychiatry service	-0.462	0.134	16212.905	-3.445**
Other / Unclassified	0.019	0.263	15090.104	0.072
Inpt Rehab (Specialized)	-0.535	0.133	20417.768	-4.023***
Home care	0.439	0.078	14604.050	5.629***
Residential (board & care)	-0.072	0.116	14608.888	-0.622

Private home, no home care	0.290	0.055	15112.161	5.250***
Inpatient acute care (RC)	--	--	--	--
Referral service * time				
Ambulatory care int.	-0.288	0.489	16986.177	-0.589
Inpt rehab (general) int.	0.175	0.084	17618.122	2.076*
Inpt continuing care int.	0.066	0.186	20774.986	0.355
Residential care (LTCH) int.	0.316	0.184	18245.737	1.722
Inpt psychiatry service int.	-0.320	0.269	18223.865	-1.187
Other / Unclassified int.	-0.208	0.536	16052.560	-0.387
Inpt Rehab (Specialized) int.	-0.072	0.273	21316.545	-0.265
Home care int.	0.336	0.148	15506.248	2.264*
Residential (board & care) int.	0.262	0.221	15213.407	1.188
Private home, no home care int.	0.055	0.107	16216.982	0.517
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

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Table 59.

Parameter estimates of fixed effects for the discharge model on CHESS scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.235	0.014	15704.842	162.625***
Demographic				
Sex	0.021	0.020	15122.656	1.088
Age	0.032	0.011	14879.790	2.961**
Age^2	< 0.001	< 0.001	14957.425	-2.862**
Admission (LOS)	< 0.001	< 0.001	19290.842	-0.197
Time	-0.503	0.021	18006.611	-24.341***
Referral service				
Ambulatory care	0.129	0.245	16452.338	0.525
Inpt rehab (general)	-0.535	0.041	16721.009	-12.920***
Inpt continuing care	-0.191	0.088	19584.249	-2.184*
Residential care (LTCH)	-0.612	0.092	14554.621	-6.674***
Inpt psychiatry service	-0.574	0.129	16330.978	-4.448***
Other / Unclassified	-0.109	0.253	15237.575	-0.432
Inpt Rehab (Specialized)	-0.581	0.128	20164.228	-4.525***
Home care	0.331	0.075	14618.902	4.420***
Residential (board & care)	-0.081	0.112	14740.869	-0.722

Private home, no home care	0.235	0.053	15044.117	4.418***
Inpatient acute care (RC)	--	--	--	--
Referral service * time				
Ambulatory care int.	-0.309	0.471	16942.486	-0.656
Inpt rehab (general) int.	0.102	0.081	17450.899	1.259
Inpt continuing care int.	0.156	0.180	20600.051	0.864
Residential care (LTCH) int.	0.452	0.177	18076.475	2.557*
Inpt psychiatry service int.	-0.330	0.260	17882.656	-1.270
Other / Unclassified int.	-0.166	0.516	16286.582	-0.322
Inpt Rehab (Specialized) int.	-0.021	0.264	21140.978	-0.078
Home care int.	0.289	0.143	15529.845	2.028*
Residential (board & care) int.	0.202	0.212	15278.728	0.953
Private home, no home care int.	0.106	0.103	16120.749	1.031
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	-0.045	0.347	17680.816	-0.129
Inpatient acute care	-0.487	0.029	20860.765	-16.531***
Inpt rehab (general)	-0.694	0.057	22547.671	-12.092***
Inpt continuing care	-0.343	0.085	19431.225	-4.054***
Inpt psychiatry service	-0.690	0.193	21821.284	-3.579***
Other / Unclassified	-0.543	0.124	18792.933	-4.378***

Inpt Rehab (Specialized)	-0.708	0.099	21968.390	-7.153***
Home care	-0.696	0.027	19771.520	-25.312***
Residential (board & care)	-0.638	0.043	18294.907	-14.685***
Private home, no home care	-0.969	0.033	19511.525	-29.332***
Residential care (LTCH)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

$*p < .05$. $**p < .01$. $***p < 0.001$.

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Table 60.

*Parameter estimates of fixed effects for the discharge*time model on CHESS scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	2.226	0.014	15214.953	161.877***
Demographic				
Sex	0.023	0.020	15094.513	1.162
Age	0.033	0.011	14859.379	3.147**
Age^2	< 0.001	< 0.001	14935.981	-3.007**
Admission (LOS)	< 0.001	< 0.001	19263.381	-0.139
Time	-0.663	0.027	16592.083	-24.493***
Referral service				
Ambulatory care	0.151	0.245	16404.189	0.619
Inpt rehab (general)	-0.524	0.041	16646.510	-12.687***
Inpt continuing care	-0.185	0.087	19524.837	-2.114*
Residential care (LTCH)	-0.619	0.091	14507.374	-6.775***
Inpt psychiatry service	-0.564	0.129	16182.005	-4.379***
Other / Unclassified	-0.106	0.252	15205.907	-0.422
Inpt Rehab (Specialized)	-0.581	0.128	20113.425	-4.532***
Home care	0.344	0.075	14581.376	4.601***
Residential (board & care)	-0.073	0.111	14676.938	-0.656

Private home, no home care	0.231	0.053	14963.020	4.369***
Inpatient acute care (RC)	--	--	--	--
Referral service * Time				
Ambulatory care int.	-0.179	0.470	16900.517	-0.381
Inpt rehab (general) int.	0.094	0.081	17427.459	1.162
Inpt continuing care int.	0.182	0.180	20551.883	1.014
Residential care (LTCH) int.	0.510	0.177	18005.842	2.885**
Inpt psychiatry service int.	-0.287	0.260	18039.842	-1.103
Other / Unclassified int.	-0.081	0.514	16268.756	-0.158
Inpt Rehab (Specialized) int.	0.005	0.263	21085.046	0.017
Home care int.	0.336	0.142	15484.133	2.363*
Residential (board & care) int.	0.214	0.213	15223.004	1.006
Private home, no home care int.	0.123	0.103	16045.129	1.196
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	0.152	0.459	19880.980	0.330
Inpatient acute care	-0.475	0.029	20490.313	-16.163***
Inpt rehab (general)	-0.616	0.064	21533.902	-9.667***
Inpt continuing care	-0.336	0.084	19352.141	-3.983***
Inpt psychiatry service	-0.681	0.196	21229.418	-3.479***
Other / Unclassified	-0.532	0.124	18145.819	-4.287***

Inpt Rehab (Specialized)	-0.690	0.108	18920.681	-6.407***
Home care	-0.652	0.032	16846.699	-20.702***
Residential (board & care)	-0.581	0.047	14413.248	-12.346***
Private home, no home care	-0.884	0.035	17152.641	-25.135***
Residential care (LTCH)	--	--	--	--
Discharge service * Time				
Ambulatory care int.	-0.480	0.985	20062.885	-0.487
Inpatient acute care int.	0.277	0.057	22742.560	4.848***
Inpt rehab (general) int.	0.448	0.122	21757.111	3.662***
Inpt continuing care int.	0.492	0.170	20005.456	2.893**
Inpt psychiatry service int.	0.216	0.386	21689.381	0.558
Other / Unclassified int.	0.226	0.247	18746.048	0.914
Inpt Rehab (Specialized) int.	0.181	0.206	20107.501	0.877
Home care int.	0.275	0.060	17709.890	4.612***
Residential (board & care) int.	0.377	0.091	15369.964	4.148***
Private home, no home care int.	0.524	0.068	17845.897	7.746***
Residential care (LTCH) int.	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

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Table 61.

Summary of model fit statistics predicting CICN scores

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	51 955.303	0.116 (0.005)	0.397 (0.006)
Demographic model	7	51 846.067	0.111 (0.005)	0.398 (0.006)
Time model	8	50 950.798	0.085 (0.005)	0.402 (0.006)
Referral service model	18	50 795.838	0.085 (0.005)	0.399 (0.006)
Referral * Time model	28	50 678.783	0.082 (0.005)	0.399 (0.005)
Discharge service model	38	50 147.786	0.073 (0.005)	0.396 (0.005)
Discharge * Time model	48	50 098.724	0.072 (0.005)	0.396 (0.005)

Note. Each model contains all predictors of each previous model. Residual is also known as ‘repeated’ variance.

