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Patient-Related Characteristics Associated with Rehospitalization in Medicare Recipients with Heart Failure Receiving Telehomecare

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Abstract
Heart failure (HF) is the leading cause of rehospitalization in the United State. One potential way to reduce HF rehospitalizations is through the use of telehomecare, which is a remote monitoring intervention in home care settings. However, studies on telehomecare use conducted in the United States have demonstrated mixed results in reducing HF rehospitalizations. Little is known about risk factors for rehospitalization during a telehomecare episode. The aims of the study were to identify patient characteristics associated with all-cause rehospitalizations and patient characteristics associated with time-to-first rehospitalization within 60 days of the home health care episode. This is a non-experimental, cross-sectional secondary analysis of the Outcome Assessment Information Set dataset from Medicare recipients with HF provided with telehomecare. This study used multiple logistic regression, decision tree techniques and survival analysis methods. The main findings of this study were that results of a formal pain assessment and the ability to dress one's lower body safely were associated with rehospitalizations. In particular, subjects who were independent in dressing their lower body had a consistently higher risk of rehospitalization than functionally dependent groups. While the logistic regression model and survival analysis presented the associations between rehospitalization and single risk factors, the decision tree techniques presented the relative contributions of and interactions between risk factors for rehospitalization as a global picture, which may provide clinicians with a visual guide to targeting those patients most likely to benefit from telehomecare, or who may need additional interventions.

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PATIENT-RELATED CHARACTERISTICS ASSOCIATED WITH REHOSPITALIZATION IN MEDICARE RECIPIENTS WITH HEART FAILURE RECEIVING TELEHOMECARE

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Dedication

I dedicate this dissertation to my mother and Joyce Windham, who have never stopped believing in me and who continue to teach me about being a hard worker.

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ABSTRACT

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Kathryn H. Bowles

Heart failure (HF) is the leading cause of rehospitalization in the United State. One potential way to reduce HF rehospitalizations is through the use of telehomecare, which is a remote monitoring intervention in home care settings. However, studies on telehomecare use conducted in the United States have demonstrated mixed results in reducing HF rehospitalizations. Little is known about risk factors for rehospitalization during a telehomecare episode. The aims of the study were to identify patient characteristics associated with all-cause rehospitalizations and patient characteristics associated with time-to–first rehospitalization within 60 days of the home health care episode. This is a non-experimental, cross-sectional secondary analysis of the Outcome Assessment Information Set dataset from Medicare recipients with HF provided with telehomecare. This study used multiple logistic regression, decision tree techniques and survival analysis methods. The main findings of this study were that results of a formal pain assessment and the ability to dress one's lower body safely were associated with rehospitalizations. In particular, subjects who were independent in dressing their lower body had a consistently higher risk of rehospitalization than functionally dependent groups. While the logistic regression model and survival analysis presented the associations between rehospitalization and single risk factors, the decision tree techniques

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CHAPTER 1: INTRODUCTION AND OVERVIEW

Background of the Study

Heart failure (HF) is the leading cause of rehospitalizations to acute care settings (rehospitalization) among Medicare recipients including older adults (65 and older) and disabled younger people, such as people with End-Stage Renal Disease in the United States (U.S.) (Bui & Fonarow, 2012; Korves et al., 2012; Radhakrishnan & Jacelon, 2012; Rich, 2006; Rich et al., 1993; Schulman, Mark & Califf, 1998; Wade et al., 2011;Manning ; Jencks et al., 2009; Keenan,2008). HF rehospitalization creates a significant financial burden for patients, their family caregivers, and the public health system (McManus, 2004; Riggs, Madigan, & Fortinsky, 2011; Soran et al., 2010) and specifically accounts for nearly 17 percent of the total Medicare budget of 102.6 billion dollars (Jencks, 2009). Despite advanced medical and/or nursing interventions to reduce (re)hospitalizations in older adults with HF, 30-day rehospitalization rates have not improved over time (Hilleman, 2005; Manning, 2011).

HF is a complex and chronic condition (Benatar, Bondmass, Ghitelman & Avitall, 2003; Wolinsky, Smith, Stump, Overhage & Lubitz, 1997). Fluid overload is a common reason for rehospitalization, despite being preventable with daily weight monitoring and/or titrated diuretic use (Fredericks, Beanlands, Spalding, & Da Silva, 2010; Jurgens, Hoke, Byrnes, & Riegel, 2009; Madigan, 2008). Patients with HF exacerbations often tolerate worsening of symptoms for a few days and delay seeking timely medical care (Jurgens et al., 2009), precipitating acute care needs. HF exacerbations are largely avoidable by monitoring blood pressure, heart rate, pulse oximetry and/ or weight (Bui & Fonarow, 2012; Jurgens et al., 2009). Early detection of warning symptoms such as

weight gain or tachycardia along with preemptive action such as titrating diuretics, dietary changes or limited fluid intake can halt the exacerbation symptoms (Benatar et al., 2003; Wolinsky et al., 1997).

Older adults with HF are at particularly high risk for rehospitalization because they may experience a delayed response to early symptoms of HF exacerbation such as fatigue or weakness impeding recognition, and age-related changes in cognitive function (e.g., decreased sensory perception) resulting in impaired self-care or self-management skills (Bui & Fonarow, 2012; Jurgens et al., 2009; Riegel et al., 2010). In order to maintain optimal health status, older adults with HF require intense monitoring in the home care setting after hospital discharge (Hoyt & Bowling, 2001; Radhakrishnan & Jacelon, 2012). However, researchers may also need to pay attention to patients under age 65 because rehospitalization rates in those under age 65 increased by 15% from 2000 to 2010 whereas no changes were noted in those aged 65 and older according to the National Hospital Discharge Survey report(Hall, Levant, & DeFrances, 2012) . This sub-population was more likely to be discharged home than patients aged 65 and older (Hall, Levant, & DeFrances, 2012).

Home health care has been extensively used to bridge the gap between acute care settings and home, in order to alleviate some of patients' own responsibility for their care (Bui & Fonarow, 2012; Manning,2011). Among home health care patients, nearly 75 percent of them were admitted to home health care services after a hospitalization (Madigan, 2008). In particular, home health care may be cost-effective for HF patients because the savings of care per month for HF patients receiving homecare was $153 compared to the cost of inpatient care (Rich, 1995; Basic home care statistics, 2010).

Despite the use of home health care services, rehospitalizations continue to occur at an alarming rate in a recent home health study on HF patients, a 30-day rehospitalization rate of 26 percent was found (Madigan et al., 2012). According to Home Health Compare reports from the Center for Medicare and Medicaid Services (CMS), the home health care rehospitalization rate is 27 percent, resulting in nearly 918,000 home care patients experiencing a hospitalization over a one year period (Delta Health Technologies, DHT, 2012). In addition, two studies reported the same 30-day rehospitalization rate (nearly 20%) in Medicare recipients with HF including older adults and the disabled (Bueno et al., 2010; Jencks, Williams & Coleman, 2009). As part of efforts to reduce the rehospitalization rate and to prevent 30-day rehospitalizations homecare agencies are increasingly employing telehealth in home health care settings (telehomecare) for HF patients after a hospital discharge (National Association for Home care & Hospice , NAHC, 2013).

Telehealth is the use of electronic information and telecommunications technologies to support clinicians and patients at a distance (U.S.Department of Health and Human Services, USDHHS, 2013). Telehomecare (THC) offers remote monitoring via telehealth technology with biometric devices in the home, enabling the transmission of data related to blood pressure, heart rate, oxygen saturation and weight or glucose to telehealth nurses on a daily basis (Bowles & Baugh, 2007; Bowles, Riegel, Weiner, Glick, & Naylor, 2010; Dansky, Vasey, & Bowles, 2008; Gellis et al., 2012; Radhakrishnan & Jacelon, 2012; Demiris, 2004). THC patients take their vital signs and weights on a daily basis, and the data are saved in the main monitor and are electronically transmitted. The transmitted data and automatic color coded alerts (red and green) appear on the computer

screens of the THC nurses. The red alerts represent readings outside of programmed parameters, which are individualized for each patient. THC nurses set up the parameters based on the patients' baseline measures. They check on patients via telephone by asking questions on certain typical clinical topics of concern, such as symptoms, diet or medications. If a patient requires immediate care, the THC nurses inform the patient's primary care provider.

Every home health care agency has different THC equipment and systems, but in general the THC system provides home healthcare providers with data that allow them to quickly recognize early signs and symptoms of HF exacerbation and intervene (Bowles & Baugh, 2007; Bowles et al., 2010; Dansky et al., 2008; Gellis et al., 2012; Radhakrishnan & Jacelon, 2012). The goal of THC is to support patient self-management (Radhakrishnan & Jacelon, 2012) and serve as an early-warning system to home health care providers. Ideally, THC use would prevent avoidable rehospitalizations (Bowles, Holland, & Horowitz, 2009; Browning, Clark, Poff, & Todd, 2011).

Statement of the Problem

The HF population experiences a high number of rehospitalizations, which often occur within 60 days after hospital discharge (Jurgens et al., 2009; Miller & Missov, 2001; Moser, Doering & Chung, 2005). Reduction of rehospitalizations for patients in the HF population has been emphasized as a measure of quality of care (Jencks, Williams & Coleman, 2009). Although the Center for Medicare and Medicaid Services (CMS) is currently penalizing hospitals for excessive 30-day rehospitalization rates (Goodman, Fisher, & Chang, 2011), responsibility for these rehospitalizations rests with home health

care agencies as well as with the hospital from which the patient was discharged (Golbeck et al., 2011; Joynt, Orav, & Jha, 2011; Joynt & Jha, 2012).

Despite the efforts of home health care agencies to reduce rehospitalization rates among their patients, and to prevent 30-day rehospitalizations by using THC interventions, the majority of THC clinical trials conducted in the U.S. for the HF population have yielded mixed results (Madigan et al., 2013). The most recent THC studies for the HF population showed that there were no differences between patients who received THC and those who received usual care (Chaudhry et al., 2010; Madigan et al., 2013).

Similarly, when compared to usual care, some THC studies have also used time-to-first rehospitalizations as an outcome to measure (Bowles et al., 2011; DeBusk et al., 2004; Dunagan, et al., 2005; Goldberg, Piette, Walsh, Frank, Jaski & Smith, 2003; Madigan et al., 2013). However, most of the studies have shown that there are no significant differences in time-to-rehospitalization between those with THC and those with usual care (i.e. nursing visits) (Bowles et al., 2011; Goldberg et al., 2003; Madigan et al., 2013;Wakefield et al., 2008), except for one study showing that patients receiving THC had significantly longer time-to-rehospitalization (Bowles et al., 2009). These mixed and disappointing results may be the result of using THC for patients who are too vulnerable, or from inadequate targeting of those patients who would most fully benefit from the technology. Little is known about the association between THC HF patient characteristics and outcomes (Madigan et al., 2013). This study begins to fill this gap by identifying the characteristics of patients receiving THC associated with readmission and time-to-rehospitalization.

Purpose of the Study

The purpose of this study was to identify patient-related characteristics associated with all-cause rehospitalizations and patient-related characteristics associated with time-to–first rehospitalization within 60 days of the home health care episode in Medicare recipients with HF receiving THC. The following aims guided this analysis:

Study Aims

Aim 1. Identify patient-related characteristics associated with all-cause rehospitalization in Medicare recipients with HF receiving THC.

H1. Selected predisposing, enabling resources and need characteristics would predict the likelihood of all-cause rehospitalization in Medicare recipients with HF receiving THC.

Aim 2. Identify patient-related characteristics associated with time-to-first rehospitalization for all-causes in Medicare recipients with HF receiving THC.

H2. Selected predisposing, enabling resources and need characteristics would be associated with time-to-first rehospitalization in Medicare recipients with HF receiving THC.

Significance of the Study

The significance of this study lies in its ability to provide information on how THC can be more effectively targeted to reduce rehospitalizations. Using THC appropriately with Medicare recipients with HF in home health care may reduce the financial and clinical burden on patients, family caregivers, and the health care delivery system. Study findings may assist clinicians to better target the ideal candidates for

success with THC or consider possible alternatives such as more nursing visits for those who are less likely to receive benefits from THC alone. Improving how healthcare personnel select THC users will optimize the use of technology to alleviate the burden of rehospitalizations for patients, families, and the healthcare system. Study findings may also elucidate other modifiable factors where home health care nurses might provide additional interventions beyond THC.

Currently, there are no uniform THC guidelines for targeting appropriate patients due to a lack of evidence about the patient characteristics that maximize patient response to THC interventions (NAHC, 2013). This lack of evidence creates barriers to more widespread adoption of THC (Golbeck et al., 2011). Among older HF patients, targeting the individual patient characteristics that are predictive of response to THC in order to select the best suited patients may result in decreased rehospitalization rates and health care costs (NAHC, 2013). Thus, study findings may lead to a new screening tool or protocol for THC use. A screening tool or protocol can be used to guide home health care providers to implement the most appropriate interventions for the HF population (Gellis et al., 2012). It is critical for home health care agencies to identify patient characteristics affecting outcomes for better utilization of THC to improve outcomes as the use of THC is growing (DHT, 2012).

Definitions of the terms

Table 1.1 shows definitions of the terms of Medicare recipients, home health care services, self-care, self-management, rehospitalization, Outcome and ASsessment Information Set (OASIS) and patient-related characteristics.

Table 1.1.Definition of the terms

Key terms	Definition
Medicare recipients	People who are aged 65 and older, who are disabled with aged 65 and under, or

	who have End-Stage Renal Disease
Home Health Care Services	A formal, regulated program of care, providing a range of medical, therapeutic, and nonmedical services; delivered by a variety of health care professionals in the patient's home (Jones, Harris-Kojetin, & Valverde.R, 2012). Home health care episode is usually 60 days.
Self-care	1.The decision-making process patients use to maintain physiological stability (Bui & Fonarow, 2012; Riegel et al., 2009) 2.Self-care includes multiple components, such as adhering to medications, following diet and exercise recommendations, and actively monitoring for fluid overload (Bui & Fonarow, 2012)
Self-management	1.Self-adjustment of the treatment regimen (Bui & Fonarow, 2012) 2.A complex process: patients have to recognize a change in themselves (e.g., edema), evaluate they symptom, decide to take action, implement a treatment strategy (e.g., taking an extra diuretic dose), and evaluate the response to therapy (Bui & Fonarow, 2012; Riegel et al., 2009)
Rehospitalization	A subsequent hospitalization occurring during the 60 day home health care episode for patients discharged from the hospital setting to entering the home health care setting (Anderson, Clarke, Helms & Foreman, 2005).
Outcome and ASsessment Information Set (OASIS)	A mandatory and standardized assessment tool for home health care patients covered by Medicare (NAHC,2013)- see Appendix 1

CHAPTER 2: CONCEPTUAL FRAMEWORK AND REIEW OF THE LITRATURE

Introduction

In the past several decades, information and communication technology has gradually been incorporated into the health care delivery system. Particularly, home health care has adapted telehealth technology, also known as telehomecare (THC), for patients with chronic illnesses (Bowles & Baugh, 2007; Bowles et al., 2009; Frantz, 2004). The objectives of THC are to reduce health care utilization and associated health care costs by early recognition of HF exacerbation. However, randomized control trials of THC in the HF population conducted in the United States (U.S) have shown inconsistent results in terms of rehospitalization rates (Bowles et al., 2009; Chaudhry et al., 2010; DeBusk et al., 2004; Dunagan et al., 2005; Goldberg, Piette, Walsh, Frank, Jaski, Smith, Rodriguez, et al., 2003; Jerant, Azari, & Nesbitt, 2001; Madigan et al., 2013; Soran et al.,

2008; Wakefield et al., 2009). This may be because there are patients with HF who are not well suited for THC.

In addition, the patient characteristics associated with rehospitalization in HF patients receiving THC are relatively unknown (Madigan et al., 2013). Despite advanced THC technology, THC works well with some patients, but not for others. To provide optimized care to older adults with HF who have complicated medical conditions, home health care agencies need to target appropriate patients for THC by identifying patient-related characteristics associated with healthcare utilization outcomes in terms of rehospitalizations. The identification of patient-related characteristics associated with unsuccessful use of THC in terms of rehospitalizations would help home healthcare agencies, clinicians and researchers develop effective care plans and referrals to THC. In this chapter, I provide an overview of the conceptual framework that guides the study and review the literature on rehospitalization in Medicare recipients with HF, THC and potential risk factors.

Conceptual Framework

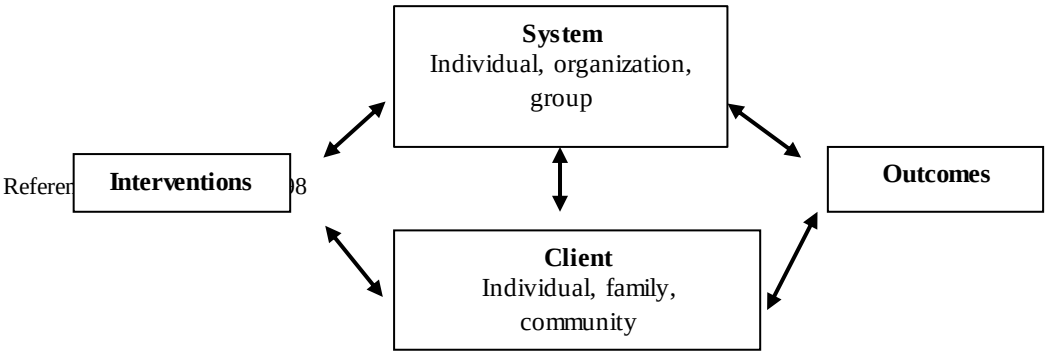
The conceptual framework which guides this study is influenced by the Quality Health Outcomes Model (QHOM) and the Initial Behavioral Model (IBM) (1960s). The structure of the QHOM was adopted to explain the relationship between the concepts as a primary structure: client, intervention, system and outcomes (see Figure 2.1). The three components (predisposing, enabling resources and need characteristics) from the IBM were adopted to organize client (patient) characteristics (see Figure 2.2). Thus, the conceptual framework for this study was developed by triangulating the QHOM and the

IBM to guide the development of a predictive model of patient-related characteristics associated with rehospitalization and associated with time-to-first rehospitalization.

Quality Health Outcomes Model (QHOM).

The QHOM (see Figure 2.1) was introduced at American Academy of Nursing Expert Panel on Quality Health Care and emphasizes bi-directional relationships between the concepts connecting interventions and outcomes (Mitchell, Ferketich & Jennings, 1998). It posits that the effects of interventions on outcomes are mediated by client and system characteristics (Mitchell et al., 1998).

Figure 2.1. Quality Health Outcomes Model



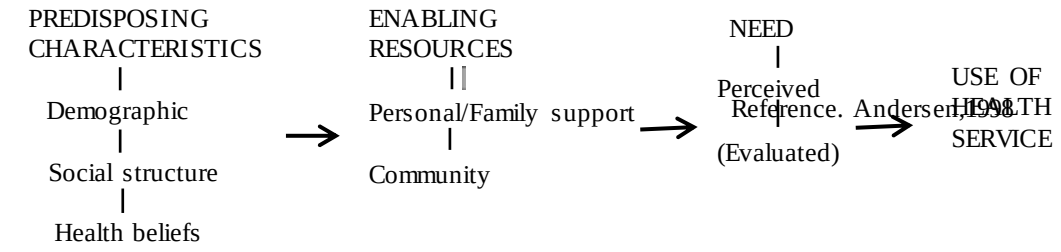
Referen 8

Initial Behavioral Model.

This study uses the IBM by Andersen to organize the selection of the variables from the study dataset of start of care assessments of home care patients with HF and group them into three components: predisposing, enabling resources and need characteristics. Andersen, a medical sociologist and health services researcher, first designed the model in the 1960s to explain the relationship between patient and environmental factors and the use of health care services (Babitsch, Gohl & von Lengerke, 2012). As shown in Figure

2.2, the model predicts that there are three groups of characteristics which influence the use of health care services (Andersen, 1995). His model explains the causal ordering of each component influencing the use of health services.

Figure 2.2. The Initial Behavioral Model (1960s)



Reference. Andersen, 1968.

Predisposing characteristics are defined as characteristics that are inherently personal and relatively unchangeable (Andersen, 1995; Fortinsky, Madigan, Sheehan, Tullai-McGuinness & Fenster, 2006; Riggs et al.,2011). They include (a) demographic characteristics, such as age and gender,(b) social structure characteristics, such as education, occupation, and race/ethnicity and (c) health beliefs, including people's perception attitudes, values, and knowledge about health and health services (Andersen, 1995; Fortinsky et al., 2006) .

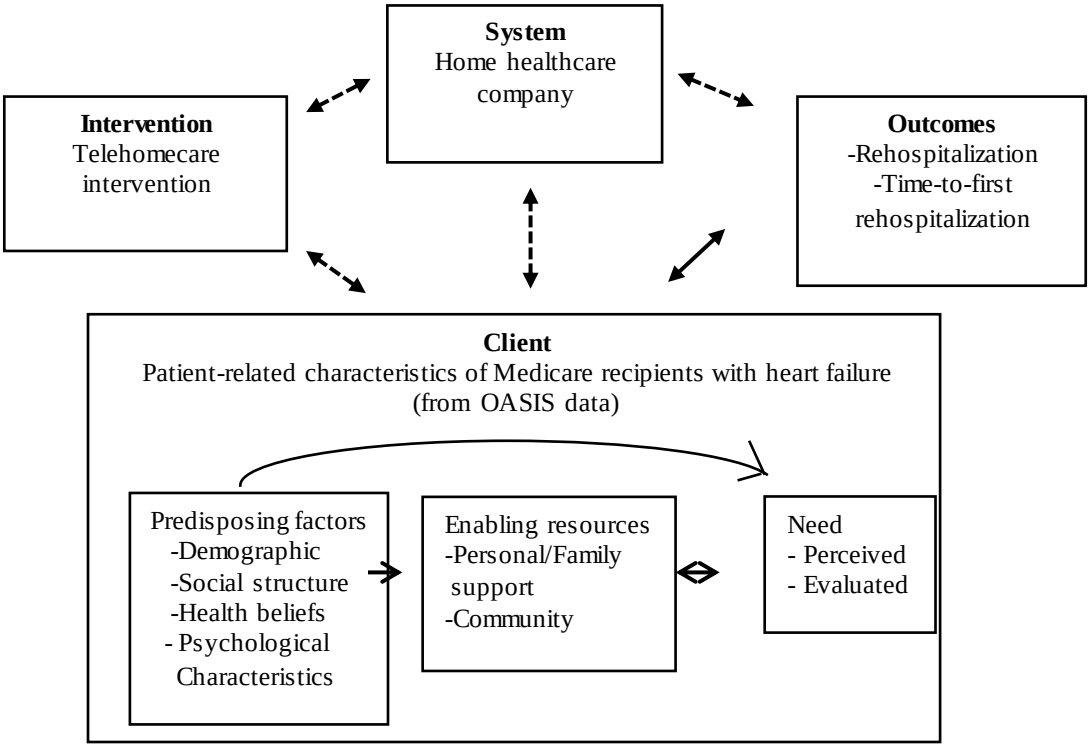
Enabling resources are defined as those characteristics which influence a person's ability to procure health care (Andersen, 1995; Fortinsky et al., 2006; Riggs et al, 2011). They include (a) personal and family factors, such as health insurance, income, health care costs, and family support, (b) community or organizational characteristics such as the availability of a regular source of health care, the disposition of that source, transportation, travel and waiting time (Andersen, 1995; Fortinsky et al., 2006).

Need characteristics are defined as the patients' requirements for healthcare based on their functional and health status, specifically disease-related characteristics (Andersen, 1995; Fortinsky et al., 2006). They include (a) perceived need based on the patient's view of their own functional and health status, and experience with illness symptoms, pain and concerns about their health and (b) evaluated need based on the assessments of home health care providers about the patient's health status and their need for medical attention (Andersen, 1995; Fortinsky et al., 2006; Riggs et al., 2011). Evaluated need varies with the changing of treatment or medical care (Andersen, 1995; Fortinsky et al., 2006).

Triangulated Conceptual Framework

The triangulated conceptual framework focuses on the relationship between patient-related characteristics of Medicare recipients with HF who received THC (client) and the outcomes: rehospitalizations and time-to-first rehospitalization (see Figure 1.3). As illustrated in Figure 2.3, in this study, the home healthcare company represents the system concept; THC represents the intervention; Medicare recipients with HF represent the client; and the outcomes are rehospitalization and time-to-first rehospitalization. The characteristics of Medicare recipients with HF influence outcomes and the use of interventions. This indicates that predisposing, enabling and need characteristics from the study dataset related to the client may influence variation in outcomes as the triangulated conceptual framework looks directly at the relationship between clients and outcomes; that is, the associations between the characteristics of THC Medicare recipients with HF and rehospitalizations. Thus, the major relationship that this study was investigating was between clients and outcomes.

Figure 2.3. Triangulated Conceptual Framework from the Quality Health Outcomes Model and the Initial Behavioral Model



For this study, predisposing characteristics include (a) the demographic characteristics of age and gender, (b) the social structure characteristics of race/ethnicity, (c) the health beliefs characteristics: none and (d) the psychosocial-cognitive functioning characteristics, recent confusion, anxiety and depression screening. Enabling resources include (a) the personal/family characteristics of Medicare and Medicaid eligibility and patient living situation (b)the home care community or organizational factors including interventions received such as multi-factor fall risk assessment ,drug regimen review, medication follow-up, medication intervention, patient/caregiver high risk drug education and interval between the referral and first visit. Need characteristics include (a) perceived need characteristics of dyspnea interfering with activity, urinary incontinence or urinary catheter presence, grooming, dressing upper body, dressing lower body,

bathing, toilet transferring, ambulation/locomotion, feeding or eating, prior functioning activities of daily living (ADL)/instrumental activities of daily living (IADL) and ability to use telephone (b) evaluated need characteristics of management of oral medications, risk for hospitalization, overall status and risk factors affecting current health status and/or outcome.

The triangulated conceptual framework for this study is a combination of the QHOM and the IMB. The IBM was not wholly suited to this study because it focuses on measuring disproportionate access to health care services at the family level, while this study was examining patient-related characteristics associated with rehospitalizations at the patient level. Furthermore, the IBM does not explain the impact of an intervention. Although THC is not directly measured in this study, THC is an important concept in the conceptual framework because this study examined the patient characteristics associated with rehospitalizations after THC is implemented. However, the IBM was still useful for this study because it guides the selection of the independent variables from the patient assessment in the study dataset, organizing them into three components (predisposing, enabling resources and need characteristics) to examine their association with healthcare utilization outcomes. Thus, I modified the IBM in that the original IBM presents a unidirectional relationship among all three components while I suggest that some need characteristics may influence enabling resources, and some predisposing characteristics may directly influence need characteristics. For example, a patient who has impaired cognitive function (predisposing) may be more likely to be dependent in functional status (need).

For this study, rehospitalization is defined as the event in which patients, who are admitted to home health care within 14 days from a hospital discharge, require another hospitalization during the 60 day home health care episode. Rehospitalization differs from hospitalization because hospitalization occurs without a previous hospital stay (Manning, 2011). Reduction of rehospitalizations for HF patients in home health care has been emphasized as a measure of patient outcomes and quality of care (Chaudhry et al., 2010; Rosati et al., 2003). Time-to-first rehospitalization is defined as the number of days from the index hospitalization discharge to the first rehospitalization within 60 days. Overall, the triangulated conceptual framework from the QHOM and the IBM explains how the outcomes depend on certain patient-related characteristics from the study dataset and guides the analysis of the associations between characteristics of Medicare recipients with HF on THC and healthcare utilization outcomes.

Review of the Literature

Heart Failure

HF affects nearly six million people in the U.S. (Blecker, Paul, Taksler, Ogedegbe, & Katz, 2013; Lloyd-Jones et al., 2010; Retrum et al., 2013). According to the American Heart Association (AHA), HF is a chronic condition that causes poor circulation from weakened muscles in the heart resulting in fatigue and shortness of breath (AHA, 2013). HF is progressive and life-limiting, but stability can be achieved with medication adherence and close monitoring of the signs and symptoms of HF exacerbation (Gardetto & Carroll, 2007). Signs and symptoms of HF exacerbation include dyspnea, persistent dry coughing or wheezing, edema in the lower extremities, sudden weight gain (3-4lbs in

1 to 2 days or 2lbs overnight), loss of appetite, confusion, paroxysmal nocturnal dyspnea, fatigue or arrhythmia (AHA, 2013; Gardetto & Carroll, 2007).

The majority of HF patients also have multiple co-morbidities and multiple medications. Coronary artery disease, past myocardial infarction, hypertension, severe lung disease, diabetes and sleep apnea often contribute to the development and worsening of HF (AHA, 2013). Common HF medications include Angiotensin-Converting Enzyme (ACE) inhibitors, beta blockers, calcium channel blockers, diuretics, antiplatelet agents, vasodilators, anticoagulants, digitalis preparations and statins (AHA, 2013). Self-management for HF patients after hospital discharge is complex, and older adults with HF need appropriate interventions for effective continuous self-management to prevent avoidable rehospitalizations (Bui & Fonarow, 2012; Riegel et al., 2009).

Self-management involves coping with multiple symptoms of HF including fluid overload, decreased physical activity and decreased cognitive function as well as the ability to recognize the need for changes in treatment strategy (Riegel, Dickson, Goldberg, & Deatrick, 2007; Riegel, Lee, Dickson & Carlson, 2009). Due to the complex nature of the disease, daily monitoring may be necessary for HF patients to improve their self-management skills. In particular, older adults with HF frequently need assistance with daily monitoring in the home to achieve success in the transitional period after hospital discharge to prevent rehospitalization (Naylor et al., 2004).

Telehomecare (THC) Studies for Heart Failure Patients

Telehomecare. Increasingly, home healthcare agencies are using THC to augment the work of the traditional homecare nurses (Bui & Fonarow, 2012). THC has emerged as a potential solution to manage HF patients in the community to prevent

rehospitalization (Browning et al., 2011). Although there are no official reports on the use or the cost effectiveness of THC from governmental organizations, Fazzi et al. found that the use of THC increased over a couple of years (2004 to 2005) from 17% to 20% (Fazzi, Ashe & Doak, 2007). According to the BlackBerry State of the Industry Report in 2009, nearly 23% of home health care agencies implemented THC with budgets of $500,000 (BlackBerry State of the Industry Report, 2009; DHT, 2012). THC is attractive to home health care agencies due to its promise of reducing rehospitalization rates and nursing visits to lower medical costs (Gordon, 2011). The National Association for Home Care & Hospice (NAHC) 2012 Legislative Priorities recognized that THC is a vital component of home health care for patients with chronic illnesses such as HF (NAHC, 2013). However, THC is not reimbursed under the Medicare program, although 13 state Medicaid programs now provide reimbursement of THC (NAHC, 2013) .

THC is a growing technology and is costly, but it could be cost effective compared to the costs of rehospitalization (Fazzi, Ashe & Doak, 2007). The cost of THC ranges from $5,000 to more than $15,000 for a computer base station including video-conferencing equipment, an Internet modem, and electronic charting software (Fazzi et al., 2007) in addition to the nursing time to monitor, install and follow-up. In the meantime, the costs of one time hospitalization for HF in older adults increased from $7,000 in the 1990s to $18,086 over the last two decades (Duong, 1997; Titler, Jensen, Dochterman, Xie, Kanak, Reed, Sheer, 2008; Wang, Zhang, Ayala, Wall & Fang, 2010; Weinstraub et al., 2003). If a patient experiences repeated hospitalizations, costs of repeated hospitalization would be higher than costs of THC. Rehospitalization costs currently account for about 20 percent of the Medicare budget (i.e. $17.4 billion of

$102.6 billion) (Jencks et al., 2009). Estimated Medicare expenditures for potentially avoidable rehospitalizations were approximately $12 billion per year (Medicare Payment Advisory Commision, MedPAC, 2009) . In an era of ever-increasing healthcare costs, reducing rehospitalizations has been targeted as a way to contain costs (Jencks et al., 2009; Korves et al., 2012; Madigan et al., 2012). The most recent THC study suggests that the cost effectiveness and long term impact of THC in Medicare recipients needs to be investigated (Madigan et al., 2013).

Health care utilization outcomes in randomized control trials of telehomecare vs usual care. Multiple randomized control trials of THC in the HF population have been conducted in the U.S. since 1999 (Dansky et al., 2008). The most recent study found no statistical differences between the patients receiving THC and usual care (no THC involved) in all-cause rehospitalizations and time-to rehospitalization (Madigan et al., 2013). In some THC literature, the intervention group is defined as those participants who received THC; the control group is defined as those participants who received usual home health care service (Madigan et al., 2013;Bowles et al.,2011). To date, the widespread optimism that greeted the utilization of THC for older adults with HF as a way to improve outcomes has been short-lived.

In the randomized control trials of THC in the HF population to date, five major categories of outcome measures have been used: health care utilization, quality of life (QOL), length of hospital stay (LOS), cost-savings, and mortality. Health care utilization includes all-cause rehospitalization or hospitalization, HF-related rehospitalization or hospitalization, all-cause or HF-related ED use, the number of rehospitalizations or

hospitalizations, and time-to-rehospitalization for HF or all-cause. The most common outcome for THC studies is rehospitalization or hospitalization.

Among studies of the impact of THC on rehospitalizations or hospitalizations conducted in the U.S., only one study reported a statistically significant reduction in rehospitalizations in the intervention group at six months (DeBusk et al, 2004). However, this same study failed to show a significant reduction at12 months (Dunagan et al., 2005). Two studies reported that there was a significant difference between the control and the intervention group in the rate of hospitalization (Dansky et al., 2008; Dansky & Vasey, 2009). But again, long-term effects were lacking: the Dansky team (2008) reported significant reduction of hospitalization at two months but no differences at four months.

Nine studies assessed time-to rehospitalization or time-to-first rehospitalization, or time-to-HF rehospitalization or time-to hospitalization (Bowles, et al., 2009a; Browning, et al., 2011; Chaudhry et al., 2010; DeBusk et al., 2004; Dunagan,et al., 2005; Goldberg, Piette, Walsh, Frank, Jaski, Smith, Rodriguez et al., 2003; Madigan et al., 2013; Wakefield, et al., 2008; Weintraub, et al., 2010). Seven (77%) out of the nine studies showed that there were no statistically significant differences between the control group and the interventional group for time-to rehospitalization or time-to-first rehospitalization or time-to-HF rehospitalization or time-to hospitalization (Bowles et al., 2011; Boyne, Vrijhoef, Wit, & Gorgels, 2011; Chaudhry et al., 2010; DeBusk et al., 2004; Goldberg, Piette, Walsh, Frank, Jaski, Smith, Rodriguez et al., 2003; Madigan et al., 2013; Wakefield et al., 2009; Weintraub et al., 2010). One study demonstrated significant improvements in the group of patients that received telephone support, but not in the group of patients that received home telemonitoring (Bowles, Holland & Horowitz, 2009).

The Dunagan team (2005) found that the intervention group had a longer time-to first HF hospitalization at six months and twelve months than the control group.

Research to date on patient outcomes in relation to the use of THC has shown that rehospitalization or hospitalization is the most common outcome measure in THC randomized control trials studies. Overall, the majority of THC studies conducted in the U.S do not demonstrate that THC improves overall health care utilization outcome measures. This may be due to reasons such as lack of power to detect significance and lack of a standardized THC protocol as well as variation in the type of THC equipment used, intervention design, study length, severity of subjects' HF (i.e. New York Heart Association class) and other participant characteristics.

Patient characteristics. Examination of the distribution of patient characteristics across the twenty-three reviewed THC studies do not illuminate trends related to better or worse healthcare utilization outcomes. To learn more about how THC effects vary by age, gender, race or clinical characteristics, it is recommended that investigators perform subgroup analyses on the outcomes among the intervention groups to clarify any different responses based on these variables (Weintraub et al., 2010). Perhaps larger study populations and more diverse study participants may be needed for rigorous subgroup analyses in order to understand how best to use THC interventions for improved patient outcomes.

The Dansky team (2008) indicated that studies with small sample sizes make it difficult to show the effectiveness of the THC intervention. Bowles and colleagues (2011) experienced a higher dropout rate in the THC group than the control group, often due to rejection of the equipment. They suggested involving the physician and family members

to support the use of this technology. According to Bowles et al.'s systematic review (2007), one pilot study indicated that common reasons for intervention dropout were severe illness, lack of interest, or lack of trust in the equipment (Bowles & Baugh, 2007; Finkelstein, Speedie & Potthoff, 2006)

One potential way to more effectively implement THC in the HF population is to target those individuals most likely to benefit from THC (Bui & Fonarow, 2012). To date the lack of specific data on patient-related characteristics makes it difficult for home health care agencies to target appropriate services to reduce the likelihood of an adverse event, such as avoidable rehospitalization (Madigan., Tullai-McGuinness & Fortinsky, 2003).

Heart Failure Risk Factors of Rehospitalization in Home Health Care Settings.

Among HF patients receiving homecare services, the most common patient characteristics associated with rehospitalizations/hospitalizations are age (Rosati & Huang, 2007;Rosati et al., 2003), gender (Rosati et al., 2003), race (Rosati et al., 2003), Medicare and Medicaid eligibility (Rosati & Huang, 2007;Rosati et al., 2003), source of admission to home care (Rosati et al., 2003), functional status (Rosati et al., 2003), severity of dyspnea (Rosati et al., 2003), and living alone (Rosati & Huang, 2007;Rosati et al., 2003). Other factors such as number of medications, prior hospitalizations (Hoskins et al., 1999; Rosati et al., 2003) and chronic diseases are also associated with rehospitalizations (Rosati et al., 2003) .

Unfortunately, study findings on the association between HF patient characteristics in home health care settings and healthcare utilization use have been inconsistent. For example, one home health care study found that age younger than 85

years and female gender were risk factors for rehospitalization (Madigan., et al., 2012) while another study found that age and gender did not affect rehospitalization among older adults (Hoskins, Walton-Moss, Clark, Schroeder, & Thiel, 1999). In a third study, clinical factors such as urinary incontinence, urinary catheters, respiratory symptoms, dyspnea and depression were strongly associated with rehospitalization (Rosati & Huang, 2007). Although home health care studies identifying rehospitalization risk factors have not shown directional results, functional status has been identified in multiple studies as a factor influencing rehospitalizations (Fortinsky et al., 2006; Rosati & Huang, 2007; Rosati et al., 2003). However, one study reported that bathing and eating activities daily of living (ADL) items were not risk factors for rehospitalizations among older adults with HF (Hoskins et al., 1999).

To identify patient characteristics associated with rehospitalizations in this study, the following items from previous studies of home health care patients using older versions of the Outcome ASsessment Information Set (OASIS), the dataset used in this study, were considered: age, gender, race, living alone, prior hospitalization during the past 14 days, risk for hospitalization, symptoms in heart failure patients, heart failure follow-up, cognitive impairment, confusion and anxiety within the last 14 days, depression, medication follow-up and management of oral medications, and needing assistance with activities of daily living (Bowles &Carter, 2003; Fortinsky et al., 2006; Madigan et al., 2012; Rosati & Huang, 2007; Rosati et al., 2003) . Evidence of HF patient characteristics associated with rehospitalizations in home care settings has been inconsistent. Thus, most of the OASIS items from a recent home care study that sought to determine factors associated with 30-day rehospitalization in a large sample of home

health care patients with HF (Madigan et al., 2012) have been adopted for this study as independent variables potentially associated with rehospitalizations and time-to-first rehospitalization.