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Table 62.

Parameter estimates of fixed effects for the demographic model on CICN scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.437	0.005	13813.096	286.513***
Demographic				
Sex	-0.017	0.010	13905.092	-1.618
Age	0.008	0.006	13362.994	1.437
Age^2	< 0.001	< 0.001	13499.391	-0.545
Admission (LOS)	< 0.001	< 0.001	17923.093	1.039

Note. LOS = Length of Stay. SE= Standard Error.

*$p < .05$. **$p<.01$. ***$p<.001$.

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Table 63.

Parameter estimates of fixed effects for the time model on CICN scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.414	0.005	11529.923	290.518***
Demographic				
Sex	-0.027	0.010	13331.455	-2.787**
Age	0.004	0.005	12688.199	0.836
Age^2	< 0.001	< 0.001	12839.735	0.051
Admission (LOS)	< 0.001	< 0.001	18126.025	-3.052**
Time	-0.295	0.010	16064.264	-30.548***

Note. LOS = Length of Stay. SE= Standard Error.

*$p < .05$. **$p<.01$. ***$p<.001$.

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Table 64.

Parameter estimates of fixed effects for the referral service model on CICN scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.437	0.005	12277.991	271.969***
Demographic				
Sex	-0.030	0.010	13522.820	-3.029**
Age	0.003	0.005	12869.033	0.538
Age^2	< 0.001	< 0.001	13022.977	0.324
Admission (LOS)	< 0.001	< 0.001	18265.040	-3.182**
Time	-0.294	0.010	16239.666	-30.446***
Referral service				
Ambulatory care	-0.016	0.115	19951.890	-0.142
Inpt rehab (general)	-0.209	0.021	16418.331	-10.067***
Inpt continuing care	-0.088	0.042	9715.671	-2.086*
Residential care (LTCH)	-0.193	0.046	11783.011	-4.226***
Inpt psychiatry service	-0.130	0.063	9677.173	-2.062*
Other / Unclassified	0.161	0.122	9951.113	1.313
Inpt Rehab (Specialized)	-0.309	0.063	12490.573	-4.881***
Home care	-0.101	0.034	19251.357	-2.986**
Residential (board & care)	-0.070	0.050	19431.306	-1.399

Private home, no home care	-0.057	0.026	15566.654	-2.189*
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < 0.001$.

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Table 65.

*Parameter estimates of fixed effects for the referral * time model on CICN scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.434	0.005	11979.814	272.569***
Demographic				
Sex	-0.029	0.010	13438.543	-2.994**
Age	0.004	0.005	12777.273	0.707
Age^2	< 0.001	< 0.001	12934.787	0.145
Admission (LOS)	< 0.001	< 0.001	18214.070	-3.124**
Time	-0.334	0.010	16152.344	-32.057***
Referral service				
Ambulatory care	0.049	0.124	14873.195	0.391
Inpt rehab (general)	-0.194	0.021	13946.407	-9.266***
Inpt continuing care	-0.147	0.045	17109.118	-3.241**
Residential care (LTCH)	-0.194	0.045	12151.282	-4.276***
Inpt psychiatry service	-0.105	0.065	14176.045	-1.622
Other / Unclassified	0.146	0.127	15232.249	1.148
Inpt Rehab (Specialized)	-0.301	0.067	18198.200	-4.484***
Home care	-0.027	0.037	12714.904	-0.728
Residential (board & care)	0.002	0.055	12695.356	0.029

Private home, no home care	-0.029	0.026	12257.196	-1.112
Inpatient acute care (RC)	--	--	--	--
Referral service * time				
Ambulatory care int.	0.353	0.240	15936.651	1.471
Inpt rehab (general) int.	0.213	0.041	15494.509	5.139***
Inpt continuing care int.	0.382	0.095	19131.215	4.043***
Residential care (LTCH) int.	0.367	0.091	15827.772	4.051***
Inpt psychiatry service int.	-0.143	0.134	16963.957	-1.069
Other / Unclassified int.	0.161	0.264	17257.826	0.612
Inpt Rehab (Specialized) int.	< 0.001	0.139	19818.620	-0.003
Home care int.	0.361	0.072	13991.921	5.040***
Residential (board & care) int.	0.344	0.106	13786.622	3.231**
Private home, no home care int.	0.294	0.052	14070.531	5.676***
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

$*p < .05$. $**p < .01$. $***p < 0.001$.

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Table 66.

Parameter estimates of fixed effects for the discharge model on CICN scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.521	.007	14091.634	223.197***
Demographic				
Sex	-0.019	0.010	13432.124	-1.967*
Age	0.007	0.005	12735.295	1.308
Age^2	< 0.001	< 0.001	12895.402	-.794
Admission (LOS)	< 0.001	< 0.001	18280.501	-2.113*
Time	-0.375	0.010	16870.853	-35.775***
Referral service				
Ambulatory care	-0.024	0.122	15018.978	-0.196
Inpt rehab (general)	-0.190	0.021	14038.107	-9.208***
Inpt continuing care	-0.170	0.045	17246.849	-3.804***
Residential care (LTCH)	-0.220	0.045	12190.020	-4.916***
Inpt psychiatry service	-0.146	0.064	14539.529	-2.273*
Other / Unclassified	0.108	0.125	15431.326	0.857
Inpt Rehab (Specialized)	-0.310	0.066	18299.392	-4.687***
Home care	-0.059	0.037	12787.609	-1.609
Residential (board & care)	-0.015	0.055	12764.763	-0.278

Private home, no home care	-0.046	0.026	12334.861	-1.758
Inpatient acute care (RC)	--	--	--	--
Referral service * time				
Ambulatory care int.	0.346	0.236	16098.593	1.466
Inpt rehab (general) int.	0.191	0.041	15550.815	4.686***
Inpt continuing care int.	0.420	0.093	19178.111	4.499***
Residential care (LTCH) int.	0.406	0.089	15886.573	4.550***
Inpt psychiatry service int.	-0.135	0.132	16959.375	-1.027
Other / Unclassified int.	0.178	0.260	17486.373	0.685
Inpt Rehab (Specialized) int.	0.016	0.137	19891.469	0.116
Home care int.	0.345	0.071	14086.165	4.899***
Residential (board & care) int.	0.340	0.105	13865.365	3.247**
Private home, no home care int.	0.308	0.051	14138.864	6.044***
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	-0.153	0.167	7728.525	-0.918
Inpatient acute care	-0.077	0.015	14063.343	-5.177***
Inpt rehab (general)	-0.233	0.030	21643.125	-7.649***
Inpt continuing care	-0.128	0.043	14533.839	-2.985**
Inpt psychiatry service	-0.105	0.100	18340.761	-1.042
Other / Unclassified	-0.226	0.063	15838.340	-3.594***

Inpt Rehab (Specialized)	-0.419	0.052	20322.469	-8.079***
Home care	-0.216	0.014	19834.445	-15.176***
Residential (board & care)	-0.142	0.022	17042.758	-6.410***
Private home, no home care	-0.307	0.017	18673.072	-18.042***
Residential care (LTCH)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

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Table 67.