Madigan et al (2012) demonstrated that the following variables were associated with a higher likelihood of rehospitalization in HF patients: (1) predisposing factors: 85 years old and younger, urinary continence, better cognitive functioning and female gender; (2) enabling factors: independence or some dependence on oral medication management; and (3) need factors: dyspnea interfering with activity. These patient characteristics have been extracted from the OASIS data to match the variables for this study. Furthermore, the following variables were associated with lower likelihood of rehospitalization: (1) predisposing factors: none; (2) enabling factors: only covered by Medicare compared to dually eligible patients; and (3) need factors: lower levels of dyspnea compared to dyspnea at rest, and independence or some dependence of ADL/Instrumental ADL (IADL) compared to total dependence (Madigan et al., 2012).

Madigan et al. (2012) also examined time-to-rehospitalization and found that the following variables were associated with shorter time- to- rehospitalization: (1) predisposing factors: 85 years old and younger, urinary continence, better cognitive functioning and male gender (2) enabling factors: independence or some dependence on oral medication management and (3) need factors: dyspnea interfering with activity (Madigan et al., 2012). These patient characteristics were included as independent variables for this study. The following variables are associated with longer time- to-rehospitalization: (1) predisposing factors: none; (2) enabling factors: only covered by Medicare compared to dually eligible patients; and (3) need factors: lower levels of

dyspnea compared to dyspnea at rest and independence or some dependence for ADL/IADL compared to total dependence (Madigan et al., 2012).

Heart Failure Patient Characteristics Associated with Rehospitalizations in Telehomecare.

To date, there is a dearth of evidence on whether the above described characteristics are predictors or risk factors of hospitalization among patients receiving THC. For example, living alone was identified as a predictor of rehospitalization in HF patients receiving home healthcare services without THC (Bui & Fonarow, 2012; Madigan, Tullai-McGuinness & Fortinsky, 2003), but living alone was not found to be a risk factor for rehospitalization in HF patients receiving THC (Radhakrishnan, 2011; Vallina, 2009) . Only two previous studies specifically examined risk factors for rehospitalization in THC patients (Radhakrishnan, 2011; Vallina, 2009). One study did not find any risk factors for rehospitalization (Vallina, 2009). The other study found the following risk factors: severe dyspnea, number of medications, and type of prescribed cardiac medications (Radhakrishnan, 2011). Those two studies evaluated risk factors for rehospitalization among HF patients on THC using version B of the OASIS dataset (Radhakrishnan, 2011; Vallina, 2009).

No studies have used the latest version of the dataset, the OASIS-C, released in 2010. This study may fill that gap by using OASIS-C data to identify HF patient-related characteristics associated with rehospitalization while receiving THC. This study included new items from the OASIS-C, including the following items related to medication management: medication follow-up, medication intervention and patient/caregiver high risk drug education. Examining patient-related characteristics

associated with rehospitalization specifically among a cohort of THC patients will provide a better understanding of the characteristics of patients who are most appropriate for the use of THC.

Rehospitalizations in Medicare Recipients

Rehospitalizations in Medicare recipients occur frequently and contribute to increased Medicare expenditures. As the number of Medicare recipients rapidly grows, rehospitalization costs are becoming an increasingly alarming concern (Jencks et al., 2009; Stone 2010). Nearly 20 percent of 11.9 million Medicare recipients in 2003 and 2004 experienced at least one rehospitalization (Jencks et al., 2009). Despite efforts to reduce rehospitalization, the Medicare Payment Advisory Commission (MedPAC)'s 2005 report showed similar rehospitalization rates as in 2003 and 2004 (Jencks et al., 2009; MedPAC, 2007).

In 2000 and 2010 data from the National Hospital Discharge Survey, nearly 1 million HF patients experienced hospitalizations (Hall, Levant, & DeFrances, 2012). The overall range of hospitalization rates for those HF patients 65 years of age or older is between 71% and 76% annually, figures which did not significantly change over a 10 year period (Hall, Levant, & DeFrances, 2012). In 2012, the 30-day rehospitalization rate for patients with HF became an indicator-of-quality measure as identified in the Reporting Hospital Quality Data for Annual Payment Update program from the Centers for Medicare and Medicaid Services (CMS) (USDHHS, 2012b).

To reduce rehospitalization rates, CMS began imposing a financial penalty on hospitals for rehospitalizations (Goodman et al., 2011). Currently, the penalty is two percent of the total Medicare bill per hospital per year starting in 2013 to 2015, but will

increase to three percent for hospitals with an excessive number of rehospitalized patients (Goodman et al., 2011). Although penalties are not the solution to reduce rehospitalizations, they have raised awareness of the patterns and reasons for avoidable rehospitalizations across the healthcare system.

The Patient Protection and Affordable Care Act (PPACA) of 2010 includes provisions to apply pressure to reduce avoidable rehospitalizations by reducing Medicare payments to acute-care facilities with higher rates of rehospitalization than national averages (Stone, 2010). HF has been selected as one of the primary rehospitalization reasons for examination because it is one of the most common principal discharge diagnoses in the Medicare program, and it is the most frequent diagnosis of high rehospitalization rates among older adults (Bui & Fonarow, 2012; Fredericks et al., 2010; Rich et al., 1995).

The Role of Home Health Care in Reducing Avoidable Re-hospitalizations

The aging population has increased the demand for home health care, and home health care has become increasingly available(Goldberg, 2011). As of 2011, 78 million members of the Baby Boom generation reached 65 years old (NAHC, 2013) and approximately 3.4 million Medicare recipients received home healthcare services from nearly 11,900 home health care agencies in 2010 (MedPAC, 2011). Home health care plays a critical role because the transition process from hospital to home is overwhelming for many Medicare recipients (Manning, 2011; Rosati & Huang, 2007; Schumacher & Marren, 2004). Along with the costs of rehospitalization, patients with HF make up a large portion of the home healthcare budget: home healthcare for patients with HF costs an estimated $2.2 billion per year (Madigan et al., 2012). In the meantime, the increasing

population of older adults with chronic diseases, such as HF, has led to higher rates of rehospitalization and to higher healthcare costs (Wilkinson & Whitehead, 2009). Along with the costs of rehospitalization, patients with HF make up a large portion of the home healthcare budget (Goldberg, 2011) .

It is imperative that health care providers continue developing individualized transitional care plans for older adults with HF moving from hospital to home who are at high risk of rehospitalization (Manning, 2011; Naylor et al., 2004; Walker, Hogstel & Curry, 2007). Home health care is an essential healthcare system to bridge the gap between hospital and home to reduce avoidable rehospitalizations for HF patients (Manning, 2011). Preventing avoidable rehospitalizations is one of the indicators for quality of home health care as well as acute care (Benbassat & Taragin, 2000; Rosati et al., 2003). As part of the Medicare Care Transitions Act of 2009, the federal government mandated reductions in rehospitalizations with better care coordination and follow-up services, including home health care (MedPAC, 2011). PPACA requires Congress to implement a home health care value-based purchasing program to enhance the quality of care in the growing number of home health care agencies (USDHHS, 2012). PPACA includes reforms providing incentives to clinicians for patients with chronic illnesses who are clinically maintained in the home and imposes penalties for multiple rehospitalizations (USDHHS, 2012).

Home health care services include skilled nursing, nursing aids, social work, speech therapy, physical therapy, and occupational therapy (MedPAC, 2011). Skilled nursing visits are the major home health care service (75% among other services) (Rogers & Schott, 2008). THC is part of skilled-nursing service (NAHC, 2013). Home health care

agencies have been implementing different types of THC interventions to manage HF to improve patient outcomes and reduce the financial burden on Medicare (Fazzi et al., 2007;Golbeck et al., 2011). Home health care agencies can help HF patients including Medicare recipients with multiple chronic conditions, with THC to promote self-management skills (Fazzi et al., 2007; Golbeck et al., 2011; Radhakrishnan & Jacelon, 2012). THC may be enhanced through the identification of patient-related characteristics associated with rehospitalization.

Outcome and ASsessment Information Set (OASIS)

Medicare-certified home healthcare agencies have been mandated to use the OASIS system as the data-collection tool for all Medicare recipients (18 years or older) except for maternity patients since 1999 (NAHC, 2013). Home healthcare nurses collect information about patient characteristics during each care episode. The OASIS data set has been used for clinical assessment, care planning and other interval-level applications, outcome monitoring, and broader evaluations of home health care service outcomes (Goldberg, 2011; NAHC, 2013; USDHHS, 2012). A subset of the OASIS-based performance measures calculated by the CMS is reported to the public via the Home Health Compare web site (www.medicare.gov/HHCompare/Home.asp) and also is calculated for payment algorithms under the Medicare Prospective Payment System (USDHHS, 2012).

The OASIS dataset has been tested and refined over the past two decades through a research and demonstration program funded primarily by the CMS (CMS, 2010b). There have been multiple revisions of the OASIS items, related to concerns about data collection, evaluation of payment algorithms, and improvement of outcome reporting

(CMS, 2009). Specifically, those revisions include the recommendations below in Table 2.1:

Table 2.1.Specific recommendations for revisions in home health care quality measurement (CMS, 2009)

Year	Recommendations
2001	Institute of Medicine (IOM) identified six focus areas for improving health care quality (Safety, effectiveness, patient-centeredness, timeless, efficiency, and equity)
2005	National Quality Forum (NQF) endorsed the initial set of home health care quality measures for public reporting along with recommendations for future changes to the measures
2006	Medicare Payment Advisory Commision (MedPAC) Report to Congress included recommendations for expanding home health care quality measures to 1) broaden the patient population covered by the OASIS 2) capture safety as an aspect of quality 3) capture an aspect of care directly under providers' influence 4) reduce variation in practice 5) provide incentives to improve information technology
2008	NQF developed a new set of guidelines and frameworks for measures and priorities

The OASIS system was updated to the OASIS-C version (see Appendix 1) in 2010 by CMS, a process that was informed by key stakeholders to improve the quality measurement of home health care (CMS, 2010b). In OASIS-C, the CMS eliminated the items on previous versions that were not used for quality measures, payment, or risk-assessment purposes (CMS, 2010b). The biggest difference between the OASIS-C and the previous version is that the OASIS-C adds the process of the care plan to data collection, in addition to the outcomes that were the focus of the previous version (CMS, 2009, 2010b). The OASIS-C includes new items related to process-quality measures for specific diagnoses that may require improvement (see Table 2.2) (CMS, 2009, 2010b).

Table 2.2.Process-of-care items in OASIS-C (CMS, 2009)

Domains	Process-of-care items
Timeliness	Date of referral and physician-ordered start of care
Care coordination	Patient-specific parameters for physician notification
Population health and prevention	Influenza and pneumococcal vaccines
Effectiveness of care	Formal pain assessment, pain interventions, and pain management steps
Effective care and	Pressure ulcer risk assessment, prevention measures, and use of moist healing

prevention	principles
Disease specific: high risk, high volume, problem prone	1)Diabetic foot care plan, education and monitoring 2)Heart failure symptoms of volume overload and follow-up
Influences self-management abilities	1)Depression screening 2)Intervention/referral
Safety	Falls risk assessment, planning and interventions
High priority for safety-care coordination	Medication adverse events/reaction, reconciliation and follow up; drug education

CMS states that implementation of processes of care will lead to improved outcomes (CMS, 2009). There has been no psychometric testing published on the OASIS-C. However, there have been several studies on the reliability and validity of the previous versions of OASIS, using varied methodological approaches (Kinatukara, Rosati, & Huang, 2005; O'Conner & Davitt, 2012) . A report of U.S. Department of Health and Human Services (USDHHS) to Congress states that the OASIS outcome measure scores capture differences in patient-related characteristics during the home health care episode, including past treatment and risk adjustment (USDHHS, 2012). In general, utilizing OASIS is essential as a data source that presents the status of a home health care population and patient outcomes, and as a tool for determining level of reimbursement as well as the risk factors for rehospitalizations (CMS, 2010a, 2010b). Thus, this study used OASIS-C items to explore the association between patient-related characteristics from the OASIS-C dataset and rehospitalizations. Exploring how patient-related characteristics affect the relative success or failure of telehomecare in preventing rehospitalizations could prove invaluable for home healthcare providers trying to optimize the effectiveness of THC for Medicare recipients with HF.

Summary

HF patients comprise a significant proportion of those patients in home health care (Madigan, 2008). Most HF patients are admitted to home health care after hospital

discharge because they need continuous interventions, such as THC, due to the complex nature of HF (Bui & Fonarow, 2012; Madigan, 2008). Given the current literature, it is unclear which factors affect rehospitalization rates for HF patients receiving THC in the U.S. Due to the mixed study results, it is critical to identify HF patient characteristics influencing healthcare utilization outcomes while on THC in order to direct future research and determine the appropriateness of implementing THC with a HF population, for example guiding intervention inclusion and exclusion criteria.

The identification of risk factors for rehospitalizations using the OASIS-C dataset can help home health care providers target patients most likely to benefit from THC, and may trigger additional interventions or possible alternatives for those with predictive risk characteristics. This study used the robust set of factors obtained from the assessment and process items collected via the OASIS-C. This study aims to identify patient characteristics from the OASIS-C data associated with rehospitalizations and time-to-first rehospitalization among Medicare recipients with HF who received THC, as well as to inform home health care providers of significant study results.

CHAPTER 3: STUDY DESIGN AND METHODOLOGY

Introduction

The aims of this study were to identify patient characteristics associated with all-cause rehospitalizations in Medicare recipients with HF receiving telehomecare (THC) and to identify HF patient characteristics associated with time-to-first rehospitalization for all-causes in Medicare recipients with HF receiving telehomecare. The chapter is organized into seven sections: research design, sample, protection of human subjects, instrumentation, the process of the sample selection procedures, and data analysis plan.

Research Design

This study is a non-experimental, cross sectional secondary data analysis using a total of 84 items from the latest version of the Outcomes and Assessment Information Set (OASIS-C) collected from Medicare recipients with HF receiving THC. This study examined 84 items as possible patient-related characteristics associated with rehospitalization and time-to-first-rehospitalization within 60 days of the home health care episode.

Data Source

This study was a unique research collaboration between academia and the home care industry to develop knowledge leading to screening criteria useful to agencies as they target HF patients for THC. The data source is a large for-profit home health care company that has approximately 120 sites that currently conduct THC. The average number of THC HF patients seen by their agencies per year is nearly 300. This home health care company was asked at least for 600 subjects but the study would most benefit from all THC patients from January 1, 2011 to August 31, 2013. This study was a first step in identifying those who are at risk for rehospitalizations while receiving THC and who may need additional care by using a robust sample from the OASIS-C dataset (CMS, 2010a; NAHC, 2013). The OASIS is a mandatory assessment tool for home health care patients covered by Medicare.

The data source was a de-identified OASIS-C dataset provided by a for-profit home health care company. The OASIS-C data was collected on home health care patients who received THC from multiple home health care agencies. The raw OASIS-C data is stored at a private home health care company. The data were de-identified and

sent to the researcher by the home health care company from the database used for reporting to the Center for Medicare and Medicaid Services (CMS). The key for identification was kept by the home health care company.

In order to initiate THC, a physician order was required. If not already ordered, a home health care nurse would call the primary care physician based on assessment of need followed by application of a screening tool. In addition to having HF as a new onset or exacerbation of a current diagnosis, patients receiving THC at this company had to meet the following criteria listed in Table 3.1.

Table 3.1.Inclusion and exclusion criteria for telehomecare placement for the home care company

Inclusion criteria	Exclusion criteria
•Physician ordered Telemonitoring. •New onset or exacerbation of current diagnosis (i.e. Heart Failure, COPD, Hypertension). •History of re-hospitalization or emergent care visits. •High risk for clinically significant change in condition. •Requires ongoing symptom management related to dyspnea, blood pressure, fatigue, medication side effects/adverse effects, or edema. •New or changed medications. •Patient/Caregiver has functional ability to safely use remote monitoring equipment in terms of sight, hearing, manual dexterity, and ability to communicate and follow simple commands. • Plain old telephone system(POTS)	•Patient refuses telemonitoring. •Patient is physically and/or cognitively unable to learn the process and has no willing/able caregiver. •Patient has combative/behavioral problems. •Patient's environment is not conducive and /or safe for remote monitoring or installation (i.e. infestation).

The telehomecare device is called the "Honeywell HomMed Monitor". Cost to the agency to monitor a patient monthly and to maintain the equipment is approximately $102 per month. A telemonitoring kit includes a monitor, blood pressure cuff, pulse oximeter finger probe, oximeter adapter cable, weight scale, attachment cable and monitor power supply (see Appendix 2).

Sample

The home health care company provided the admission (i.e. start of care), transfer, and discharge OASIS-C data for Medicare recipients with HF who received THC. The dataset was from a home health care company in the Eastern U.S. that had multiple agencies. Eligible subjects were identified from the OASIS-C as having a diagnosis of HF based on the International Classification of Disease, Ninth Revision (ICD-9) coding; they also had to have received THC and had a discharge from an in-patient facility stay including short-stay acute hospital, long-term care hospital or in-patient rehabilitation hospital or unit within 14 days of the start of home care.

Power analysis. Estimating the power required to detect significant differences in the patient characteristics between rehospitalization and those without rehospitalization was analyzed based on the primary research question. The determination of sample size is based on the following assumptions: a two-sided α equal to 5 percent; a 25 percent baseline probability of event (re-hospitalization rate in heart failure patients) (Stone , 2010); and the percentage of female patient (74 percent) as an independent variable of interest in the THC group (Madigan et al., 2013). A sample of 499 subjects achieves 80 percent power to detect an odds ratio as high as 0.53 (i.e. 10 percent fewer re-hospitalizations than the national average of 25 percent) to be statistically significant at the alpha level of 0.05 based on a logistic regression model, which corresponds to a deviation in the re-hospitalization rate from the national average of 25 percent to a rate as low as 15 percent.

Conversely, a sample of 526 subjects achieves 80 percent power to detect an odds ratio as low as 1.84 (13 percent more re-hospitalizations than the national average of 25

percent) to be statistically significant at the alpha level of 0.05 based on a logistic regression model. The projected sample size for this study was nearly 600, thus it was anticipated that the study would have adequate power to detect a clinically significant deviation in rehospitalizations from the national average. This was based on a model with only one independent variable. However, inclusion of multiple independent variables should further improve statistical power. PASS was used to determine the power for the purpose of the logistic regression because the outcome is binary (rehospitalizations versus non-rehospitalization).

Protection of Human Subjects

A memorandum of understanding and data use agreement was signed between the University of Pennsylvania School of Nursing and the private home health care company. In compliance with the HIPAA privacy rule, this study used a limited data set including only age and a single categorical variable for aged 90 and older. A limited data set must have all direct identifiers removed, including: name and social security number; health plan beneficiary numbers, and other account numbers. The home health care company de-identified and provided the principal investigator (PI) with the start of care, transfer, and discharge OASIS-C data files of Medicare recipients with HF who received telehomecare starting January 1, 2011 and who were discharged or rehospitalized by August 31, 2013 after approval from the Institutional Review Board (IRB) of the University of Pennsylvania was obtained.

As defined by the National Institute of Health, this study falls under Exemption Category 4 because it involved the study of de-identified existing data from the OASIS-C dataset. All subject level data was de-identified, and subjects could not be identified

directly or through identifiers linked to subjects. There was no further interaction or intervention with the subjects. Prior to conducting this research, I worked with my dissertation supervisor to obtain approval from the IRB of the University of Pennsylvania.

All data were used for research purposes only. The data were stored in a secure file on the University of Pennsylvania School of Nursing's server. The server was protected by a firewall and registered as a University "Critical Host" Participant. Nightly backups and weekly backups were stored at a secure off- site location. The server was monitored via the Enterprise System Monitoring Solution and has antivirus protection.

All data analysis was done on the research server accessed by a private, password protected desktop or password secured laptop that was kept in a locked storage cabinet when not in use. Files that were shared with the statistical consultant were shared via SecureShare. SecureShare is a web-based application for secure file exchange available to Penn faculty and staff. It provides a secure and easy-to-use mechanism to ensure the safety and privacy of University data. Files were encrypted when they were uploaded, downloaded, and while being stored. E-mail notifications were automatically sent to designated recipients when files were available for retrieval. Files were available for 30 days and were deleted after retrieval.

The School of Nursing is monitored by security personnel and requires Penn dentification to be presented for access after business hours. All documentation was stored in a locked file cabinet in a secured office that was only accessible to approved doctoral fellows and faculty. The combination of the file cabinet lock was known only to Youjeong Kang.

Instrumentation (Outcome and Assessment Information Set)

Outcome and Assessment Information Set (OASIS) has been used as a standardized assessment instrument for home health care patients (Madigan et al., 2003) to evaluate quality improvement and patient outcomes, including case-mix adjustment for factors affecting those outcomes (Hittle et al., 2003). OASIS is a mandated assessment instrument for home health care agencies based on Medicare requirements. Multiple versions of OASIS have been used over the years; the most current version is OASIS-C and that is the version that was used in this study.

OASIS-C data consists of five domains: socio-demographic, environmental, health status, health-service use, and functional status information (CMS, 2010b). The entire list of OASIS-C items is shown in Appendix 1. OASIS-C contains nearly 100 items of patient characteristics that must be assessed at specific time intervals: on admission to home care (i.e. start of care), every 60 days (recertification), upon transfer, discharge, and resumption of care (CMS, 2010b). Each time periods aligns with different OASIS-C items and different purposes. Three specific time points for this study as defined by CMS are shown below in Table 3.2 (CMS, 2010b).

Table 3.2. Specific Time Points of the OASIS Tool(CMS, 2010b)

Specific time points	Definition
Start of Care	Admission data: further visits planned. Signifies patient admission to agency.
Transfer to an Inpatient Facility	Happens when patient gets hospitalized 1.Transferred to an inpatient facility—patient not discharged from an agency 2. Transferred to an inpatient facility—patient discharged from agency
Discharge from Agency—Not to an Inpatient Facility	1. Death at home 2. Discharge from an agency

This study used the start of care, transfer, and discharge OASIS-C files. First, determination of in-patient hospitalization prior to home health care was determined from

the OASIS-C item "in-patient discharge date." To be able to determine that the patient had a hospital stay during the 60 days of a home health care episode, the items "to which inpatient facility has the patient been admitted?" and "discharge/transfer/death date" in the transfer OASIS-C tool were used. If the patient did not return to home health care from rehospitalization within 60 days of the initial home health care episode, the item "discharge/transfer/death date" in the discharge OASIS-C tool captured the status of rehospitalization.

This study was able to explore previously unknown patient-related characteristics associated with rehospitalization from the start of care OASIS-C items. Among new items in the OASIS-C, six items were related to medication management, which is a process-of-care item. Lack of medication safety in home care settings is an avoidable adverse event as defined by CMS (Madigan, 2007). According to a systematic review of adverse events experienced by home care population, adverse drug events were the most frequently reported as well as line-related adverse events (Masotti, McColl, & Green, 2010). Particularly, older adults are at risk for avoidable adverse events due to medication errors (Metlay et al., 2005). In addition, non-adherence to medications frequently causes early rehospitalizations (Chin & Goldman, 1997; DeBusk et al., 2004; Krumholz et al., 1997).

Few studies have evaluated reliability and validity for the items from the previous versions of OASIS. Studies have demonstrated that inter-rater reliability of many OASIS items is excellent (kappa>0.8), and most items are substantial or strong (kappa 0.6 to 0.8) although some items had poor inter-reliability (Hittle et al., 2003; Kinatukara, et al., 2005; Madigan & Fortinsky, 2004). The reliability coefficients (kappa) of the following

items are greater than 0.6 : all activities of daily living (ADL), most instrumental activities of daily living (IADL), management of oral medications, dyspnea, urinary incontinence, acute care hospitalization, and confusion frequency (Hittle, et al., 2003; Madigan & Fortinsky, 2004). Evidence for the validity of the OASIS items has demonstrated that the functional status items have been the most strongly validated. Although there are no studies to evaluate the reliability and validity of the OASIS-C, twenty-three OASIS-C measures were already endorsed in 2009, and the rest of the measures have been under review by the National Quality Forum (USDHHS, 2012).

The Process of Sample Selection

Three OASIS-C datasets including start of care (N=836), transfer (N=512) and discharge (N=836) files were obtained. The datasets were cleaned, and appropriate subjects were selected based on predetermined inclusion/exclusion criteria (see Table 3.3).

Table 3.3. Inclusion/exclusion criteria for this study

Inclusion	Exclusion
*Presence of any types of heart failure *Aged 55 and older *Discharged from the in-patient facilities within 14 days prior entering home health care *Medicare recipients	*Multiple rehospitalizations after the first rehospitalization *If home care entry date was after 8/31/2013

The steps listed below detail the process and rationale for decisions made in creating the new dataset (see Figure 3.1).

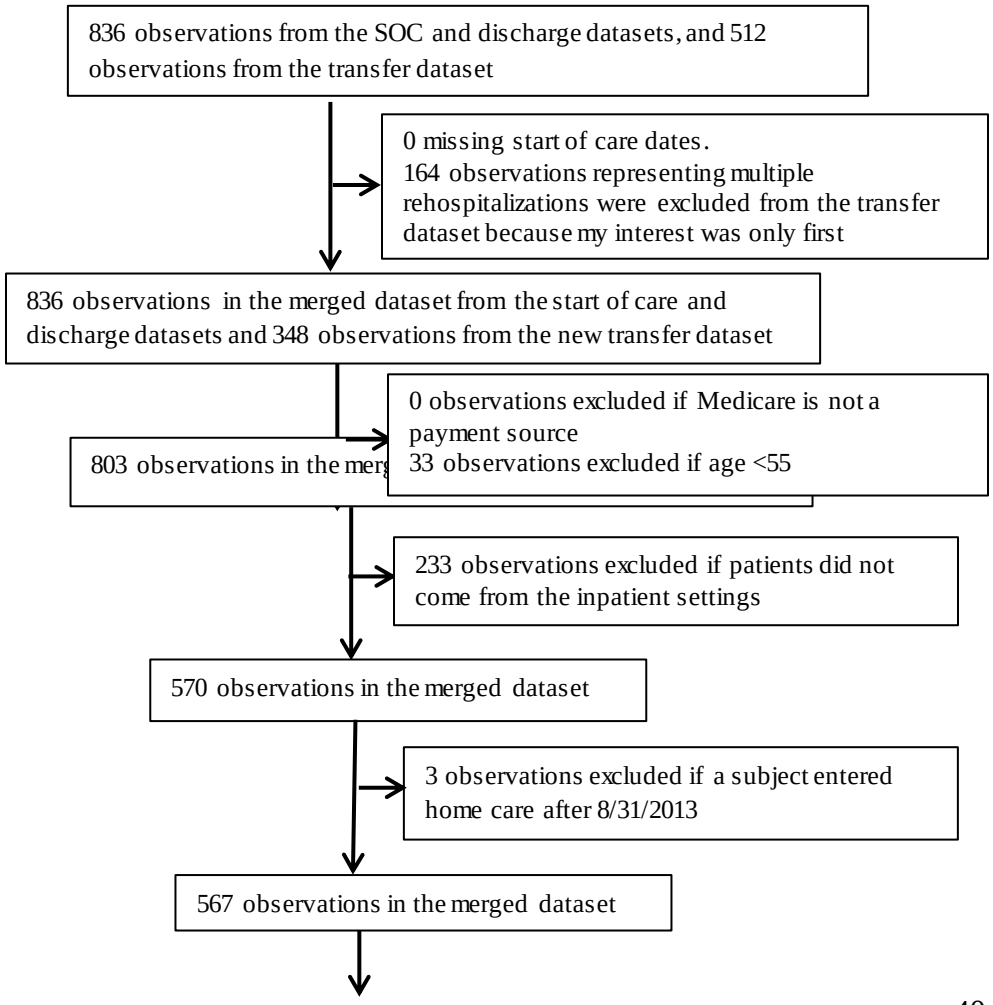
1. To verify the target disease (heart failure), the start of care file was used to identify subjects with HF ICD-9 codes (see table 3.4). This required re-coding 31 variables related to patients' diagnoses for which ICD-9 codes were provided. For example, if any of these variables had a code representing heart failure (HF), the indicator

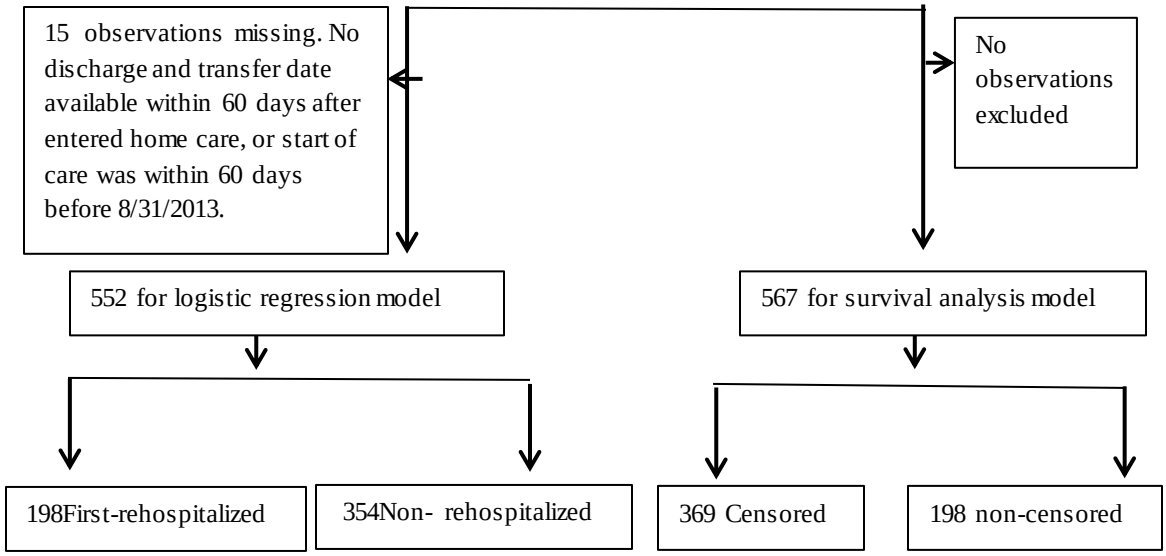
variable would be given the value "1"; otherwise, the response was coded "0". These variables were used to create a new variable (HF=1, non-HF=0). This identified 836 subjects and ensured that even if HF ICD-9 codes were not the primary diagnosis, all potentially eligible subjects were identified.

Table 3.4. Definition of ICD-9 codes for heart failure

ICD-9 codes	Definition
402.01	Malignant hypertensive heart disease with heart failure
402.11	Benign hypertensive heart disease with heart failure
402.91	Unspecified hypertensive heart disease with heart failure
404.01	Hypertensive heart and chronic kidney disease, malignant, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified
404.03	Hypertensive heart and chronic kidney disease, malignant, with heart failure and with chronic kidney disease stage V or end stage renal disease
404.11	Hypertensive heart and chronic kidney disease, benign, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified
428.00-428.99	Heart failure

Figure 3.1. The process of sample selection





2. From this sample (n=836), the transfer file (event=512) was used to identify subjects who were rehospitalized because only those hospitalized would have a transfer file. However, some subjects had multiple rehospitalizations. So, only the first rehospitalization per subject was retained, resulting in 348 unique study IDs within the transfer dataset. Thus, a total of 164 observations representing multiple rehospitalizations were excluded from the transfer dataset, and a new transfer file was created, including subjects who had only first-time rehospitalizations (n=348). The start of care, the new transfer file, and discharge dataset were merged based on the study IDs.
3. The next step was to ensure that all subjects in the merged dataset met the inclusion criteria. From this merged dataset, 33 subjects under the age of 55 years and 233 subjects who did not come from the in-patient facilities were excluded (see Table 3.5). Furthermore, three subjects were excluded because their home care entry date was

after 8/31/2013. All subjects met the inclusion criteria based on payment resource (Medicare). Thus, a total of 567 subjects remained in the merged dataset.

Table 3.5. The distribution of in-patient facilities

(M1000)Inpatient facility : From which of the following inpatient facilities was the patient discharged during the past 14 days? (Mark all that apply)	Entire group (N=567) Count (%)
Short-stay acute hospital	528 (93)
Long-term care hospital	5(1)
Inpatient rehabilitation hospital or unit	34 (6)

4. Subjects (n=15) were treated as missing data if there were no discharge and transfer date available within 60 days after they entered home care, and if start of care was fewer than 60 days before 8/31/2013, for construction of the logistic regression model (N=552) .Otherwise, no subjects were treated as missing data from the survival model (N=567).
5. For the logistic regression model and decision tree, there were 198 subjects with a first-time rehospitalization and 354 non-rehospitalized subjects within the 60 days of the home health care episode.
6. For the survival model, there were 369 censored "1"subjects and 198 non-censored "0" subjects; "1"=lost to follow-up or discharged from home health care;
   " 0"=rehospitalized to in-patient facilities.
7. To further verify the presence of the target disease (i.e. heart failure) in the final dataset, item number M1500 (Symptoms in heart failure patients) was used to identify subjects with HF (see table 3.6). The question asks home health care providers to indicate whether the patient has a heart failure diagnosis and has exhibited symptoms indicative of heart failure, based on clinical heart failure guidelines (including dyspnea, orthopnea, edema, or weight gain) at any point.

Table 3.6. Symptoms in Heart Failure Patients at the first time rehospitalization (N=198)

Symptoms in Heart Failure Patients	Count (%)
No	86 (45)
Yes	102 (53)
Not assessed	3 (2)
Missing	7

Data Analysis

Methods. Three methods were used to conduct this study: multiple logistic regressions, survival analysis, and a decision tree technique. Multiple logistic regressions and survival analysis were generated using SAS™ 9.4, and a decision tree technique was generated using WEKA. Multiple logistic regression and survival analysis were selected because the primary outcomes of interest were rehospitalization within 60 days (yes/no) and time-to-first rehospitalization. A decision tree was generated because it is a technique for predictive model development, but would not be used as a substitute for regression methods (Lemon, Roy, Clark, Friedmann, & Rakowski, 2003).

A multiple logistic regression model was generated to predict the likelihood of experiencing rehospitalization (predicted outcome) (Aim 1). A decision tree was generated for the visual interactions among risk factors to identify the profile of patients most at risk of the outcome using a tree-building technique (Lewis, 2000). The prediction rule developed from the decision tree was compared to the prediction model developed using multiple logistic regression.

The logistic procedure in SAS™ 9.4 was used, and a binomial distribution was specified using a logit link function (Allison, 1999). The equation of the logistic regression model consists of the following: 'π' represents the probability of

rehospitalization, X is a matrix of covariates, and α is the intercept of the linear regression model (Allison, 1999). The equation is formulated as

$$\log\left(\frac{\pi}{1-\pi}\right) = \alpha + \mathrm{Bx}$$

A decision tree is a computationally robust intensive data-mining tool that automatically searches for important patterns and relationships and uncovers the hidden structure, such as complex interactions even in highly complex data (Steinberg & Phillip, 1995). This discovered knowledge is then used to generate reliable predictive models. Use of a decision tree in scientific research is diverse, ranging from fields like psychotherapy to medical research and health sciences (Lemon, et al., 2003; Steinberg & Phillip, 1995).

A decision tree has several advantages compared to traditional statistical methods including regression modeling or multivariate modeling such as logistic regression models: a) a decision tree can handle non-parametric data more efficiently because no distribution assumptions are required of the dependent variables, and there is no need for transformations if the data are not normally distributed; b) a decision tree can handle missing data with less bias because it counts missing observations as a new category or as a surrogate category containing missing values instead of dropping missing values from the analysis; c) a decision tree can uncover complex interactions between the variables or complex patterns in the dataset that can cause difficulty in modelling ; and d) a decision tree can provide an easier interpretation of the results even for non-statisticians because the results obtained from a decision tree are viewed graphically (De'ath & Fabricius, 2000; Lemon et al., 2003; Lewis, 2000).

A decision tree may also be an alternative to traditional statistical methods that are poorly structured for multiple comparisons (De'ath & Fabricius, 2000; Gordon, 2013; Lemon et al., 2003). Also, when statistical interactions are examined with three or more variables at a time using traditional multivariate methods, it can cause difficulty in interpreting the results (Lemon et al., 2003; Lewis, 2000). In particular, multiple logistic regressions have difficulty handling possible interactions due to the normal distribution (parametric) assumptions (Lewis, 2000). In addition, traditional statistical methods require extensive input such as frequent adjustment of the methods compared to a decision tree which uses "machine learning" meaning that the interpretation of the results are straightforward (Lemon et al., 2003; Lewis, 2000).

Despite the advantages of a decision tree, it has not been used as frequently as traditional statistical methods because of a lack of awareness of the use of decision trees in general (Lemon et al., 2003) and possible misclassification errors (Gordon, 2013). Some statisticians are also skeptical about using a decision tree technique because of the lack of goodness of fit testing as opposed to traditional statistical methods (Gordon, 2013). However, a decision tree technique was considered for this study because the OASIS-C data for this study may have unknown complex interactions between the independent variables. In particular, the variables of functional status (grooming, dressing upper body, dressing lower body, bathing, toilet transferring, ambulation/locomotion and feeding or eating) may have more than two interactions causing difficulty in modelling if solely a multiple logistic regression analysis is used, which requires more procedures than a decision tree. Another benefit of a decision tree for this study is that the decision tree model's graphic depiction allows for easier interpretation than a multiple logistic

regression analysis. A multiple logistic regression analysis was also considered because it has been commonly used and estimates regression coefficients and tests for the significance of the independent variables. Thus, it was difficult to specify a priori which analysis would be more beneficial for this study so both the logistic regression method and the decision tree results are presented.

In addition to analyzing the risk of rehospitalization within 60 days of the home health care episode over time, time- to-first rehospitalization was analyzed as an outcome using survival analysis. Survival analysis was developed to analyze event history data by modeling the timing of events such as death, injury, onset of disease, or disease reoccurrence (Allison, 2010), while allowing censored data. The event time is measured from the beginning of an observation period to (a) the point when an event occurred (i.e. admission to home health care) ; (b) the end of the study period (i.e. after 60 days) ; or (c) a loss to follow-up or withdrawal from the study (Rosner, 2006). There are two reasons to employ a special method for events: *censoring and time dependent explanatory variables* (Rosner, 2006). When individuals do not experience any events during the observation period or are lost follow-up after a study period, these are called censored observations. A censored individual may or may not experience an event after a study period (Rosner, 2006), but the survival analysis will account for the time spent in the study until the patient was lost to follow-up.

The Steps of Data Analysis

For data analysis, two outcome variables were created: rehospitalization within 60 days of the home health care episode (yes/no) for the logistic regression model and time-

to-first-rehospitalization within 60 days of the home health care episode for the survival analysis.

Outcome variables. 1. Calculation of rehospitalization and time-to-first-rehospitalization within 60 days took place using the operational definitions listed below (see table 3.7).

Table 3.7 Operationsl definition of the variables that were calculated for the outcome variables

Outcome	Operational definition
Time-to-first Rehospitalization	First-time rehospitalization within 60 days after entering home care
Time-to-transfer to in-patient facility	Transfer date minus start of care date
Time-to-discharge from home care	Discharge date minus start of care

2. Observations for any subjects who had not been observed for at least 60 days following initial discharge were removed from the dataset for the logistic model, but were still included in the survival analysis.
3. If time-to-transfer was less than or equal to 60 days, then the outcome variable for Aim 1 "rehospitalized" was equal to 1. If time-to-transfer was greater than 60 days, then "rehospitalized" was equal to 0 (non-rehospitalized).
4. If time-to-transfer was missing then censor=1, if time-to-event>60 then censor.
5. If a subject started home health care on or after 7/2/2013, which is within 60 days of the end of study (i.e. on or before 8/31/2013), but did not experience rehospitalization and the discharge and/or transfer dates were missing, then the variable "rehospitalized" was recoded as "missing."
6. If start of care was within 60 days of the end of study (i.e. on or before 8/31/2013), but the subject's transfer and/or discharge dates were missing, then the time-to-event data was censored and time-to-event was equal to the end of study minus start of care.