*Parameter estimates of fixed effects for the discharge*time model on CICN scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	1.521	0.007	14109.058	223.595***
Demographic				
Sex	-0.018	0.010	13418.916	-1.912
Age	0.008	0.005	12727.135	1.503
Age^2	< 0.001	< 0.001	12886.510	-0.986
Admission (LOS)	< 0.001	< 0.001	18282.649	-2.098*
Time	-0.384	0.014	16355.647	-28.221***
Referral service				
Ambulatory care	-0.025	0.122	15026.688	-0.207
Inpt rehab (general)	-0.189	0.021	14031.995	-9.180***
Inpt continuing care	-0.170	0.045	17235.097	-3.797***
Residential care (LTCH)	-0.223	0.045	12187.618	-4.989***
Inpt psychiatry service	-0.147	0.064	14519.578	-2.294*
Other / Unclassified	0.105	0.125	15448.805	0.836
Inpt Rehab (Specialized)	-0.308	0.066	18309.198	-4.671***
Home care	-0.060	0.037	12789.371	-1.628
Residential (board & care)	-0.015	0.055	12779.416	-0.266

Private home, no home care	-0.048	0.026	12314.888	-1.839
Inpatient acute care (RC)	--	--	--	--
Referral service * Time				
Ambulatory care int.	0.358	0.236	16109.893	1.517
Inpt rehab (general) int.	0.188	0.041	15562.619	4.613***
Inpt continuing care int.	0.412	0.093	19154.250	4.422***
Residential care (LTCH) int.	0.402	0.089	15873.943	4.507***
Inpt psychiatry service int.	-0.120	0.132	17165.184	-0.908
Other / Unclassified int.	0.183	0.259	17510.773	0.706
Inpt Rehab (Specialized) int.	0.013	0.137	19934.180	0.096
Home care int.	0.345	0.070	14078.948	4.892***
Residential (board & care) int.	0.323	0.105	13851.084	3.066**
Private home, no home care int.	0.301	0.051	14127.282	5.903***
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	-0.004	0.239	20784.417	-0.015
Inpatient acute care	-0.081	0.015	15506.077	-5.414***
Inpt rehab (general)	-0.205	0.033	17702.705	-6.219***
Inpt continuing care	-0.130	0.043	16512.208	-3.032**
Inpt psychiatry service	-0.127	0.101	16616.030	-1.258
Other / Unclassified	-0.226	0.063	15851.198	-3.602***

Inpt Rehab (Specialized)	-0.428	0.055	15879.271	-7.847***
Home care	-0.246	0.016	14353.902	-15.628***
Residential (board & care)	-0.133	0.023	12272.667	-5.778***
Private home, no home care	-0.293	0.018	14952.034	-16.638***
Residential care (LTCH)	--	--	--	--
Discharge service * Time				
Ambulatory care int.	-0.440	0.516	21761.521	-0.854
Inpatient acute care int.	0.080	0.030	18987.551	2.688**
Inpt rehab (general) int.	0.140	0.064	18549.656	2.209*
Inpt continuing care int.	0.052	0.088	18139.007	0.596
Inpt psychiatry service int.	-0.367	0.200	17991.076	-1.835
Other / Unclassified int.	-0.314	0.126	17474.472	-2.486*
Inpt Rehab (Specialized) int.	-0.046	0.106	17602.718	-0.431
Home care int.	-0.101	0.030	15690.777	-3.361**
Residential (board & care) int.	0.067	0.045	13850.980	1.501
Private home, no home care int.	0.095	0.034	16342.579	2.785**
Residential care (LTCH) int.	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

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Table 68.

Summary of model fit statistics predicting RUG-III scores

	Number of parameters	-2 log likelihood	Covariance Parameters	
			Intercept (SE)	Residual (SE)
Null model	3	89 893.696	1.103 (0.026)	1.503 (0.021)
Demographic model	7	89 796.098	1.086 (0.026)	1.505 (0.021)
Time model	8	89 649.763	1.064 (0.026)	1.506 (0.021)
Referral service model	18	89 524.118	1.050 (0.026)	1.504 (0.021)
Referral * Time model	28	89 502.949	1.047 (0.026)	1.504 (0.021)
Discharge service model	38	88 475.752	0.937 (0.024)	1.486 (0.020)
Discharge * Time model	48	88 457.917	0.935 (0.024)	1.486 (0.020)

Note. Each model contains all predictors of each previous model. Residual is also known as 'repeated' variance.

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Table 69.

Parameter estimates of fixed effects for the demographic model on RUG-III scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	5.888	0.012	16155.010	495.950
Demographic				
Sex	0.103	0.024	16284.275	4.276
Age	0.050	0.013	16051.100	3.843
Age^2	< 0.001	< 0.001	16128.472	-4.459
Admission (LOS)	0.001	0.000	19746.864	4.371

Note. LOS = Length of Stay. SE= Standard Error.

*$p < .05$. **$p<.01$. ***$p<.001$.

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Table 70.

Parameter estimates of fixed effects for the time model on RUG-III scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	5.855	0.012	14150.971	483.814***
Demographic				
Sex	0.093	0.024	16251.442	3.871***
Age	0.047	0.013	16001.604	3.597***
Age^2	< 0.001	< 0.001	16079.670	-4.234***
Admission (LOS)	0.001	< 0.001	20044.036	2.961**
Time	-0.281	0.023	18416.264	-12.133***

Note. LOS = Length of Stay. SE= Standard Error.

*$p < .05$. **$p<.01$. ***$p<.001$.

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Table 71.

Parameter estimates of fixed effects for the referral service model on RUG-III scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	5.878	0.013	14857.907	451.045***
Demographic				
Sex	0.084	0.024	16303.172	3.501***
Age	0.047	0.013	16035.126	3.636***
Age^2	< 0.001	< 0.001	16113.964	-4.306***
Admission (LOS)	0.001	< 0.001	20068.143	2.763**
Time	-0.281	0.023	18467.808	-12.131***
Referral service				
Ambulatory care	-0.459	0.269	20269.503	-1.703
Inpt rehab (general)	0.191	0.049	19583.413	3.865***
Inpt continuing care	-0.381	0.105	16947.159	-3.641***
Residential care (LTCH)	-0.160	0.112	16664.091	-1.433
Inpt psychiatry service	-0.699	0.157	15730.405	-4.458***
Other / Unclassified	-1.266	0.306	14507.094	-4.143***
Inpt Rehab (Specialized)	-0.056	0.154	18117.385	-0.362
Home care	-0.511	0.080	20272.743	-6.422***
Residential (board & care)	-0.065	0.118	20291.899	-0.555

Private home, no home care	-0.244	0.062	18565.799	-3.912***
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

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Table 72.

*Parameter estimates of fixed effects for the referral * time model on RUG-III scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	5.878	0.013	14616.551	449.867***
Demographic				
Sex	0.083	0.024	16299.194	3.447**
Age	0.048	0.013	16038.168	3.702***
Age^2	< 0.001	< 0.001	16117.689	-4.366***
Admission (LOS)	0.001	< 0.001	20062.997	2.706**
Time	-0.279	0.025	18454.160	-11.127***
Referral service				
Ambulatory care	-0.405	0.301	17289.799	-1.343
Inpt rehab (general)	0.181	0.051	17504.903	3.548***
Inpt continuing care	-0.335	0.108	20044.329	-3.105**
Residential care (LTCH)	-0.192	0.112	15522.728	-1.710
Inpt psychiatry service	-0.723	0.158	17027.386	-4.565***
Other / Unclassified	-1.295	0.310	16410.519	-4.174***
Inpt Rehab (Specialized)	-0.144	0.159	20599.015	-0.911
Home care	-0.465	0.092	15645.019	-5.064***
Residential (board & care)	-0.075	0.136	15719.355	-0.553

Private home, no home care	-0.221	0.065	15876.756	-3.395**
Inpatient acute care (RC)	--	--	--	--
Referral service * time				
Ambulatory care int.	0.233	0.579	17812.735	0.402
Inpt rehab (general) int.	-0.082	0.100	18258.669	-0.821
Inpt continuing care int.	-0.390	0.223	21036.278	-1.751
Residential care (LTCH) int.	-0.614	0.218	18729.575	-2.818**
Inpt psychiatry service int.	0.328	0.320	18940.093	1.026
Other / Unclassified int.	0.320	0.634	17497.226	0.504
Inpt Rehab (Specialized) int.	0.750	0.326	21482.220	2.300*
Home care int.	0.176	0.175	16537.461	1.006
Residential (board & care) int.	-0.044	0.260	16363.869	-0.170
Private home, no home care int.	0.151	0.126	17012.985	1.195
Inpatient acute care (RC)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

Appendix D

Table 73.