7. The observation period ended on August 31, 2013, and there were eight subjects who had a start of care date within 60 days of that date between 7/2/2014 and 8/31/2014, but no transfer date or no discharge date; there were seven subjects who were rehospitalized after 8/31/2013. Thus, these data points are censored. Logistic modeling doesn't account for censoring of data, but survival analysis does; therefore, the sample size for the two analyses differs: 552 subjects for logistic modeling, and 567 for the survival model.

Aim 1 was to identify patient-related characteristics associated with all-cause rehospitalizations in Medicare recipients with HF receiving telehomecare within the 60 days of the home health care episode. First, descriptive statistical methods were used to describe the study population, including frequencies and percentages for binary/categorical/count variables with contingency tables; means and standard deviation for normal continuous variables; and median and interquartile range for non-normal continuous and truncated variables. Second, Chi-square/Fisher Exact analyses were performed to assess for associations between rehospitalized and non-rehospitalized patients in terms of binary/categorical/count variables; t-tests for normal continuous variables; and Wilcoxon rank sum tests for non-normal continuous variables. When imbalances were found, the relevant variables were treated as confounders (covariates) in the primary analysis. For all analyses, p-value <0.05 was considered statistically significant.

Stepwise variable selection. Bivariate analyses were conducted to select variables at the alpha level of 0.2 to build into the stepwise regression model. Stepwise variable selection was generated to identify the risk factors for rehospitalization. A

multiple logistic regression model was built to determine the relative strength of any group associations with adjustment for covariates such as the socio-demographic, environment, health status, health service utilization, and functional status variables. Hosmer-Lemeshow statistics and C-statistics (or the area under the receiver-operating characteristic curve (AUC)) were performed for the calibration and ability of the model to distinguish between rehospitalized and non-rehospitalized subjects.

Multiple logistic regressions. To fit the multiple logistic regression analysis, the Generalized Estimating Equations (GEE) method within the Genmod procedure (Allison, 1999) in SAS 9.4 was generated, and a binomial distribution was specified using a logit link function with an unstructured covariance matrix to determine the odds ratio and 95% confidential intervals for rehospitalization associated with each risk factor variable of interest.

The risk factor variables of interest were entered into a multiple logistic regressions model based on several criteria: a) if the variable occurred in a large enough number of subjects (generally >5%) of the sample; b) if the variable was found to be statistically significant, in unadjusted analyses, at a p-value of 0.20 or less; and c) if adjustment for the variable produced a change in another variable of 15% or more (Allison, 1999). The last stage of the analysis was validating the model for this study using the value of the AUC from c-statistics.

A Decision tree technique. A sample of 552 subjects were used to create a decision tree for predicting which patients were likely to be rehospitalized or not likely to be rehospitalized within 60 days of the home health care episode using WEKA software The data were divided into two sets; the test data was used to find the decision tree, while

the validation set was used to confirm the results of the decision tree. In determining the number of attributes to consider, a number of different techniques were considered and attempted. Initially, all attributes were entered into the decision tree to determine the optimal tree. This was followed by a technique that scaled down the number of attributes to only variables that were significant at the alpha = 0.2 level in the bivariate analysis. To evaluate the decision trees, the values of the AUC were used.

Aim 2 was to identify patient-related characteristics associated with time-to-first rehospitalization for all-causes in Medicare recipients receiving telehomecare within 60 days of the home health care episode. While the study objectives call for observing each patient until either rehospitalization or the completion of the home care episode, some patients might have died or relocated prior to any rehospitalization event, or may never have experienced a rehospitalization within 60 days of the home health care episode. In these cases, the time-to-event times were censored. The non-censored survival times were referred to as event times.

Survival analysis. To examine associations between all of the variables and time-to-first-rehospitalization, the Cox Proportional Hazards Regression (PHREG) procedure was conducted in SAS, which accounts for both censored and non-censored data. Cox proportional hazards models were generated to explore the association between patient-related characteristics and time- to- rehospitalization. Hazard ratios for time-to-first-rehospitalization were calculated for each statistically significant risk factor, using the Kaplan-Meier method (Allison, 2010). In addition, survival rates for each strata (i.e. category) were estimated at day 30 and day 60 for each of the significant variables. The

Kaplan-Meier curve graphically presents differences among the strata for each categorical predictor.

The Cox proportional hazards model is a semi-parametric model that is widely used in the analysis of survival data to explain the effect of explanatory variables on survival times (Cox & Snell, 1984; Allison, 2010). This model and Kaplan-Meier do not require making an assumption regarding the distribution for the survival curve, but the Cox proportional hazards model provides the additional advantage of allowing for adjustment for covariates.

Missing Data

Missing data is a common problem that almost all researchers face (Allison, 2001). In particular, this study encountered an informative censoring issue, which could cause the possible bias when survival data was analyzed. In general, informative censoring occurs when missing data is related to the outcome of interest or key risk factors of interest. Multiple imputation replaces each missing value with a set of plausible values that represent the uncertainty about the value to impute (Rubin, 2009). In this study, fifteen subjects were excluded from the analyses leading to the logistic regression model due to missing outcome data. Thus, the SAS Multiple Imputation procedure was generated to impute the missing data. Analyses were done with and without imputed data and any differences in results were reported.

CHAPTER FOUR: RESULTS

This non-experimental, cross-sectional secondary analysis of patient-related characteristics associated with rehospitalization (i.e. risk factors), used the items from the latest version of the Outcome and Assessment Information Set (OASIS-C) for Medicare

recipients with heart failure (HF) receiving telehomecare (THC). This dissertation study identified patient-related characteristics associated with rehospitalization and time-to-first rehospitalization within 60 days of the home health care episode following initial hospitalization. This study had two major aims:

1. Identify patient-related characteristics affecting all-cause rehospitalizations within 60 days of the home health care episode among Medicare recipients with HF receiving telehomecare.
2. Identify patient-related characteristics associated with time-to-first-rehospitalization within 60 days of the home health care episode for all-causes among Medicare recipients with HF receiving telehomecare.

For Aim 1, multiple logistic regression and decision tree techniques were applied using SAS™ Version 9.4 and WEKA software, respectively. For Aim 2, a survival analysis was generated using SAS™ Version 9.4. A review of the sample selection process is presented, followed by a description of patient-related characteristics captured in the OASIS-C dataset. The predisposing, enabling resources and need characteristics of the sample are described. The results of the two aims of this study are presented in sequence, followed by the results of post-hoc assessments.

After the final sample was selected based on study inclusion and exclusion criteria, the normality of the distributions for all 84 variables in the dataset were examined using descriptive statistics, treating each variable as an independent variable. Prior to building the final predictive model from the logistic regression analysis, c-statistics (the value of AUC) and Hosmer-Lemeshow goodness-of-fit-tests were used to assess the reliability of

the final model, as well as multicollinearity. Thus, a total of 84 independent variables were tested using multiple logistic regression, decision tree and survival analyses.

Overview

Overall Patient-Related Characteristics at the Start of Care Assessment

A total of 552 Medicare recipients with HF receiving telehomecare were included in the dataset for logistic regression modeling as well as decision tree analysis, and a total of 567 Medicare recipients with HF receiving telehomecare were included in the dataset for survival analysis. These subjects were identified during the course of a home health care episode, defined as the 60 days after the subject entered home care. Although there was a difference of 15 subjects in the total samples selected for logistic regression modeling and survival analysis, descriptive statistics for the two samples were similar. In addition, reasons for hospitalization were extracted from the transfer file, in order to identify the top five reasons for subjects' rehospitalizations during the home health care episode while receiving THC.

Logistic Regression Model and Decision Tree Analysis (N=552)

Nearly 36% of subjects had a first-time rehospitalization during the first 60 days after being discharged from an in-patient facility (i.e. short-stay acute care hospital, long-term care hospital, and/or in-patient rehabilitation hospital or unit). HF was the primary diagnosis for 61% of subjects (n=338), but for the remaining subjects, HF was identified as a secondary diagnosis from their documented ICD-9 codes. Among those subjects who had HF as their primary diagnosis, 34% (n=115) experienced a rehospitalization.

Overall, the median age of subjects in the logistic regression sample was 79.0 years (interquartile range (IQR) 15.0), and 10.6% of subjects were between 55 and 65

years. The proportion of females who received telehomecare (55%) was approximately 10% higher than among males. The majority of subjects were White (83%). Living arrangements for 74% of subjects were documented as living with other person(s).

Survival Analysis (N=567)

Overall, the median age of subjects in the survival analysis sample was 79.1 years (IQR 15.1), and 10.7% of subjects were between 55 and 65 years. The proportion of females who received telehomecare (55%) was approximately 10% higher than among males. The majority of subjects were White (83%). Living arrangements for 74% of subjects were documented as living with other person(s) in the home, with or without any kind of assistance.

Top five reasons for rehospitalization

Table 4.1 presents the top five most common reasons for hospitalization among subjects who were rehospitalized, out of 21 reported reasons in the transfer file. More than half of rehospitalized subjects required hospitalization due to HF complications (27%) and other heart disease (26%).

Table 4.1 Five top reasons for rehospitalization

(M2430) For what reason(s) did the patient require hospitalization?	Rehospitalized (N=198) Count (%)
Heart failure	54 (27)
Other heart disease	51 (26)
Respiratory Infection	22 (11)
Cardiac dysrhythmia	16 (8)
Other respiratory problem	16 (8)

Chi-square/Fisher Exact analyses and T-tests

Eighty-four items were used as independent variables from the OASIS-C start of care assessment. The 84 items analyzed in this study were examined as possible

patient-related characteristics affecting rehospitalization rates and associated with time-to-first-rehospitalization.

Descriptive statistics are presented in Table 4.3 (predisposing characteristics), Table 4.4 (enabling resources characteristics) and Table 4.5 (need characteristics) for potential risk factors for rehospitalization, using characteristics from the start of care file for 552 subjects. Data in Table 4.3, 4.4 and 4.5 are presented using means and standard deviations for normal continuous variables or medians and interquartile ranges for non-normal continuous variables, and using counts and columns (for rehospitalized and non-rehospitalized groups) and rows for percentages (all groups) for categorical variables.

Table 4.6 presents the details of each item for the six variables that were found to show statistically significant differences between rehospitalized versus non-rehospitalized subjects. Formal Chi-square/Fisher Exact analyses and t-tests revealed that six out of 84 of the baseline subject characteristic variables had statistically significant associations with rehospitalization status at the alpha level of 0.05. These variables are described as follows, and included two predisposing, one enabling, and three need characteristics measured for all subjects in the two groups at the time of the start of care assessment.

The two predisposing characteristics were subjects' overall health status, and subjects' receipt of a formal pain assessment performed using a standardized assessment tool. The enabling characteristic was subjects' residential circumstances and availability of assistance (defined as patients' living situation for this study). The three need characteristics were the presence of skin lesions or open wounds, the ability to dress one's lower body safely, and the total number of necessary therapy visits combined (i.e.

total of reasonable and necessary physical, occupational, and speech-language pathology visits).

Predisposing Characteristics (see Table 4.2)

The non-rehospitalized group was on average one year older than the rehospitalized subject group. There was no statistically significant difference in gender between the two groups in terms of rehospitalization rate (p-value=0.852). Although the majority of subjects were White (83%), there was no statistically significant difference in the proportion of White subjects who rehospitalized (36%) in comparison to the rehospitalization rate among non-Whites (35%) (p-value=0.800). The variable "prior indwelling/suprapubic catheter" was statiscally significant (p-value=0.039), but the distribution of the variable was highly skewed and might have biased the results due to instability (yes-99% vs no-1%). Subjects' overall health status (p-value=0.0407) and subjects' experiences with a formal pain assessment performed using a standardized assessment tool at the start of care assessment (p-value=0.019) were associated with rehospitalization within 60 days of the home health care episode.

In terms of subjects' overall health status, there are four possible categories in the OASIS-C dataset. For the purposes of this study, the categories were collapsed into three groups: stable or mildly sick subjects, moderately sick subjects and the sickest subject groups. Stable subjects were defined as being stable without escalating risk(s) for serious complications and death (NAHC, 2011). Mildly sick subjects were defined as having a current health risk(s), but also with a high probability of return to health (NAHC, 2011). Moderately sick subjects were defined as being in fragile health status with ongoing high risk(s) for serious complications and death (NAHC, 2011). The sickest subjects were

defined as having serious progressive condition(s) that could lead to death within the next year (NAHC, 2011). In this study, stable or mildly sick subject group had the lowest rehospitalization rate compared to other groups.

In terms of the presence of severe pain from a formal pain assessment using a standard pain assessment tool, subjects with severe pain had a higher proportion of rehospitalizations (47%) compared to subjects without severe pain (33%) (p-value=0.019).

Table 4.2. Descriptive Statistics of Predisposing Characteristics

Socio-demographic	Median (interquartile range) or Count (column % for subgroups, row % for entire group)			
	Rehospitalized (N=198) (column %)	Non-rehospitalized (N=354) (column %)	Entire group (N=552) (row %)	**P-value**
Age (median (interquartile range))	78.6 (16.7)	79.3 (14.0)	79.0 (15.0)	0.185
Age categories				0.546
55-64	26 (44)	33 (56)	59 (11)	
65-74	54 (36)	97 (64)	151 (27)	
75-84	69 (35)	130 (65)	199 (36)	
85-89	36 (37)	61 (63)	97 (18)	
> 90	13 (28)	33 (72)	46 (8)	
Gender				0.852
Male	90 (36)	158 (64)	248 (45)	
Female	108 (36)	196 (64)	304 (55)	
Race/Ethnicity				0.800
White	165 (36)	292 (64)	457 (83)	
Non-white	33 (35)	62 (65)	95 (17)	
Conditions prior to medical or treatment regimen change or inpatient stay within past 14 days				
Indwelling/suprapubic catheter				**0.039**
No	194 (35)	353 (65)	547 (99)	
Yes	4 (80)	1 (20)	5 (1)	
A change of urinary incontinence				0.157
No	123(38)	198(62)	321(58)	
Yes	75(32)	156(68)	231(42)	
Intractable pain				0.823
No	183 (36)	329 (64)	512 (93)	
Yes	15 (37)	25 (63)	40 (7)	
Memory loss to the extent that supervision required				0.630
No	183 (36)	323 (64)	506 (92)	
Yes	15 (33)	31 (67)	46 (8)	
No conditions prior to medical or				0.483

treatment regimen change or inpatient stay within past 14 days				
No	99 (34)	188 (66)	287 (52)	
Yes	99 (37)	166 (63)	265 (48)	
Risk for hospitalization				
Taking five or more medications				0.441
No	8 (44)	10 (56)	18 (3)	
Yes	190 (36)	344 (64)	534 (97)	
Frailty indicators				0.593
No	123 (35)	228 (65)	351 (64)	
Yes	75 (37)	126 (63)	201 (36)	
History of falls				0.243
No	128 (34)	246 (66)	374 (68)	
Yes	70 (39)	108 (61)	178 (32)	
Multiple hospitalizations in the past 12 months				0.081
No	55 (31)	124 (69)	179 (32)	
Yes	143 (38)	230 (62)	373 (68)	
Other risks				0.167
No	181 (37)	310 (63)	491 (89)	
Yes	17 (28)	44 (72)	61 (11)	
Recent decline in mental, emotional, or behavioral status				0.609
No	180 (36)	317 (64)	497 (90)	
Yes	18 (33)	37 (67)	55 (10)	
Overall health status+				**0.041**
Stable or Mildly sick group	82 (31)	186 (69)	268 (49)	
Moderately sick group	97 (41)	138 (59)	235 (42)	
The sickest group	19 (39)	30 (61)	49 (9)	
Risk factors, either present or past, likely to affect current health status and/or outcome				
Alcohol dependency				0.288
No	189 (35)	344 (65)	533 (97)	
Yes	9 (47)	10 (53)	19 (3)	
Obesity				0.191
No	141(34)	270 (66)	411 (75)	
Yes	57(40)	84 (60)	141 (25)	
Sensory status				
Vision impairment				0.365
No	150 (35)	280 (65)	440 (78)	
Yes	48 (39)	74 (61)	127 (22)	
Hearing Impairment				0.747
No	113 (36)	197 (64)	320 (56)	
Yes	85 (35)	157 (65)	247 (44)	
Understanding of verbal content				0.661
Understands	136 (37)	230 (63)	374 (66)	
Usually understands	56 (34)	109 (66)	171 (30)	
Sometimes or rarely/never understands	6 (30)	14 (70)	21 (4)	
Speech and Oral expression of language				0.622
Full Expression	138 (37)	233(63)	382 (67)	
Minimal difficulty	53 (34)	105(66)	162 (29)	
Moderate or severe difficulty	7 (30)	16(70)	23 (4)	
Formal pain assessment				**0.019**
Not assessed	-	--	8(1)	
No severe pain from a formal pain	153 (33)	305 (67)	458(83)	

assessment				
Severe pain from a formal pain assessment	40 (47)	46 (53)	86(16)	
Frequency of pain interfering with activity or movement				0.098
No pain	69 (34)	132 (66)	207 (37)	
Pain without interfering with activity or movement or less often than daily	32 (29)	80 (71)	115 (20)	
Pain with interfering with activity or movement daily	76 (39)	119 (61)	200 (35)	
Pain with interfering with activity or movement at all of the time	21 (48)	23 (52)	45 (8)	
Neuro/Emotional/Behavioral status				
Cognitive, behavioral, and psychiatric symptoms				0.778
Alert/oriented	132 (36)	234 (64)	366 (66)	
Requires prompting	53 (37)	91 (63)	144 (26)	
Requires	13 (31)	29 (69)	42 (8)	
Confusion (reported or observed within the last 14 days)				0.142
Never	131 (39)	204 (61)	335 (61)	
In new or complex situations only	52 (31)	115 (69)	167 (30)	
On awakening or during the day and evening or constantly	15 (30)	35 (70)	50 (9)	
Anxiety(reported or observed within the last 14 days)				0.800
None of the time	105 (37)	178 (63)	283 (51)	
Less often than daily	58 (35)	107 (65)	165 (30)	
Daily or all of the time	35 (34)	69 (66)	104 (19)	
PHQ2_Depressed				0.463
Not at all (0-1 day)	144 (35)	267 (65)	411 (76)	
Several days (2-6 days)	45 (40)	68 (60)	113 (21)	
More than half of the days(7-11 days) or Nearly every day (12-14 days)	9 (45)	11 (55)	20 (4)	
PHQ2_lack of interest				0.694
Not at all (0-1 day)	153 (34)	276 (64)	429 (79)	
Several days (2-6 days)	37 (38)	60 (62)	97 (18)	
More than half of the days(7-11 days) or nearly every day (12-14 days)	8 (44)	10 (56)	18 (3)	
Cognitive, behavioral, and psychiatric symptoms at least once a week				
Impaired decision-making				0.761
No	35 (66)	319 (64)	499 (90)	
Yes	18 (34)	180 (36)	53 (10)	
Memory deficit				0.673
No	179 (36)	316 (64)	495 (90)	
Yes	19 (33)	38 (67)	57 (10)	
Frequency of disruptive behavior symptoms				0.588
No	187 (36)	338 (64)	525 (95)	
Yes	11 (41)	16 (59)	27 (5)	

Note: Non-Whites: American Indian or Alaska Native, Asian, Black or African-American, Hispanic or Latino and Native Hawaiian or Pacific Islander. +:regrouped variables

Enabling Characteristics (see Table 4.3)

The patient's living situation at the start of care assessment was the only patient-related characteristic among enabling resources characteristics that was associated with rehospitalization within 60 days of the home health care episode (p-value=0.003). The subjects' living circumstances and availability of assistance (defined as patients' living situation for this study) were stratified into two groups: 1) those who lived alone with or without any kind of assistance or those who lived in a congregate situation with or without any kind of assistance, and 2) those who lived with other person(s) with or without any kind of assistance. Among the rehospitalized group, subjects who lived with other person(s) had a higher proportion of rehospitalizations (40%) than those who lived alone or who lived in a congregate situation (e.g., assisted living) with or without any kind of assistance (26%). In terms of co-morbidities, 45% of subjects had diabetes based on the variable "Plan of Care Synopsis- diabetic foot care ordered," but it was not significantly associated with rehospitalizations (p-value=0.870).