Parameter estimates of fixed effects for the discharge model on RUG-III scores

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	5.572	0.016	16817.378	340.014***
Demographic				
Sex	0.047	0.023	16430.138	2.016*
Age	0.034	0.013	16134.683	2.664**
Age^2	< 0.001	< 0.001	16218.569	-2.849**
Admission (LOS)	< 0.001	< 0.001	20138.388	1.742
Time	-0.149	0.025	18806.572	-6.007***
Referral service				
Ambulatory care	-0.161	0.293	17281.612	-0.551
Inpt rehab (general)	0.177	0.049	17405.745	3.580***
Inpt continuing care	-0.253	0.105	19963.381	-2.406*
Residential care (LTCH)	-0.093	0.109	15510.032	-0.858
Inpt psychiatry service	-0.569	0.154	17222.258	-3.697***
Other / Unclassified	-1.183	0.301	16549.478	-3.930***
Inpt Rehab (Specialized)	-0.097	0.154	20497.503	-0.625
Home care	-0.344	0.089	15680.301	-3.865***
Residential (board & care)	-0.007	0.133	15837.439	-0.049

Private home, no home care	-0.148	0.063	15876.177	-2.347*
Inpatient acute care (RC)	--	--	--	--
Referral service * time				
Ambulatory care int.	0.256	0.562	17835.496	0.455
Inpt rehab (general) int.	0.004	0.097	18189.453	0.044
Inpt continuing care int.	-0.474	0.217	20966.712	-2.185*
Residential care (LTCH) int.	-0.765	0.212	18665.615	-3.613***
Inpt psychiatry service int.	0.276	0.311	18739.483	0.886
Other / Unclassified int.	0.290	0.616	17691.977	0.471
Inpt Rehab (Specialized) int.	0.670	0.318	21417.013	2.108*
Home care int.	0.222	0.170	16583.109	1.309
Residential (board & care) int.	-0.049	0.253	16431.175	-0.195
Private home, no home care int.	0.098	0.123	16986.992	0.802
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	-0.506	0.414	16752.779	-1.221
Inpatient acute care	0.414	0.035	20572.438	11.682***
Inpt rehab (general)	0.813	0.069	22739.453	11.719***
Inpt continuing care	0.001	0.102	19605.670	0.010
Inpt psychiatry service	-0.097	0.233	21865.494	-0.418
Other / Unclassified	0.391	0.149	19372.713	2.629**

Inpt Rehab (Specialized)	0.625	0.120	22129.856	5.231***
Home care	0.852	0.033	20655.781	25.779***
Residential (board & care)	0.444	0.052	19246.777	8.540***
Private home, no home care	0.894	0.040	20286.086	22.528***
Residential care (LTCH)	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

*$p < .05$. **$p < .01$. ***$p < 0.001$.

Appendix D

Table 74.

*Parameter estimates of fixed effects for the discharge*time model on RUG-III scores*

Parameter	Estimate	*S. E.*	*df*	*t*
Intercept	5.573	.016	16391.125	339.476***
Demographic				
Sex	0.047	0.023	16417.819	2.023*
Age	0.033	0.013	16131.286	2.615**
Age^2	< 0.001	< 0.001	16213.852	-2.803**
Admission (LOS)	< 0.001	< 0.001	20128.104	1.668
Time	-0.129	0.032	17757.166	-3.963***
Referral service				
Ambulatory care	-0.163	0.293	17267.134	-0.557
Inpt rehab (general)	0.177	0.049	17377.292	3.576***
Inpt continuing care	-0.258	0.105	19943.026	-2.451*
Residential care (LTCH)	-0.092	0.109	15496.467	-0.843
Inpt psychiatry service	-0.575	0.154	17137.739	-3.731***
Other / Unclassified	-1.187	0.301	16536.384	-3.947***
Inpt Rehab (Specialized)	-0.093	0.154	20485.484	-0.605
Home care	-0.343	0.089	15670.815	-3.847***
Residential (board & care)	-0.008	0.133	15805.945	-0.059

Private home, no home care	-0.148	0.063	15837.680	-2.342*
Inpatient acute care (RC)	--	--	--	--
Referral Facility * Time				
Ambulatory care int.	0.237	0.562	17822.526	0.421
Inpt rehab (general) int.	-0.004	0.097	18194.728	-0.042
Inpt continuing care int.	-0.468	0.217	20944.525	-2.157*
Residential care (LTCH) int.	-0.767	0.212	18635.780	-3.620***
Inpt psychiatry service int.	0.299	0.312	18906.869	0.958
Other / Unclassified int.	0.280	0.616	17683.893	0.455
Inpt Rehab (Specialized) int.	0.686	0.318	21406.270	2.157*
Home care int.	0.218	0.170	16564.174	1.285
Residential (board & care) int.	-0.017	0.254	16400.909	-0.066
Private home, no home care int.	0.091	0.123	16952.090	0.740
Inpatient acute care (RC)	--	--	--	--
Discharge service				
Ambulatory care	0.178	0.553	20810.316	0.322
Inpatient acute care	0.413	0.035	20378.953	11.672***
Inpt rehab (general)	0.862	0.077	21448.816	11.204***
Inpt continuing care	0.001	0.102	19716.782	0.009
Inpt psychiatry service	-0.138	0.236	21106.715	-0.585
Other / Unclassified	0.411	0.149	18765.300	2.754**

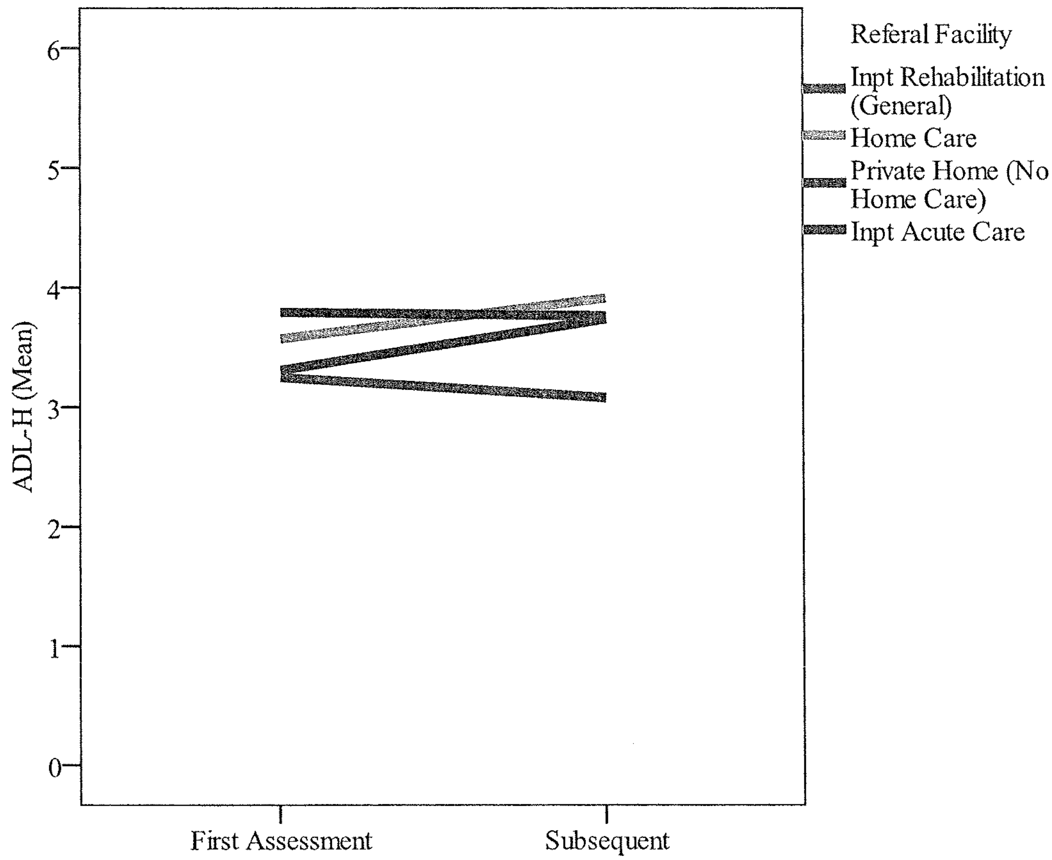
Inpt Rehab (Specialized)	0.659	0.130	19209.933	5.090***
Home care	0.856	0.038	17565.216	22.681***
Residential (board & care)	0.418	0.056	15419.615	7.450***
Private home, no home care	0.902	0.042	17880.071	21.390***
Residential care (LTCH)	--	--	--	--
Discharge service * Time				
Ambulatory care int.	-2.233	1.188	21117.035	-1.880
Inpatient acute care int.	-0.160	0.069	22495.667	-2.314*
Inpt rehab (general) int.	0.195	0.148	21715.231	1.316
Inpt continuing care int.	-0.072	0.205	20420.662	-0.350
Inpt psychiatry service int.	-0.462	0.467	21607.259	-0.991
Other / Unclassified int.	0.504	0.297	19457.455	1.696
Inpt Rehab (Specialized) int.	0.156	0.249	20314.390	0.630
Home care int.	-0.005	0.071	18402.748	-0.067
Residential (board & care) int.	-0.148	0.108	16412.848	-1.367
Private home, no home care int.	0.028	0.081	18607.964	0.345
Residential care (LTCH) int.	--	--	--	--