Table 4.3.Descriptive Statistics of Enabling Characteristics

Enabling characteristics	Mean (Standard Deviation) or Count (column % for all subjects, row % for subgroups)			
	Rehospitalized (N=198) (column %)	Non-rehospitalized (N=354) (column %)	Entire group (N=552) (row %)	P-value
Socio-demographic				
Subjects' living situation+				**0.003**
Live alone or live in a conjugated situation	37(26)	107(74)	144(26)	
Live with someone	161(40)	247(61)	408(74)	
Interval between the referral and first visit date	2.0 (2.4)	1.9 (5.3)	2.0(4.6)	0.959
Prior ADL/IADLs				
Prior functioning ambulation				0.745
Independent	188(64)	166(65)	256(46)	
Needed some help or dependent	108(37)	90(35)	296(54)	
Prior functioning household tasks				0.299
Independent	30(31)	66(69)	96(17)	
Needed some help or dependent	168(37)	288(63)	456(83)	
Prior functioning				0.552

Self-care				
Independent	213(65)	141(63)	225(41)	
Needed some help or dependent	114(35)	84(37)	327(59)	
Prior functioning Transfer				0.705
Independent	108(35)	199(65)	307(56)	
Needed some help or dependent	90(37)	155(63)	245(44)	
Multi-factor fall risk assessment				0.945
No multi-factor falls risk assessment conducted	12(37)	20(63)	32(6)	
Yes, and it does not indicate a risk for falls	14(38)	23(62)	37(7)	
Yes, and it indicates a risk for falls	172(36)	311(64)	483(88)	
Medications				
Drug Regimen Review				0.529
Not assessed/reviewed	114(37)	194(63)	308(56)	
No problems found during review	84(34)	160(66)	244(44)	
Medication Follow-up#				0.273
No	88(69)	72(62)	116(48)	
Yes	40(31)	44(38)	128(52)	
Patient/Caregiver High Risk Drug Education				0.716
No	11(41)	16(59)	27(5)	
Yes	162(35)	299(65)	461(83)	
NA-not taking any high risk drugs	25(39)	39(61)	64(12)	
Management of Oral Medications+				0.780
Able to take independently	41(38)	66(62)	107(19)	
Able to take with some help	84(36)	152(64)	236(43)	
Able to take if given reminders by another person or unable to take medication	71(34)	136(66)	207(38)	
Management of Injectable Medications+				0.407
Able to take independently	26(43)	35(57)	61(11)	
Able to take with some help	14(31)	31(69)	45(8)	
Able to take if given reminders by another person or unable to take medication	22(42)	30(58)	52(9)	
No prescription	136(35)	258(65)	394(72)	
Prior Oral Medication Management				0.931
Independent	72(37)	123(63)	195(35)	
Needed some help	92(35)	169(65)	261(48)	
Dependent	33(35)	60(64)	93(17)	
Prior injectable Medication Management				0.592
Independent	28(39)	44(61)	72(13)	
Needed some help	16(34)	31(66)	47(9)	
Dependent	13(46)	15(54)	28(5)	
No prescription	141(35)	264(65)	405(73)	
Plan of Care Synopsis; the presence of physician-ordered plan of care				
Patient-specific parameters for notifying physician				0.891
No	7(42)	10(59)	17(3)	
Yes	61(36)	108(64)	169(31)	
Physician has chosen not to establish patient-specific parameters for this patient.	130(36)	236(65)	366(66)	
Diabetic foot care				0.870
No	4(33)	8(67)	12(2)	
Yes	92(37)	157(63)	249(45)	
Patient is not diabetic or is bilateral amputee	102(35)	189(65)	291(53)	
Falls prevention interventions				0.941
No	1(33)	2(67)	3(1)	
Yes	191(36)	343(64)	534(97)	
Patient is not assessed to be at risk for falls	6(40)	9(60)	15(2)	
Depression interventions				0.596
No	11(41)	16(59)	27(5)	
Yes	36(40)	55(60)	91(16)	
Patient has no diagnosis or symptoms of	151(35)	283(65)	434(79)	

depression				
Intervention(s) to monitor and mitigate pain				0.175
No	9(56)	7(44)	16(3)	
Yes	140(36)	247(64)	387(70)	
No pain identified	49(33)	100(67)	149(27)	
Intervention(s) to prevent pressure ulcers				0.891
No	7(41)	10(59)	17(3)	
Yes	61(36)	108(64)	169(31)	
Patient is not assessed to be at risk for pressure ulcers	130(36)	236(64)	366(66)	
Pressure ulcer treatment				0.283
No	6(40)	9(60)	15(3)	
Yes	13(50)	13(50)	26(5)	
No pressure ulcers	179(35)	332(65)	511(93)	

Notes: #308 of missing data. +: regrouped variables.

Need Characteristics (see Table 4.4)

The presence of skin lesions or open wounds (p-value=0.021), the ability to dress one's lower body safely (p-value=0.031), and the total number of necessary therapy visits combined at the start of care assessment (p-value=0.048) were associated with rehospitalizations within 60 days of the home health care episode. Among the rehospitalized group, subjects with skin lesions or open wounds had a higher proportion of rehospitalizations (51%) than those without skin lesions or open wounds (34%). In addition, among subjects who had skin lesions or open wounds (n=49), 63% of those had a physician-ordered plan of care for diabetic foot care. Although respiratory assessments were notable for 95% subjects reporting any degree of shortness breath, shortness of breath was not associated with rehospitalizations.

In terms of the ability to dress one's lower body safely, there were four categories of ability in the OASIS-C dataset. For the purposes of this study, the categories were defined as independent, mildly dependent, moderately dependent and completely dependent. Independent subjects were defined as being able to obtain, put on, and remove clothing and shoes without assistance. Mildly dependent subjects were defined as being

able to dress their lower bodies without assistance, if clothing and shoes were laid out or handed to them. Moderately dependent subjects were defined as requiring assistance to put on undergarments, slacks, socks or nylons, and shoes. Completely dependent subjects were defined as being entirely dependent upon another person to dress their lower body. For the purposes of data analysis, the categories were regrouped into three levels: independent, mildly and moderately dependent, or completely dependent.

Among subjects in the study sample, 9% were independent, while 72% were moderately or completely dependent with dressing their lower bodies. Subjects in the independent group had the highest proportion of rehospitalizations (51%), and those who were mildly dependent had the lowest proportion of rehospitalizations (29%) among subjects who were rehospitalized.

In terms of therapy needs, subjects who were rehospitalized tended to have a significantly lower expected frequency of visits (9.7±6.9) at the start of care assessment than those who were not rehospitalized (11±6.6) (p-value=0.048).

Table 4.4. Descriptive Statistics of Need Characteristics

Need characteristics	Mean (Standard Deviation) or Count (column % for all subjects, row % for subgroups)			
	Rehospitalized (N=198) (column %)	Non-rehospitalized (N=354) (column %)	Entire group (N=552) (row %)	P-value
Integumentary status				
Risk of developing pressure ulcers				0.653
No	140(35)	259(65)	412(73)	
Yes	55(37)	93(63)	150(27)	
Surgical wound				0.985
No	166(36)	297(64)	463(84)	
Yes	32(36)	57(64)	89(16)	
Most problematic surgical wound+				0.990
Re-epithelialized	169(36)	302(64)	471(85)	
Fully or Early /partial granulating	19(36)	34(64)	53(9)	
Not healing	10(36)	18(64)	28(5)	
Skin lesion or open wound				**0.021**

No	173(34)	330(66)	503(91)	
Yes	25(51)	24(49)	49(9)	
Respiratory status				
Shortness of breath+				0.225
None	7(27)	19(73)	26(5)	
When walking more than 20 feet, climbing stairs	29(29)	70(71)	99(18)	
With moderate exertion	76(36)	136(64)	212(38)	
With minor exertion or at rest	86(40)	129(60)	215(39)	
Respiratory treatment				
Oxygen				0.555
No	118(35)	220(65)	338(61)	
Yes	80(37)	134(63)	214(39)	
Continuous/Bi-level positive airway pressure				0.135
No	183(35)	338(65)	521(94)	
Yes	15(48)	16(52)	31(6)	
No oxygen and airway pressure				0.347
No	87(38)	141(62)	228(41)	
Yes	111(34)	213(66)	324(59)	
Elimination status				
Urinary Tract Infection				0.229
No	181(37)	312(63)	493(90)	
Yes	16(29)	40(71)	56(10)	
Urinary Incontinence or Urinary Catheter Presence				0.268
No	93(38)	149(62)	242(44)	
Yes	105(34)	205(66)	310(56)	
Occurrence of Urinary Incontinence+				0.461
None	99(39)	154(61)	253(46)	
Timed-voiding defers incontinence	9(36)	16(64)	25(4)	
Occasional stress incontinence	38(35)	71(65)	109(20)	
During the night only , the day only or the day and night	52(31)	113(68)	165(30)	
Bowel Incontinence Frequency+				0.717
Very rare	26(67)	324(64)	508(93)	
Less than once to six times weekly, on a daily basis or more often than once daily	13(33)	184(36)	39(7)	
ADL/IADLs				
Grooming+				0.585
Independent	43(34)	82(66)	125(23)	
Grooming utensils must be placed	94(38)	152(62)	246(44)	
Moderately or completely dependent	61(34)	120(66)	181(33)	
Dressing upper body+				0.967
Independent	31(37)	53(63)	84(15)	
Mildly dependent	85(36)	151(64)	236(43)	
Moderately or completely dependent	82(35)	150(65)	232(42)	
Dressing lower body+				**0.031**
Independent	24(51)	23(49)	47(9)	
Mildly dependent	31(29)	76(71)	107(19)	
Moderately or completely dependent	143(36)	255(64)	398(72)	
Bathing +				0.743
Independent	92(63)	262(65)	406(74)	
Dependent with different degrees of	54(37)	144(35)	146(26)	

assistance				
Toilet transferring +				0.716
Independent	78(34)	152(66)	230(42)	
When reminded, assisted, or supervised by another person	95(37)	161(63)	256(46)	
Unable to perform toilet transferring without assistance or completely dependent	25(38)	41(62)	66(12)	
Toileting Hygiene				0.860
Independent	55(34)	106(66)	161(29)	
Able to manage toileting if supplied/implements are laid out for the patient	92(36)	161(64)	253(46)	
Moderately or completely dependent	51 (37)	87(63)	138(25)	
Transferring				0.697
Independent	19(30)	45(70)	64(12)	
Able to transfer with minimal human assistance	145(36)	255(64)	400(72)	
Able to bear weight and pivot during the transfer process but unable to transfer self	29(38)	47(62)	76(14)	
Unable to transfer or bedfast	5(42)	7(58)	12(2)	
Ambulation/Locomotion				0.188
Independent	5(42)	7(58)	12(2)	
With the use of a one-handed device	23(31)	51(69)	74(13)	
With the use of two-handed device	72(32)	153(68)	225(41)	
With supervision, chair fast or bedfast	98(41)	143(59)	241(44)	
Feeding or eating				0.300
Independent	116(39)	185(61)	301(55)	
Able to feed self but requires some help	81(33)	164(67)	245(44)	
Unable to feed self or requires tube feeding	1(17)	5(83)	6(1)	
Ability to plan and prepare light meals				0.886
Independent	46(38)	76(62)	122(22)	
Unable to prepare light meals	84(36)	152(64)	236(43)	
Unable to prepare any light meals or reheat any delivered meals	68(35)	126(65)	194(35)	
Ability to use telephone				0.263
Independent	153(36)	274(64)	427(78)	
Able to use telephone with some degrees of help	42(40)	64(60)	106(19)	
Unable to answer the phone	3(19)	13(81)	16(3)	
Therapy need and plan of care				
Therapy need (mean (standard deviation))				
A total number of reasonable and necessary physical, occupational, and speech-language pathology visits combined	9.7 (6.9)	11(6.6)	10.4 (6.7)	**0.048**
Care Management+				
ADL Assistance				0.370
No assistance needed	18(41)	26(59)	44(8)	
Caregiver(s) currently provides assistance	139(34)	268(66)	407(74)	
Caregiver(s) need training/supportive services or not likely to provide assistance,	41(41)	60(59)	101(18)	

unclear of caregiver status, or no caregiver available				
IADL Assistance				0.726
No assistance needed	2(25)	6(75)	8(1)	
Caregiver(s) currently provides assistance	184(36)	323(64)	507(92)	
Caregiver(s) need training/supportive services or not likely to provide assistance, unclear of caregiver status, or no caregiver available	12(32)	25(68)	37(7)	
Medication Administrator				0.756
No assistance needed	39(34)	76(66)	115(21)	
Caregiver(s) currently provides assistance	126(37)	215(63)	341(62)	
Caregiver(s) need training/supportive services or not likely to provide assistance, unclear of caregiver status, or no caregiver available	33(34)	63(66)	96(17)	
Medical Procedures/treatment				0.979
No assistance needed	160(36)	286(64)	446(81)	
Caregiver(s) currently provides assistance	27(36)	47(64)	74(13)	
Caregiver(s) need training/supportive services or not likely to provide assistance, unclear of caregiver status, or no caregiver available	11(34)	21(66)	32(6)	
Management of Equipment				0.321
No assistance needed	109(34)	215(66)	324(59)	
Caregiver(s) currently provides assistance	74(40)	110(60)	184(33)	
Caregiver(s) need training/supportive services or not likely to provide assistance, unclear of caregiver status, or no caregiver available	15(34)	29(66)	44(8)	
Supervision and Safety				0.908
No assistance needed	107(37)	185(63)	292(53)	
Caregiver(s) currently provides assistance	83(35)	153(65)	236(43)	
Caregiver(s) need training/supportive services or not likely to provide assistance, unclear of caregiver status, or no caregiver available	8(33)	16(67)	24(4)	
Advocacy of facilitation				0.344
No assistance needed	20(43)	26(57)	46(8)	
Caregiver(s) currently provides assistance	169(35)	317(65)	486(88)	
Caregiver(s) need training/supportive services or not likely to provide assistance, unclear of caregiver status, or no caregiver available	9(45)	11(55)	20(4)	
Frequency of ADL or IADL assistance				0.203
No assistance needed	174(32)	292(63)	466(85)	
Caregiver(s) currently provides assistance	11(26)	32(74)	43(8)	
Caregiver(s) need training/supportive	12(29)	29(71)	41(7)	

services or not likely to provide assistance, unclear of caregiver status, or no caregiver available				

Note.+:regrouped variables

Variable Descriptors

In order to better describe the six variables found to be significant in the bivariate analyses, Table 4.5 presents the OASIS item number and the original question wording for each item.

Table 4.5. Significant Item Descriptions

Item number	Question Wording
Predisposing characteristics	
(M1034) Patient overall health status	Which description best fits the patient's overall status? 0 - The patient is stable with no heightened risk(s) for serious complications and death (beyond those typical of the patient's age). 1 - The patient is temporarily facing high health risk(s) but is likely to return to being stable without heightened risk(s) for serious complications and death (beyond those typical of the patient's age). 2 - The patient is likely to remain in fragile health and have ongoing high risk(s) of serious complications and death. 3 - The patient has serious progressive conditions that could lead to death within a year. UK - The patient's situation is unknown or unclear.
(M1240)* Formal Pain Assessment	Has this patient had a formal Pain Assessment using a standardized pain assessment tool (appropriate to the patient's ability to communicate the severity of pain)? 0 - No standardized assessment conducted (treated as missing data because of the instability of the variable for this study) 1 - Yes, and it does not indicate severe pain 2 - Yes, and it indicates severe pain
Enabling characteristics	
(M1100)* Patient Living Situation	Which of the following best describes the patient's residential circumstance and availability of assistance? 1-Patient lives alone 2-Patient lives with other person(s) in the home regardless of availability of assistance 3-Patient lives in congregate situation (e.g., assisted living) regardless of availability of assistance
Need characteristics	
(M1350) Skin lesions or open wounds	Does this patient have a Skin Lesion or Open Wound, excluding bowel ostomy, other than those described above that is receiving intervention by the home health agency? 0 - No 1 - Yes
(M1820)* Ability to dress lower body safely	Current Ability to Dress Lower Body safely (with or without dressing aids) including undergarments, slacks, socks or nylons, shoes: 0 - Able to obtain, put on, and remove clothing and shoes without

	assistance. 1 - Able to dress lower body without assistance if clothing and shoes are laid out or handed to the patient. 2 - Someone must help the patient put on undergarments, slacks, socks or nylons, and shoes 3- Patient depends entirely upon another person to dress lower body.
(M2200) Number of therapy visits indicated	In the home health plan of care for the Medicare payment episode for which this assessment will define a case mix group, what is the indicated need for therapy visits (total of reasonable and necessary physical, occupational, and speech-language pathology visits combined)?

Note: *Variables-re-categorized for data analysis. In M1034 item, responses 0 and 1 were combined. In M1240 item, response 0 was treated as missing data because of a small number of responses (n=8). In Item M1100, responses 1 and 3 were combined. In Item M1820 item, responses 2 and 3 were combined.

Results by Study Aim

Aim 1 using Logistic Regression

Model building process. Before selecting variables which were significant at the alpha level of 0.2 for stepwise analysis, c-statistics and Hosmer-Lemeshow tests were evaluated to determine the reliability of the stepwise regression model. Although the variable "prior indwelling/suprapubic catheter" was significant, the Hosmer-Lemeshow values with the variable "prior indwelling/suprapubic catheter" were the same regardless of whether the variable was included or was not. In addition, there was no difference in the values of the area under the receiver-operating characteristic curve (AUC) from c-statistics for models including or excluding the variable for "prior indwelling/suprapubic catheter." Table 4.6 presents the values of the AUC c-statistics and Hosmer-Lomoshow discussed above.

Table 4.6. C-statistics (AUC) and Hosmer-Lemeshow goodness-fit-test

	C-statistics (AUC)	Hosmer-Lomeshow
With prior indwelling/suprapubic catheter	0.65	0.1033
Without prior indwelling/suprapubic catheter	0.65	0.1033

Bivariate analysis (see Table 4.7). A logistic regression model was used to produce unadjusted odds ratios (OR) representing the odds of subjects experiencing

rehospitalizations given the included variables. Fourteen variables that were at the alpha level of 0.2 in the bivariate analysis were selected for stepwise inclusion in the regression analysis, leading to the final logistic regression model. For all variables that were significant at the alpha level of 0.05, post hoc pair-wise comparison results are not presented in Table 4.7.

Table 4.7. Variables at the alpha level of 0.2 from Bivariate Analyses

	Odds Ratios	95% Confidential Intervals	P-value
Age	0.97	0.93, 1.01	0.183
Number of therapy visits [combined total]	0.94	0.89, 0.99	**0.047**
Formal pain assessment (no severe pain)*	1.73	1.09, 2.76	**0.022**
Skin lesion (no)*	1.99	1.10, 3.58	**0.023**
Overall health status			**0.032**
Stable or Mildly sick group (reference)			
Moderately sick group	1.59	1.10, 2.30	**0.013**
The sickest group	1.44	0.76, 2.70	0.260
Patient living situation (lives alone)*	1.88	1.23, 2.88	**0.003**
A change in urinary incontinence (no)*	0.77	0.54, 1.10	0.156
Dress lower body			**0.033**
Independent (reference)			
Mildly dependent	0.39	0.19, 0.79	**0.009**
Moderately or Completely dependent	0.54	0.29, 0.99	**0.045**
Multiple hospitalizations more than two times in the past 12 months (no)*	1.40	0.96, 2.05	0.082
Hospital risk-other risks (no)*	0.66	0.37, 1.19	0.169
Hospital risk –Risk obesity (no)*	1.30	0.88, 1.93	0.194
Confusion†	---	---	0.140
Frequency of ADL or IADL assistance†	---	---	0.190
Pain frequency interfering with patient's activity or movements†	---	---	0.098

Note: *-reference groups for each variable are denoted in parentheses. †- For all variables that were not significant at the alpha level of 0.05, post hoc pair-wise comparison results are not presented in Table 4.7.

Stepwise regression model (see Table 4.8). After stepwise inclusion of variables with the alpha level of 0.2 (as a threshold for model inclusion), and retention of variables that were significant at an alpha level of 0.05, the final regression model revealed four risk factors for rehospitalization among study subjects.

Table 4.8. The Results of Stepwise Regression

Final risk factors for rehospitalization	**p-value**
Overall health status	0.047
Formal pain assessment	0.007
Skin lesions or open wounds	0.030
Ability to dress one's lower body safely	0.036

Test for multicollinearity (see Table 4.9). The consistency between the unadjusted and adjusted p-values supports the assumption of independence among the risk factors. However, an examination of potential direct associations among the final risk factors was conducted, and two sets of factors appeared to be directly, statistically associated with one another. Specifically, the variables for subjects' overall status and their ability to dress their lower bodies safely were associated. Furthermore, the variables for formal pain assessment and subjects' ability to dress their lower bodies safely were associated (p-value=0.043). However, although these risk factors were found to be related, the significant adjusted model p-values suggest that the relationships between the variables are not completely confounding. Thus, there was no significant multicollinearity; four variables in adjusted model were eligible for inclusion in the final model.

Table 4.9. Multicollinearity

Unadjusted model	p-value
Subjects' overall health status and formal pain assessment	0.564
Subjects' overall health status and skin lesions or open wounds	0.147
Subjects' overall health status and ability to dress one's lower body safely	0.440
A formal pain assessment and ability to dress one's lower body safely	**0.043**
A formal pain assessment and skin lesions or open wounds	0.759
Ability to dress one's lower body safely and skin lesions or open wounds	0.293
Adjusted model	p-value
Overall health status	**0.027**
Formal pain assessment	**0.013**
Skin lesions or open wounds	**0.028**
Ability of dressing lower body safely	**0.023**

Final logistic regression model. C-statistics were calculated to assess the fit of the final model, using the logistic option. The value of the AUC from c-statistics was 0.63. To determine which particular exposures constituted risk factors, multiple logistic regressions were conducted. The results of the final logistic regression model are presented in terms of predisposing, enabling resources and need characteristics. Table 4.10 presents the odds ratios of the final risk factor variables, which can be used in determining which particular exposure(s) is (or are) risk factors for rehospitalization, and in comparing the magnitude of the effects of various risk factors on rehospitalization.

Predisposing characteristics. In terms of subjects' overall health status, the odds of being rehospitalized for moderately sick subjects were 1.65 times the odds of rehospitalization in the stable or mildly sick subjects, with a statistically significant difference existing between the two groups (p-value=0.010). Pairwise comparisons were generated because the variable of subjects' overall health status was significant at the alpha level of 0.05. A pairwise comparison analysis is recommended for variables with more than two categories (see Table 4.11). Pairwise comparison analysis revealed that there was no statistical difference between the moderately sick and the sickest subject groups. For subjects who received a formal pain assessment, the odds of being rehospitalized for subjects who reported severe pain were 1.84 times the odds of rehospitalization in subjects without severe pain (p-value=0.013).

Enabling characteristics. None of the enabling characteristics were predictive of rehospitalization in the multiple regression analysis.

Need characteristics. The odds of being rehospitalized for subjects who had skin lesions or open wounds were approximately twice as high as those for subjects without skin

lesions or open wounds (OR(odds ratio):1.98, p-value=0.027). The odds of being rehospitalized for subjects in the mildly dependent group were 63% lower than those in the completely independent group; the odds of being rehospitalized among either those in the moderately dependent group or those who were completely dependent for dressing their lower body were 54 % lower than for those subjects in the independent group

Table 4.10. Odds ratios and 95% confidence interval of the final risk factors

	Odds Ratio	95% confidence interval	p-value
Overall status			0.027
Stable or Mildly sick group(reference)	---	---	---
Moderately sick group	1.65	1.13, 2.41	0.010
Sickest group	1.61	0.84, 3.09	0.151
Formal pain assessment			
No severe pain (reference)	---	---	---
Severe pain	1.84	1.14 , 2.96	0.013
Skin lesions or open wounds			
No (reference)	---	---	-
Yes	1.98	1.08, 3.62	0.027
Ability to dress lower body safely			0.023
Independent (reference)	---	---	---
Mildly dependent	0.37	0.18, 0.76	0.007
Moderately or completely dependent	0.46	0.25, 0.87	0.017

Table 4.11. Pairwise comparison of subjects' overall health status and ability to dress lower body from the final model

Subjects' overall health status	Odds Ratio	95% Confidence Interval	p-value
Moderately sick group vs Sickest group	1.02	0.54, 1.95	0.952
Ability to dress lower body safely			
Moderately or completely dependent vs Mildly dependent	0.79	0.49, 1.27	0.335

(p=0.023).

Aim 1 using Decision Tree Technique

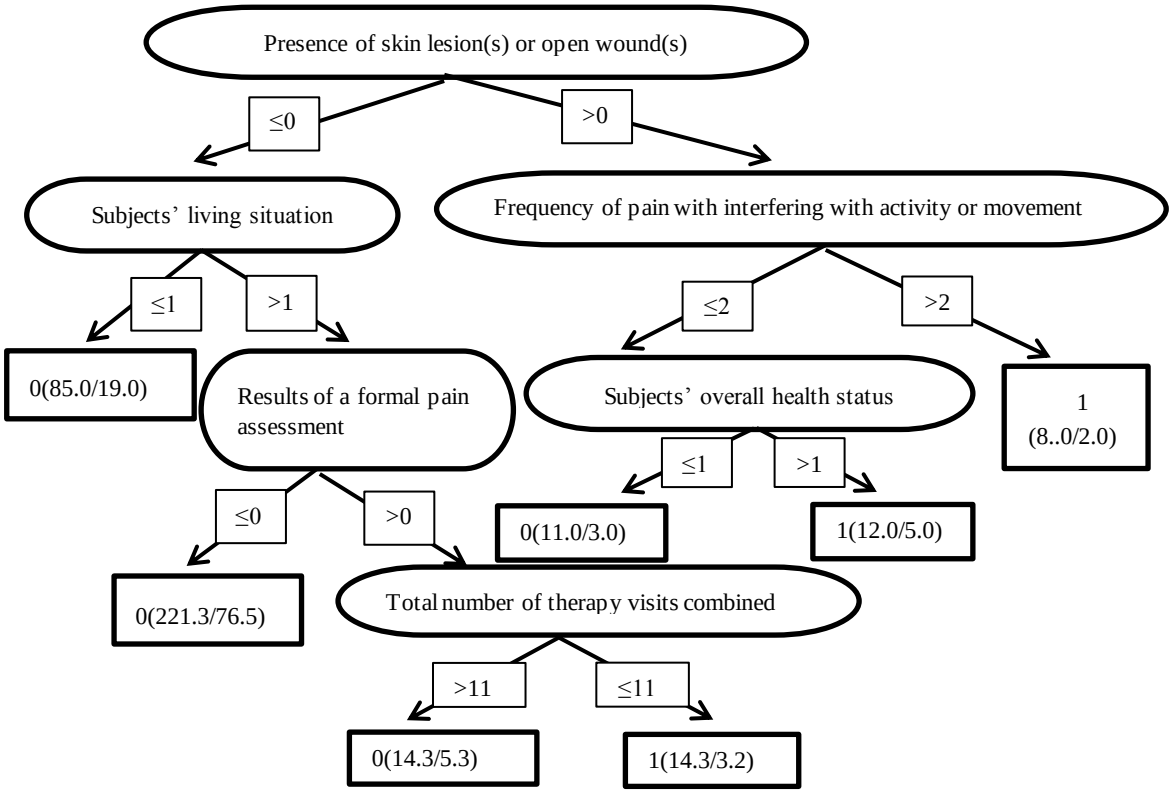
A decision tree was generated using WEKA software. A total of 84 variables within a sample of 552 subjects were used to create a decision tree for predicting which

subjects were more likely to be rehospitalized within 60 days of the home health care episode. The data were divided into two sets: the test data (n=368, 66.7% of 552) and the validation data (n=184, 33.3% of 552).

The AUC of the best model in the validation dataset was 0.588 with a Kappa statistic of 0.13. The Kappa statistic was in the low range (i.e. between 0 and 20), indicating slight agreement (Landis and Koch, 1977). The percentage of correctly classified instances (65%, accuracy) was higher than of incorrectly classified instances (35%). Although the values of the AUC, Kappa statistics and accuracy were not ideal, the results from the decision tree (see Figure 4.2) were somewhat consistent with the results from the logistic regression model.

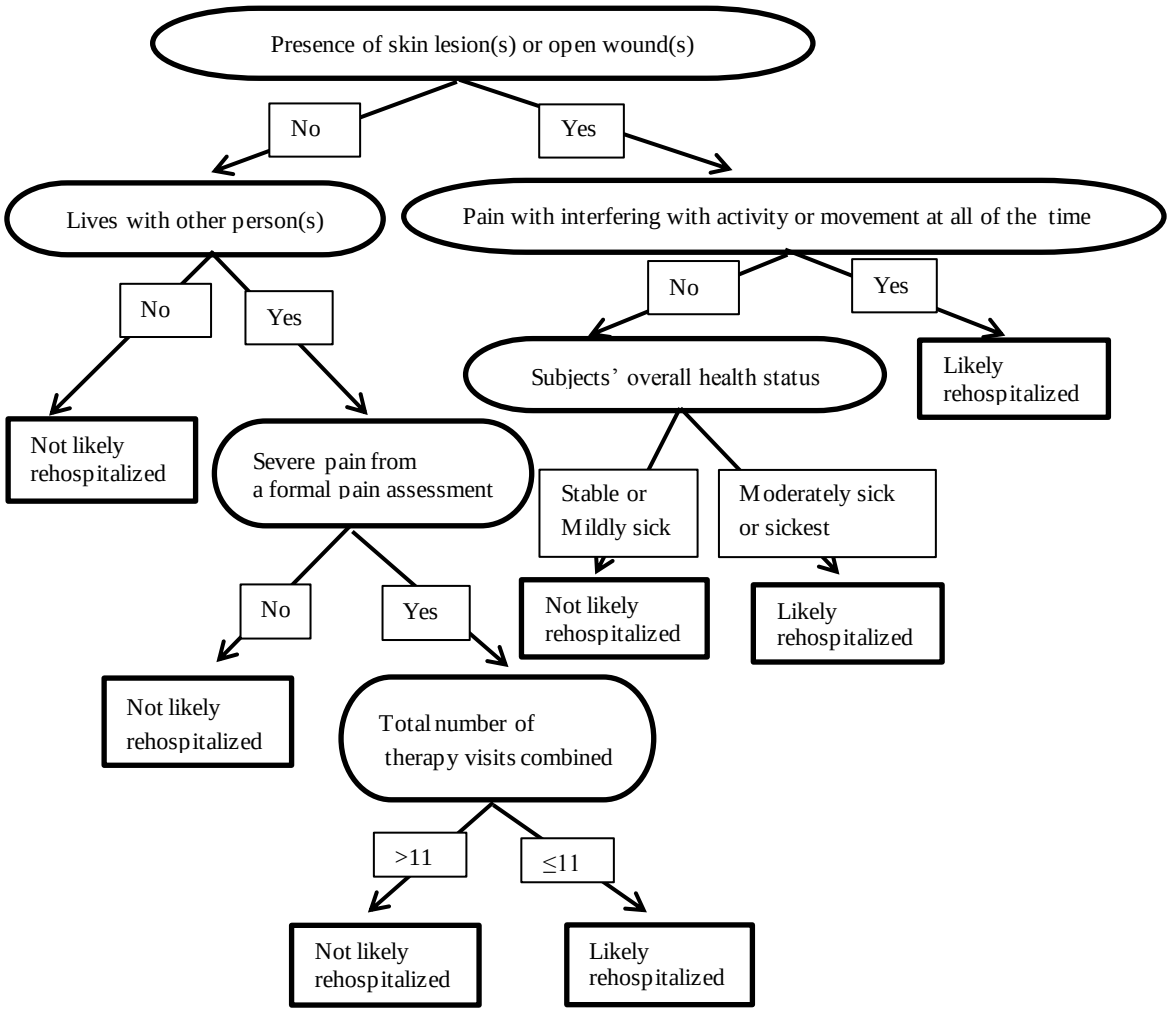
Figure 4.1 presents the decision tree derived from the best predictive model, which was chosen based upon the highest value of the AUC and clinically meaningful results. The presence of skin lesion(s) or open wound(s) was identified as the first predictor of rehospitalization that could be identified during the start of care exam, followed by subjects' living situation, subjects' overall health status, results of a formal pain assessment, frequency of pain interfering with activities and total number of therapy visits. However, the decision tree also determined optimum split points for each variable in terms of predicting rehospitalizations within the 60-day home health care episode. In particular, although subjects' overall health status had three categories, the decision tree determined that the optimum split point for subjects' overall health status resulted in dividing subjects into two categories. Thus, the optimum split point for subjects' overall health status separated subjects between the stable or mildly sick group (≤ 1), and all other health status categories (>1).

Figure 4.1. The decision tree from the model



The decision tree model can be interpreted as follows (Figure 4.2): subjects who did not have skin lesions or open wounds, who lived with other person(s) and who presented with severe pain (i.e. pain > 0 from Figure 4.1) were more likely to be rehospitalized when their total number of therapy visits combined was less than 11. When subjects who had skin lesion(s) or open wound(s) (>0 from Figure 4.1) but did not have pain interfering with activity or movement at all times and were considered to fall in either the moderately sick or sickest groups (>1), they were more likely to be rehospitalized. Finally, subjects who had skin lesion(s) or open wound(s) and had pain with interfering with activity or movement at all times were more likely to be rehospitalized.

Figure 4.2. The decision tree for home health care providers



Post-hoc Assessments

Associations between the Outcome (rehospitalization), Socio-Demographic Characteristics and Severity of Heart Failure Symptoms

A second post-hoc assessment was completed in order to further understand potential associations between severity of HF symptoms, gender and race, and rehospitalization, because there were no items related to New York Heart Association classification for the HF subjects included in the OASIS-C dataset. To examine

associations between severity of HF symptoms, rehospitalization, and demographic characteristics such as gender and race, a chi-square test was conducted. The variable "severity of HF symptoms" was created by using an item that combined six variables related to the ICD-9 codes. The item M1022 including the six variables was constructed by collecting ratings of the degree of symptom control for each condition that were documented by the admitting home health care providers, and then choosing one value among five scales that represented the degree of symptom control appropriate for each diagnosis (Guidance, 2011). From those six variables, ICD-9 codes for HF corresponding to the degree of severity were identified, and the highest severity among the variables was retained to represent the subjects' level of HF severity. In the item M1022, there were five scales, but this variable was regrouped into three scales for data analysis in this study (see Table 4.12).

Table 4.12. Description of each scale of severity of heart failure symptoms

Three scales-definition for this study	Description of each scale
0-no data available in the dataset	Asymptomatic, no treatment needed at this time
1. 1- Low	Symptoms well controlled with current therapy
2. 2- Moderate	Symptoms controlled with difficulty, affecting daily functioning or patient needs ongoing monitoring
3. 3 or 4-Severe	3- Symptoms poorly controlled; patient needs frequent adjustment in treatment and dose monitoring 4- Symptoms poorly controlled; history of rehospitalizations

There was no statistical association between severity of HF symptoms and rehospitalization in this study sample (see Table 4.13). In terms of socio-demographic characteristics, there were no statistically differences in severity of HF symptoms based on age, race, gender or subjects' living situation, between subjects who were rehospitalized and those who were not (see Tables 4.14, 4.15, 4.16 and 4.17).

Table 4.13. Association between severity of heart failure symptoms and rehospitalization (N=552)

Severity of heart failure	Non-rehospitalized	Rehospitalized	Entire group	p-

symptoms	(N=552) Count (%)	(N=354) Count (%)	(\N=198) Count (%)	value=0.479
Low	124 (66)	63 (34)	187 (34)	
Moderate	185 (64)	103 (36)	288 (52)	
Severe	45 (58)	32 (42)	77 (14)	

Table 4.14. Association between severity of heart failure symptoms and gender (N=552)

Severity of heart failure symptoms	Male (N=223) Count (%)	Female (N=284) Count (%)	p-value=0.093
Low	91 (49)	96 (51)	
Moderate	117 (41)	171 (59)	
Severe	40 (52)	37 (48)	

Table 4.15. Association between severity of heart failure symptoms and race (N=552)

Severity of heart failure symptoms	Non-white (N=95) Count (%)	White (N=457) Count (%)	p-value=0.702
Low	29 (16)	158 (84)	
Moderate	51 (18)	237 (82)	
Severe	15(19)	62 (81)	

Table 4.16. Association between severity of heart failure symptoms and subjects' living status (N=552)

Severity of heart failure symptoms	Living alone (N=144) Count (%)	Living with other person(s) (N=408) Count (%)	p-value=0.513
Low	44 (24)	143 (76)	
Moderate	81 (28)	207 (72)	
Severe	19(25)	58 (75)	

Table 4.17. Association between severity of heart failure symptoms and age (N=552)

Severity of heart failure symptoms	Low (N=192)	Moderate (N=296)	Severe (N=79)	p-value=0.479
Age (median (interquartile range))	79.5 (16.2)	79.2 (14.6)	78.4 (13.4)	

Multiple Imputation for Missing Data

Data were considered to be missing if subjects did not have a documented transfer or discharge date between 7/2/2014 and 8/31/2014 (n = 8) or if subjects were transferred to an in-patient facility after 8/31/2013 (n = 7). When predicted values were imputed for the missing data (n = 15) in the logistic regression model, all of the results were consistent with the results obtained without use of the missing data.

Table 4.18 presents associations between socio-demographic characteristics and rehospitalizations after performing the SAS Multiple Imputation procedure based on a total sample size of 567. Table 4.19 presents associations between socio-demographic characteristics and rehospitalizations based on a total sample size of 552. Tables 4.18 and 4.19 present the consistent results of socio-demographic characteristics obtained with and without use of the missing data; the variable "subjects' living situation" (i.e. living with other person (s)) was significantly associated with rehospitalization within the first 60 days of the home health care episode.

Table 4.18. Associations between socio-demographic characteristics and rehospitalization with multiple imputation

Socio-demographic characteristics	Count (column % for all subjects, row % for subgroups)			
	Rehospitalized (N=205) (column %)	Non-rehospitalized (N=362) (column %)	Entire group (N=567) (row %)	**P-value**
Age (median (interquartile range)	78.6 (15.9)	79.3 (14.3)	79.1 (15.1)	0.220
Gender				0.793
Male	93 (37)	160 (63)	253 (45)	
Female	112 (36)	202 (64)	314 (55)	
Race/Ethnicity				0.680
White	171 (37)	297 (63)	468 (83)	
Non-white	34 (34)	65 (66)	99 (17)	
Subjects' living situation				0.003
Live alone or live in a conjugated situation	38 (26)	109 (74)	147 (26)	
Live with other person(s)	167 (40)	253 (60)	420 (74)	

Note. SD: standard deviation

Table 4.19. Associations between socio-demographic characteristics and rehospitalization based a total sample of 552

Socio-demographic	Count (column % for all subjects, row % for subgroups)			
	Rehospitalized (N=198) (column %)	Non-rehospitalized (N=354) (column %)	Entire group (N=552) (row %)	p-value
Age (median (interquartile range))	78.6 (16.7)	79.3 (14.0)	79.0 (15.0)	0.185
Gender				0.852
Male	90 (36)	158 (64)	248 (45)	
Female	108 (36)	196 (64)	304 (55)	
Race/Ethnicity				0.800

White	165 (36)	292 (64)	457 (83)	
Non-white	33 (35)	62 (65)	95 (17)	
Subjects' living situation				0.003
Live alone or live in a conjugated situation	37 (26)	107(74)	144(26)	
Live with someone	161 (40)	247(61)	408(74)	

Survival Analysis

The results of survival analysis are presented according to categories from the conceptual model chosen for this study: predisposing, enabling resources and need characteristics.