Note. LOS = Length of Stay. LTCH = Long-term care home. Inpt = Inpatient. Int. = Interaction. RC = Reference Category. S.E. = Standard Error.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < 0.001$.

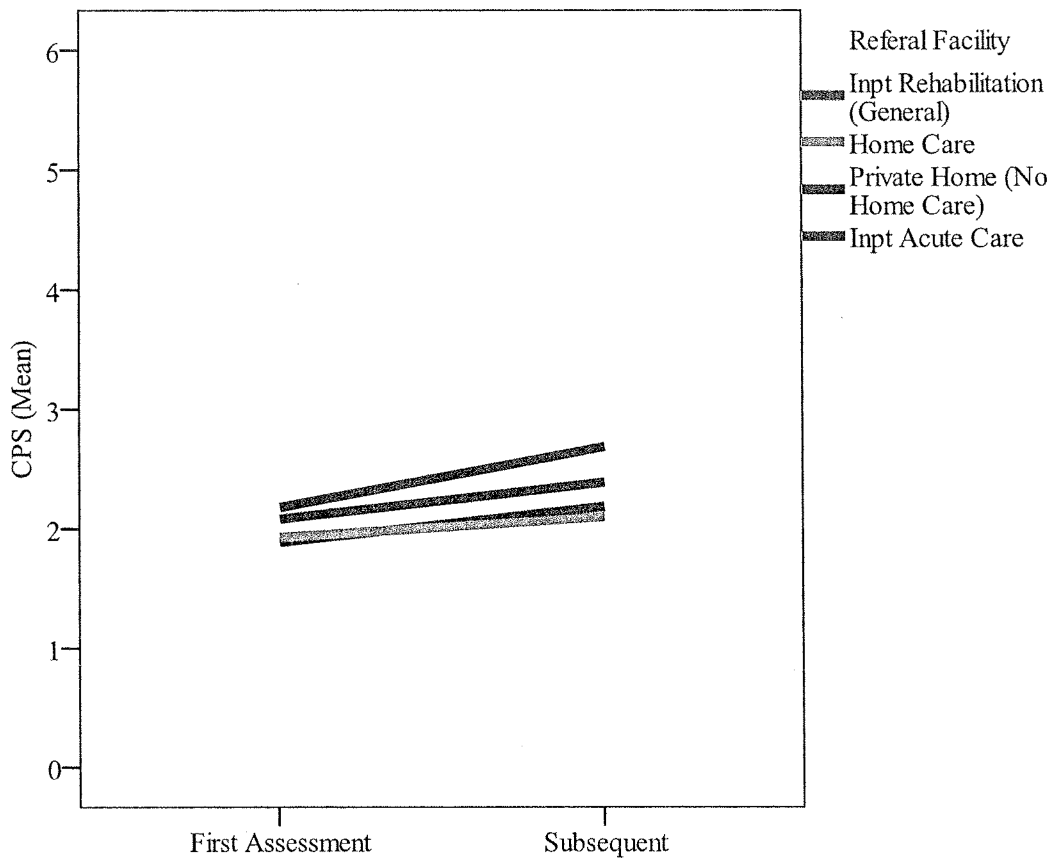
Figures

Figure 1. Average ADL-H scores between referral services over time.



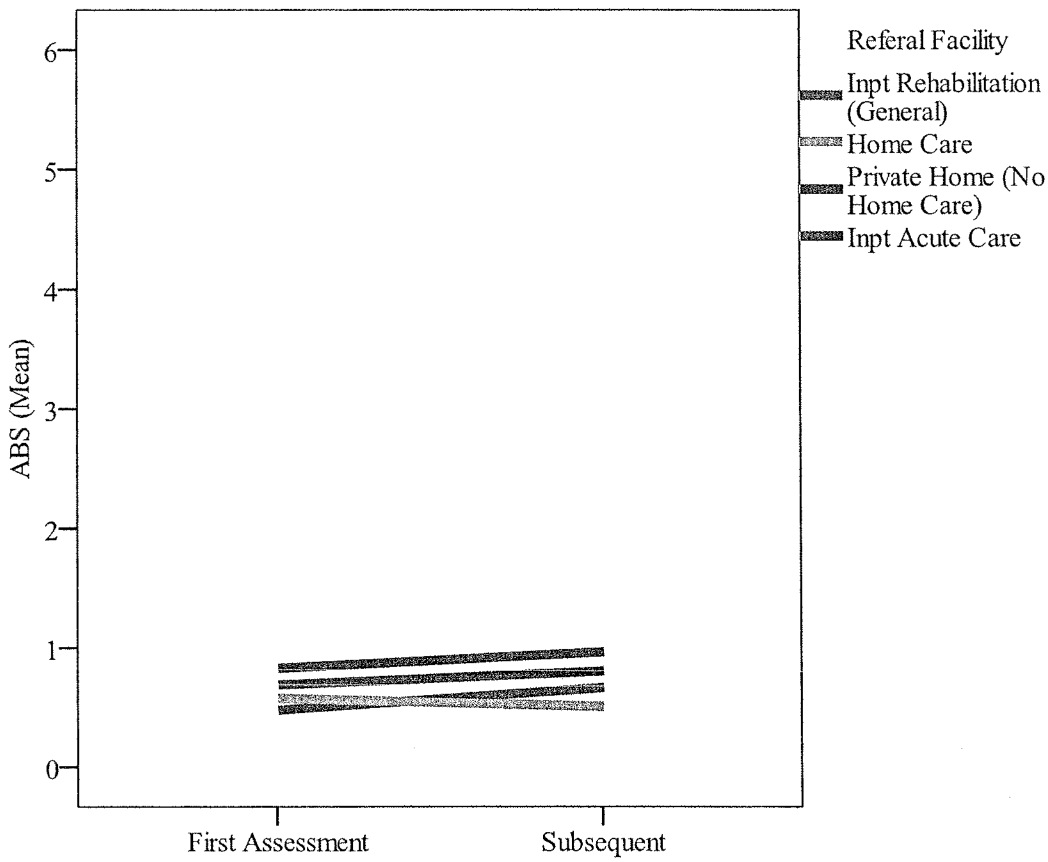
Figures

Figure 2. Average CPS scores between referral services over time.



Figures

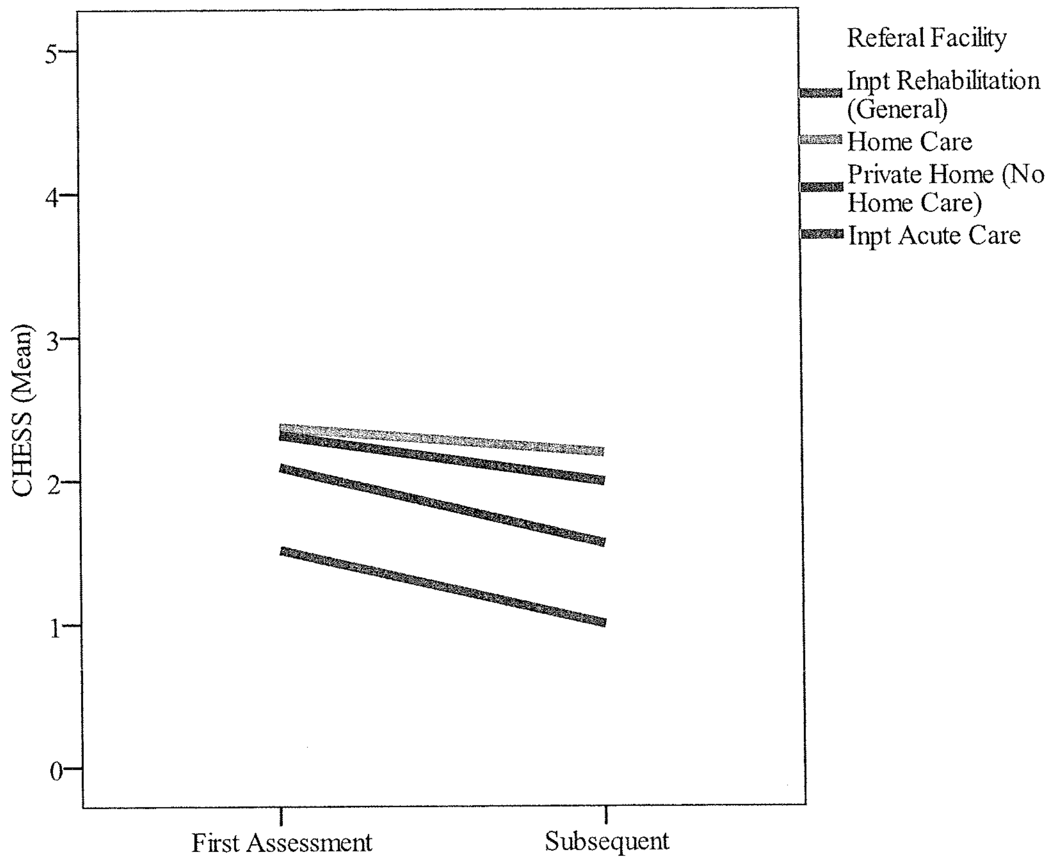
Figure 3. Average ABS scores between referral services over time.



Note. Given the restricted range of ABS scores, the range of the graph was adjusted from 12 to 6.

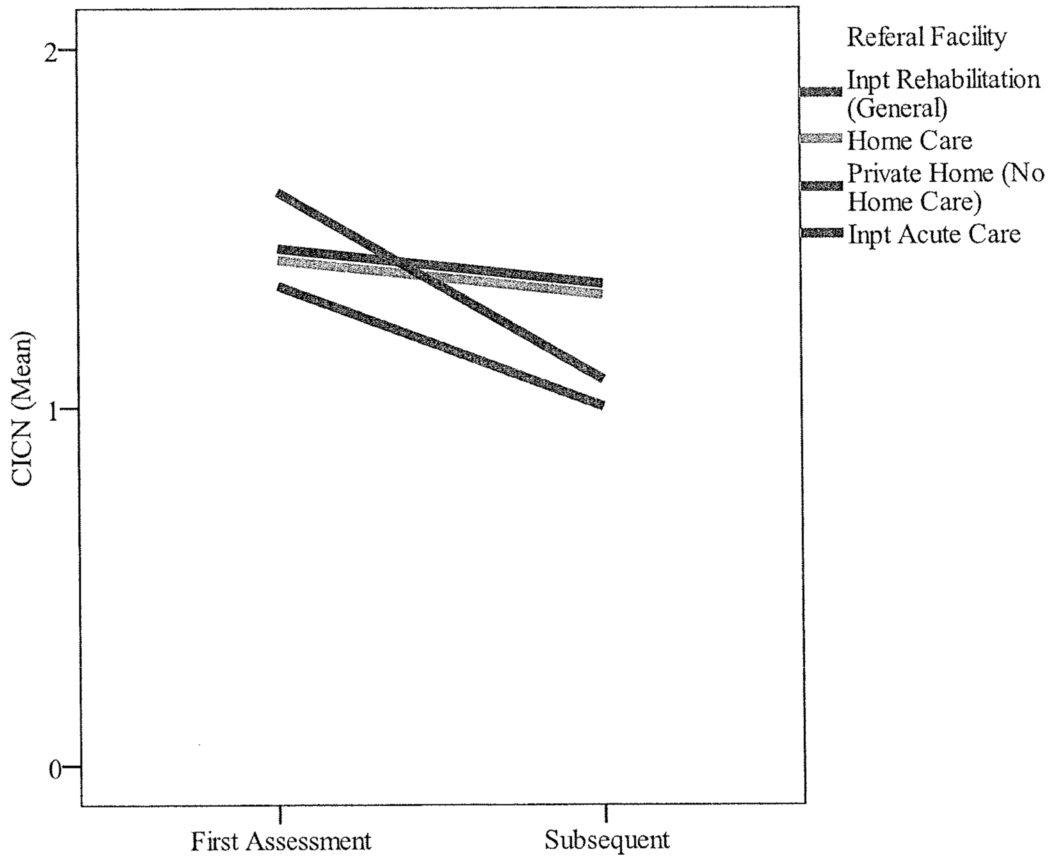
Figures

Figure 4. Average CHESS scores between referral services over time.



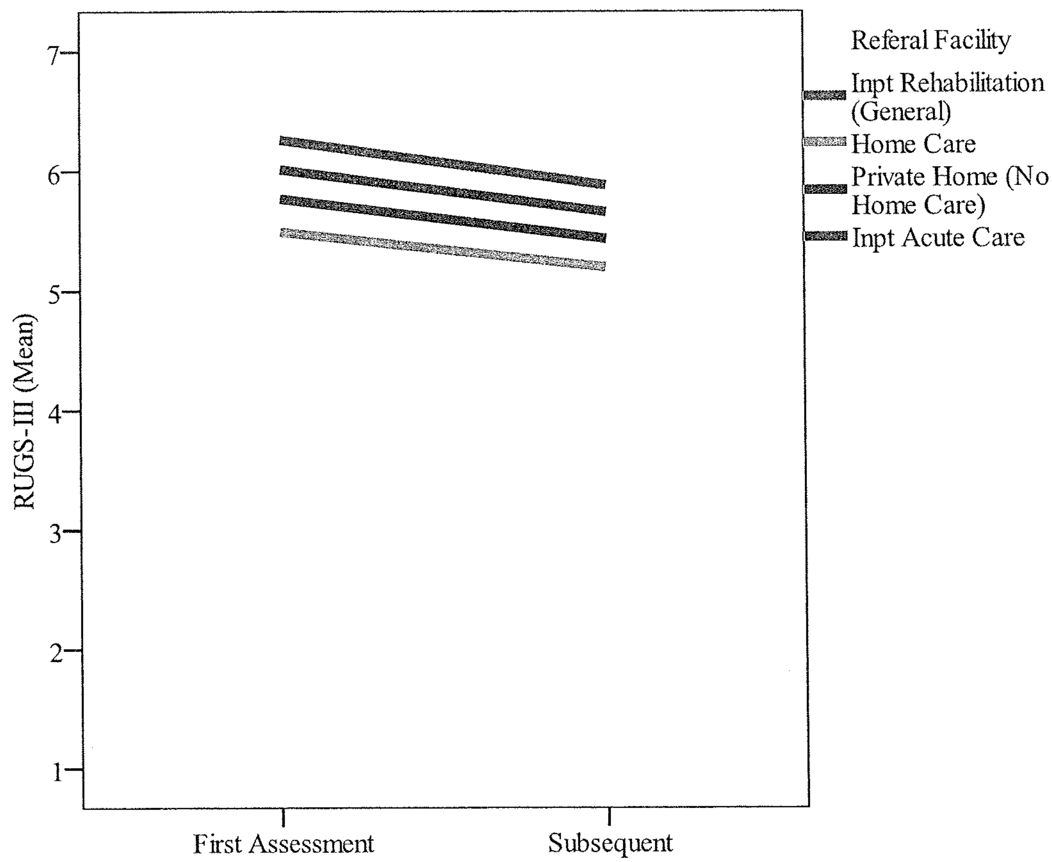
Figures

Figure 5. Average CICN scores between referral services over time.



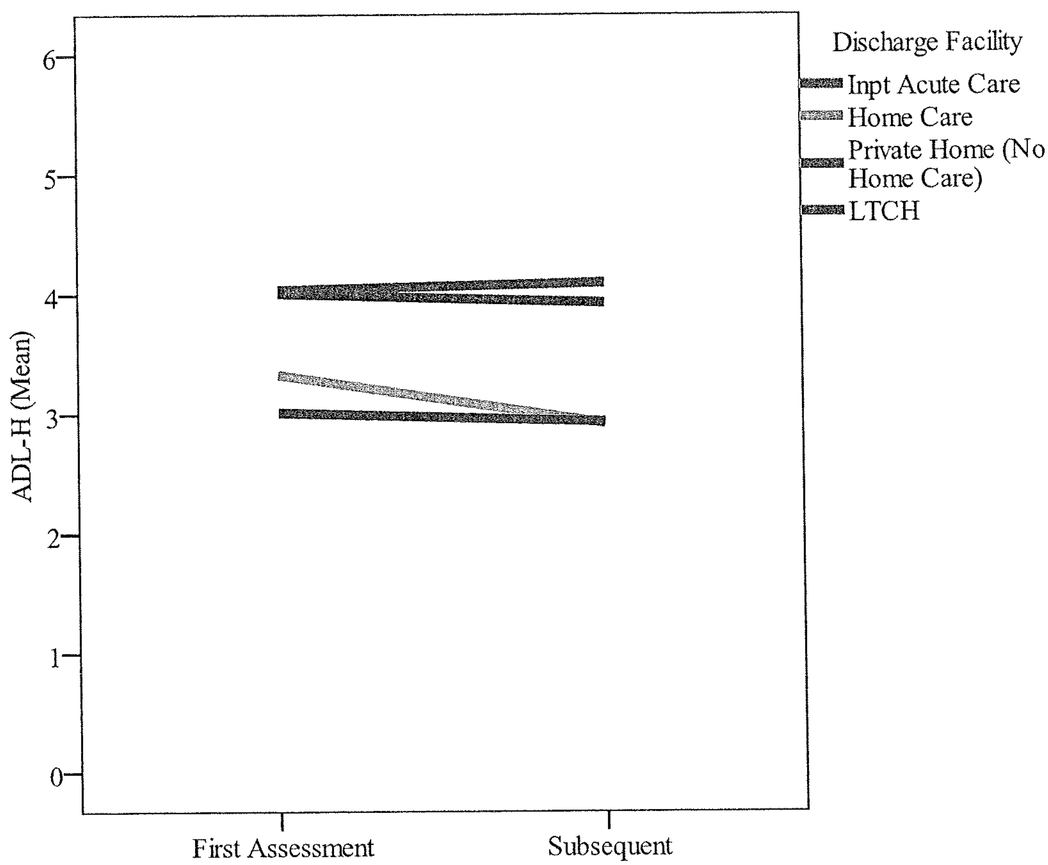
Figures

Figure 6. Average RUG-III scores between referral services over time.



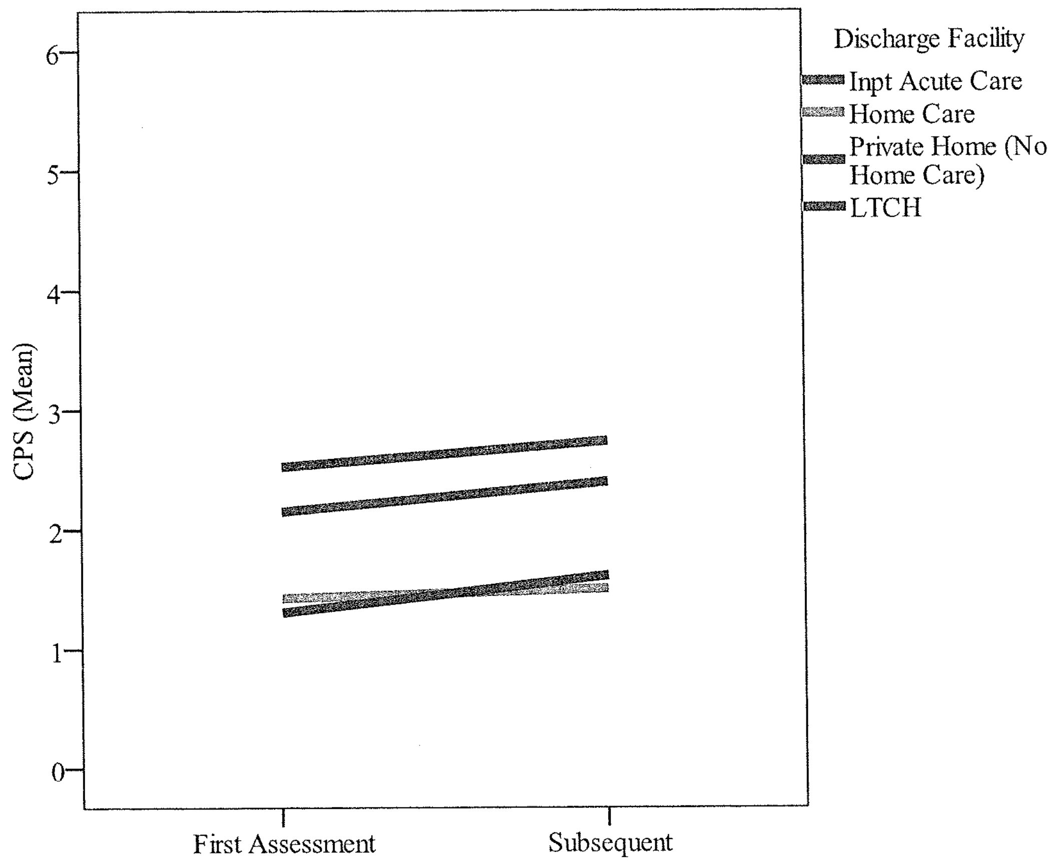
Figures

Figure 7. Average ADL-H scores between discharge services over time.



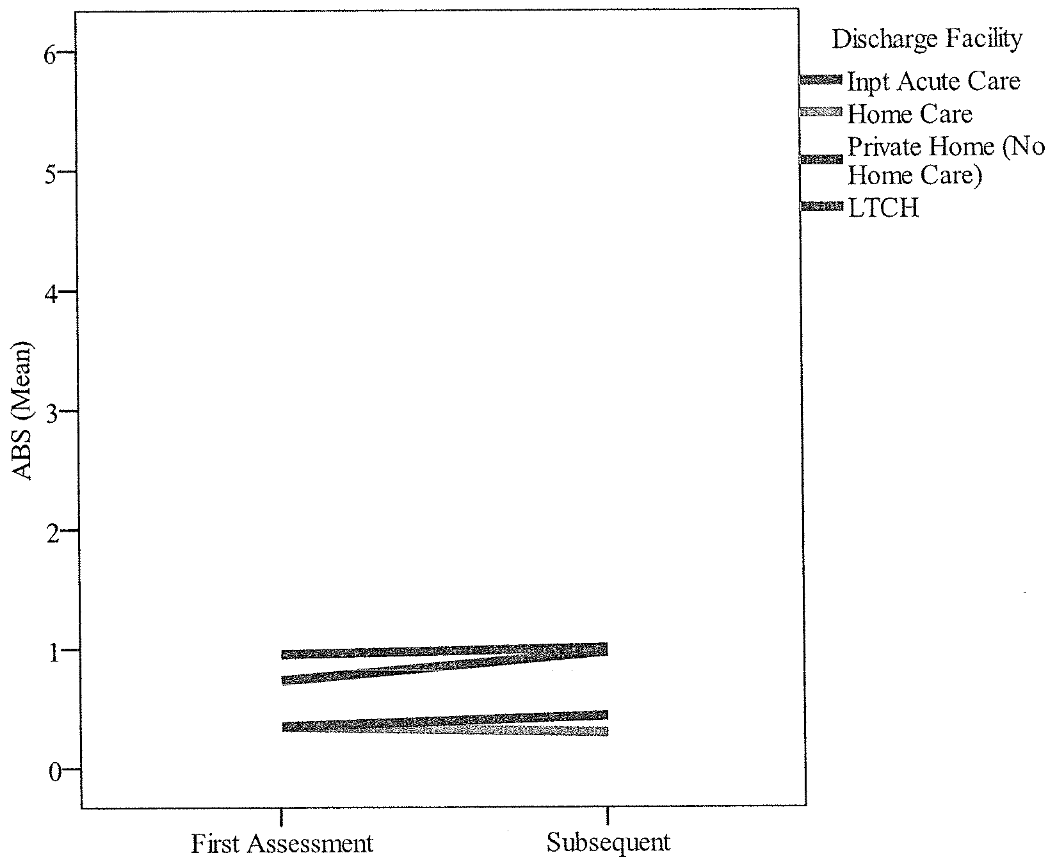
Figures

Figure 8. Average CPS scores between discharge services over time.



Figures

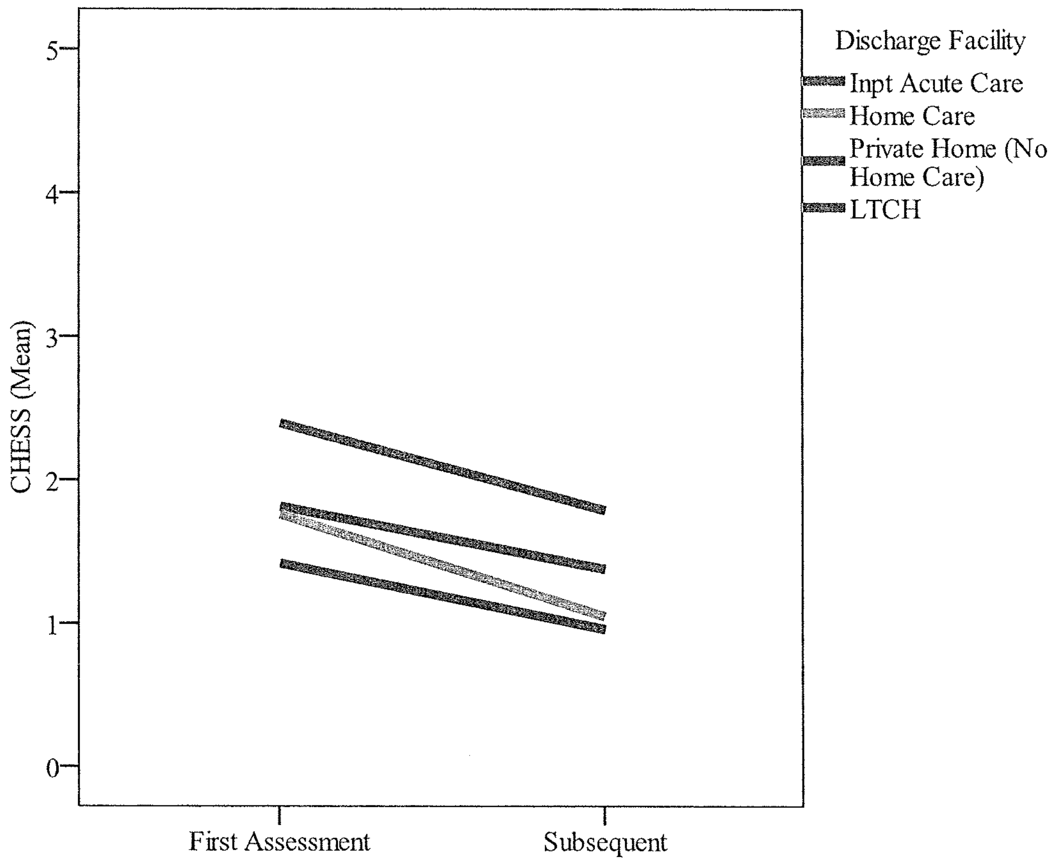
Figure 9. Average ABS scores between discharge services over time.



Note. Given the restricted range of ABS scores, the range of the graph was adjusted from 12 to 6.

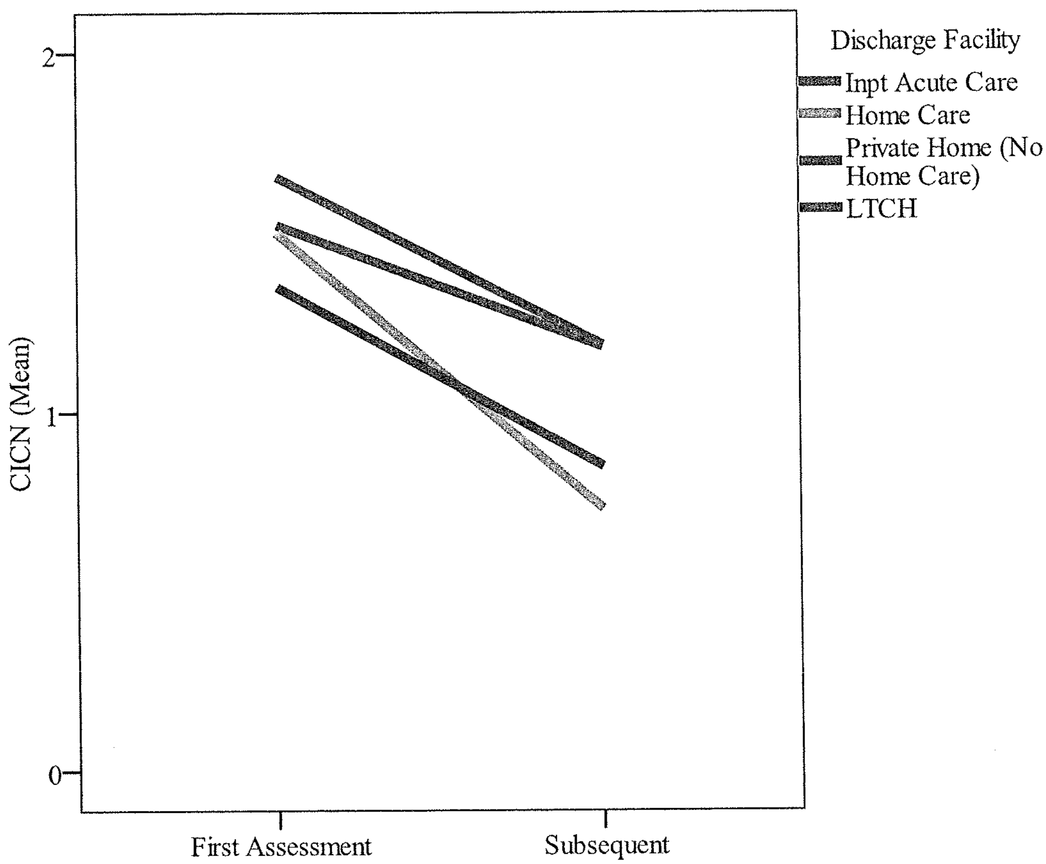
Figures

Figure 10. Average CHESS scores between discharge services over time.



Figures

Figure 11. Average CICN scores between discharge services over time.



Figures

Figure 12. Average RUG-III scores between discharge services over time.