1. Cox proportional hazards models revealed that eight variables were associated with time-to-first-rehospitalization within 60 days of the home care episode. Pairwise comparison analyses for significant variables with more than two categories were used to further examine comparisons along each level one of a given variable.
2. The Kaplan-Meir estimates present survival probabilities and 95% confidence intervals for the significant subject characteristics at 30 days and 60 days to help further clarify the results from the Cox proportional hazards model. The survival probability was measured starting from the start of home care to the occurrence of first-rehospitalization. The Kaplan-Meir curves (i.e. survival probability) present graphical differences in time-to-rehospitalization for each level of the given variable at any point in time within 60 days of the home health care episode.
3. The graph of the Epanechnikov Kernel-Smoothed Hazard Functions (i.e. Estimated Hazard rate) shows how the hazard of being rehospitalized changed over time for certain subject groups, and the expected number of rehospitalizations at the start of care.

Predisposing Characteristics

Four predisposing characteristics were associated with time-to-rehospitalization: a change of urinary incontinence prior to medical or treatment regimen change or in-patient stay within the past 14 days, multiple hospitalizations (i.e. more than two) in the past 12 months, and results of formal pain assessment (with or without reports of severe pain).

Cox proportional hazards model (see Table 4.20). Subjects experiencing a change to urinary incontinence prior to medical or treatment regimen change, or during an in-patient stay within the past 14 days, had a 26% lower risk of rehospitalization than those subjects who did not experience urinary incontinence (p=0.040) within 60 days of the home health care episode. The risk of being rehospitalized for subjects who had been hospitalized more than two times in the past 12 months was 1.40 times greater than the risk of rehospitalization among those who had fewer than two hospitalizations in the past 12 months (p-value=0.031). The risk of being rehospitalized for subjects with severe pain was 1.50 times greater than the risk of rehospitalization in those without severe pain.

Table 4.20. Hazard ratios of predisposing characteristics

Predisposing characteristics	Hazard ratios	95% confidence intervals	p-value
A change of urinary incontinence	0.74	0.56, 0.99	0.040
Multiple hospitalization (2 or more) in the past 12 months	1.40	1.03, 1.91	0.031
Formal pain assessment (with severe pain)	1.50	1.05, 2.15	0.025

Kaplan-Meir estimates. Table 4.21 presents Kaplan-Meir survival rates and 95% confidential intervals for the significant predisposing characteristics among subjects who experienced rehospitalizations at 30 days and at 60 days. Subjects who experienced a change in urinary incontinence prior to medical or treatment regimen change, or prior to an in-patient stay in the past 14 days, had a higher percentage of rehospitalizations (30-day = 25%, 60-day = 37%) than those without a change in urinary incontinence (36%,

46%, respectively). Subjects with multiple hospitalizations (i.e. more than two) in the past 12 months had a higher percentage of rehospitalizations (34%, 45%, respectively) than those with fewer than two hospitalizations in the past 12 months. Subjects with severe pain had a higher percentage of rehospitalizations (36%, 45%, respectively) than those without severe pain (23%, 36%, respectively).

Table 4.21. Kaplan-Meir survival rates and 95% confidence interval of predisposing characteristics

Predisposing characteristics	Survival Rates (95% CI) at 30 days	Survival Rates (95% CI) at 60 days
A change of urinary incontinence		
No	0.66 (0.60, 0.71)	0.54 (0.48, 0.61)
Yes	0.75 (0.68, 0.80)	0.63 (0.55, 0.69)
Multiple hospitalization (2 or more)		
No	0.77 (0.70, 0.83)	0.64 (0.55, 0.71)
Yes	0.66 (0.61, 0.71)	0.55 (0.49, 0.60)
Formal pain assessment		
Without severe pain	0.72 (0.68, 0.76)	0.60 (0.55, 0.65)
With severe pain	0.58 (0.46, 0.67)	0.49 (0.38, 0.60)

Note: CI- confidence intervals

Graphical Representations (The Kaplan-Meir curves and the Epanechnikov Kernel-Smoothed Hazard Functions). The Kaplan-Meir curves present graphical differences in hazards of rehospitalization for each risk factor: a change in urinary incontinence prior to medical or treatment regimen change or in-patient stay within the past 14 days, multiple hospitalizations (i.e. more than two times) in the past 12 months, formal pain assessment (with or without reports of severe pain) and subjects' overall health status at any point in time.

Figure 4.3 reveals that subjects who experienced a change in urinary continence had a lower probability of rehospitalization compared to those without a change in urinary incontinence at any time during the home care episode. In other words, subjects who did not have a change in urinary incontinence were at a consistently higher risk of being rehospitalized than those who had a change in urinary incontinence

Figure 4.3. Survival probability of a change in urinary continence prior to medical or treatment regimen change or in-patient stay within the past 14 days

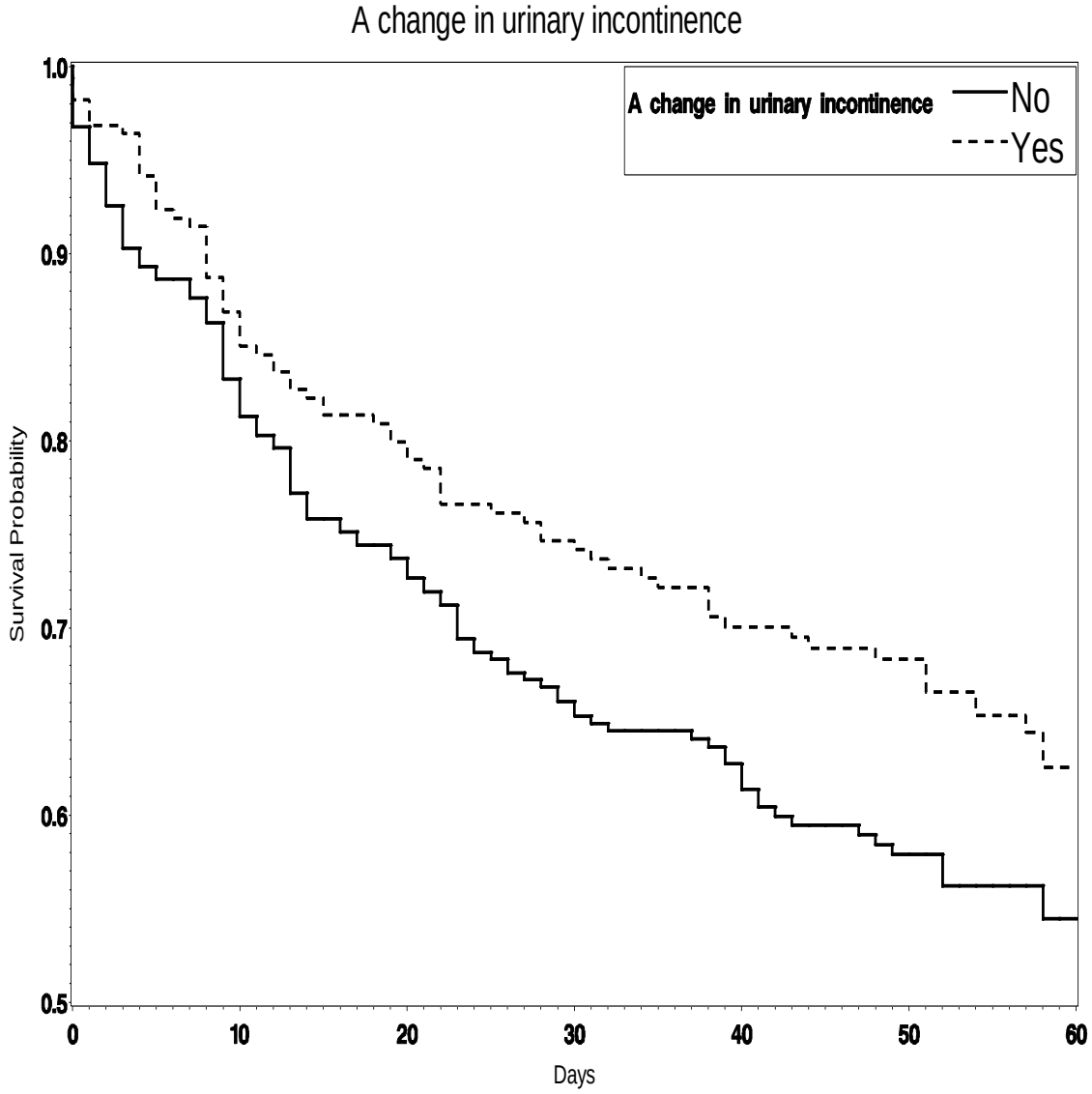
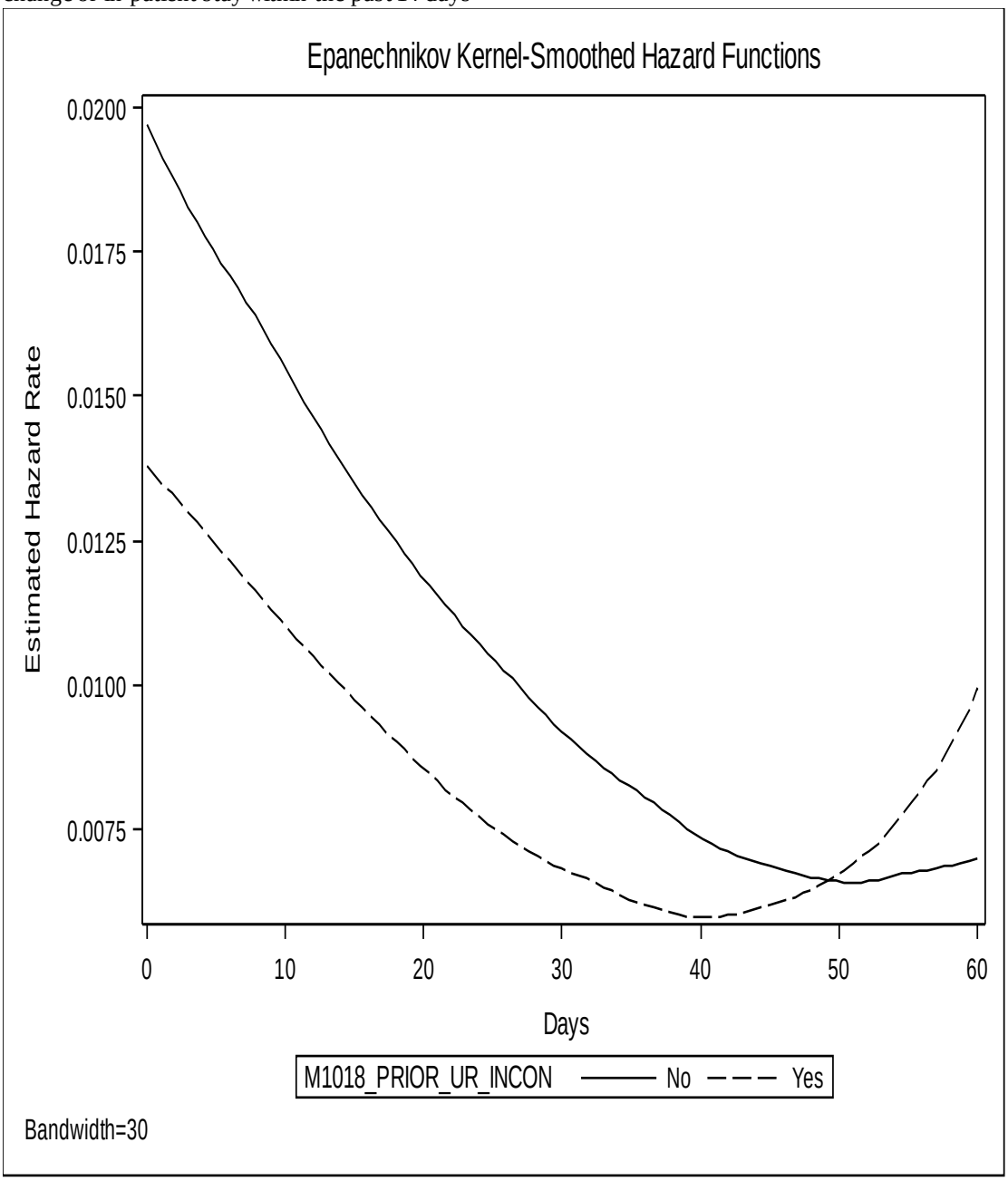


Figure 4.4 below reveals that among subjects who did not have urinary incontinence, for every 1000 persons-days at the start of care, the expected number of rehospitalizations was 20 at any point in time. Although the curves cross at about 50 days, the reliability of these curves becomes very limited this late in the home health care episode, since the end of the home health care episode was defined as the 60 days.

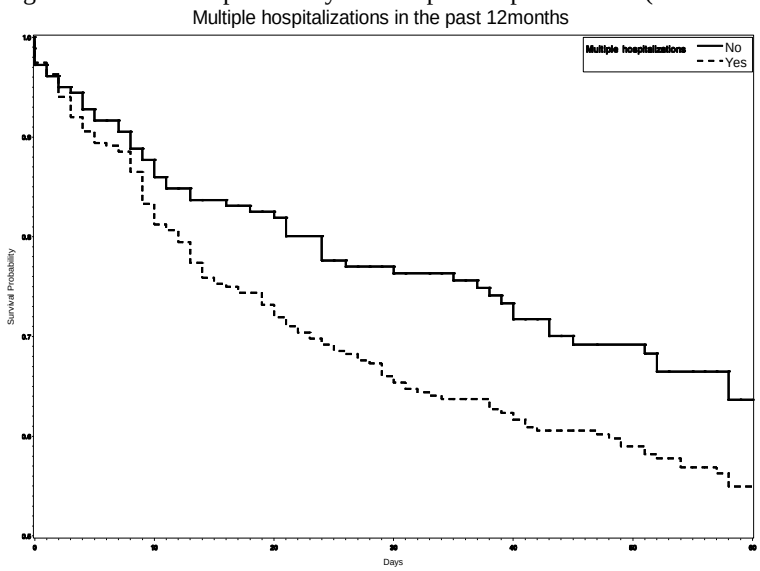
Figure 4.4. Estimated Hazard rate of a change in urinary continence prior to medical or treatment regimen change or in-patient stay within the past 14 days



Note: M 1018_PRIOR_UR_INCON-a change in urinary incontinence

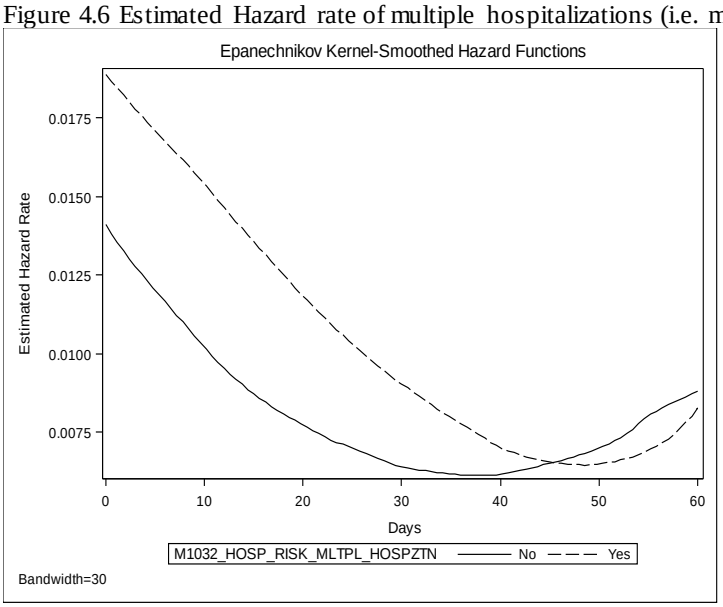
Figure 4.5 below reveals that subjects who did not have multiple hospitalizations in the past 12 months (i.e. more than two) had a lower probability of rehospitalization than those who had multiple hospitalizations in the past 12 months, at any point in time during the home care episode.

Figure 4.5. Survival probability of multiple hospitalizations (i.e. more than two)in the past 12 months



Specifically, for every 1000 persons-days at the start of care, the expected number of rehospitalizations among subjects who had multiple hospitalizations in the past 12 months was approximately 18, while the expected number of rehospitalizations among those who did not have multiple hospitalizations was approximately 14 at any point in time (Figure 4.6). Although the curves cross at about 45 days, the reliability of these curves becomes very limited this close to the end of the home care episode.

Figure 4.6 Estimated Hazard rate of multiple hospitalizations (i.e. more than two) in the past 12 months



Note:M1032_HOSP_RISK_MLTPL_HOSPZTN-multiple hospitalization (more than two) in the past 12 months

Figure 4.7. demonstrates that subjects who did not experience severe pain had a lower probability of rehospitalization at any point in time compared to those subjects who experienced severe pain when a standardized assessment tool was being used to assess their pain.

Figure 4.7.A comparison of probabilities of rehospitalization in subjects reporting severe pain

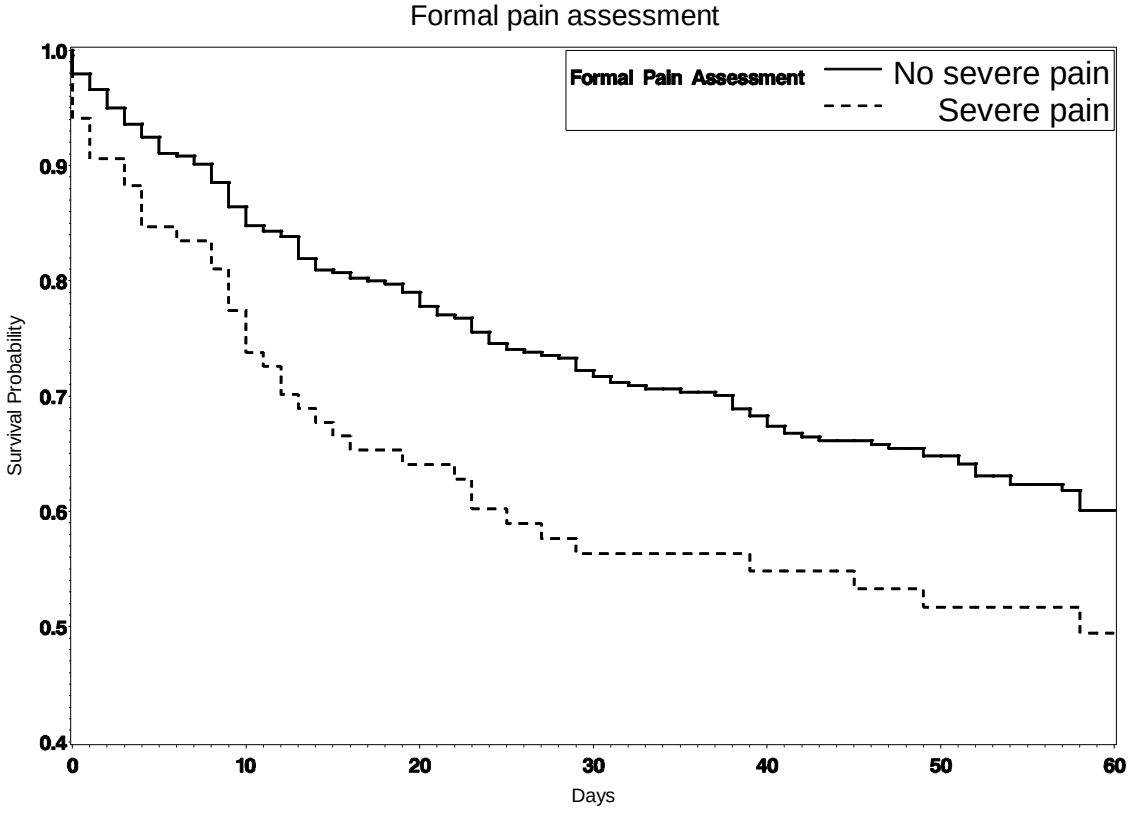
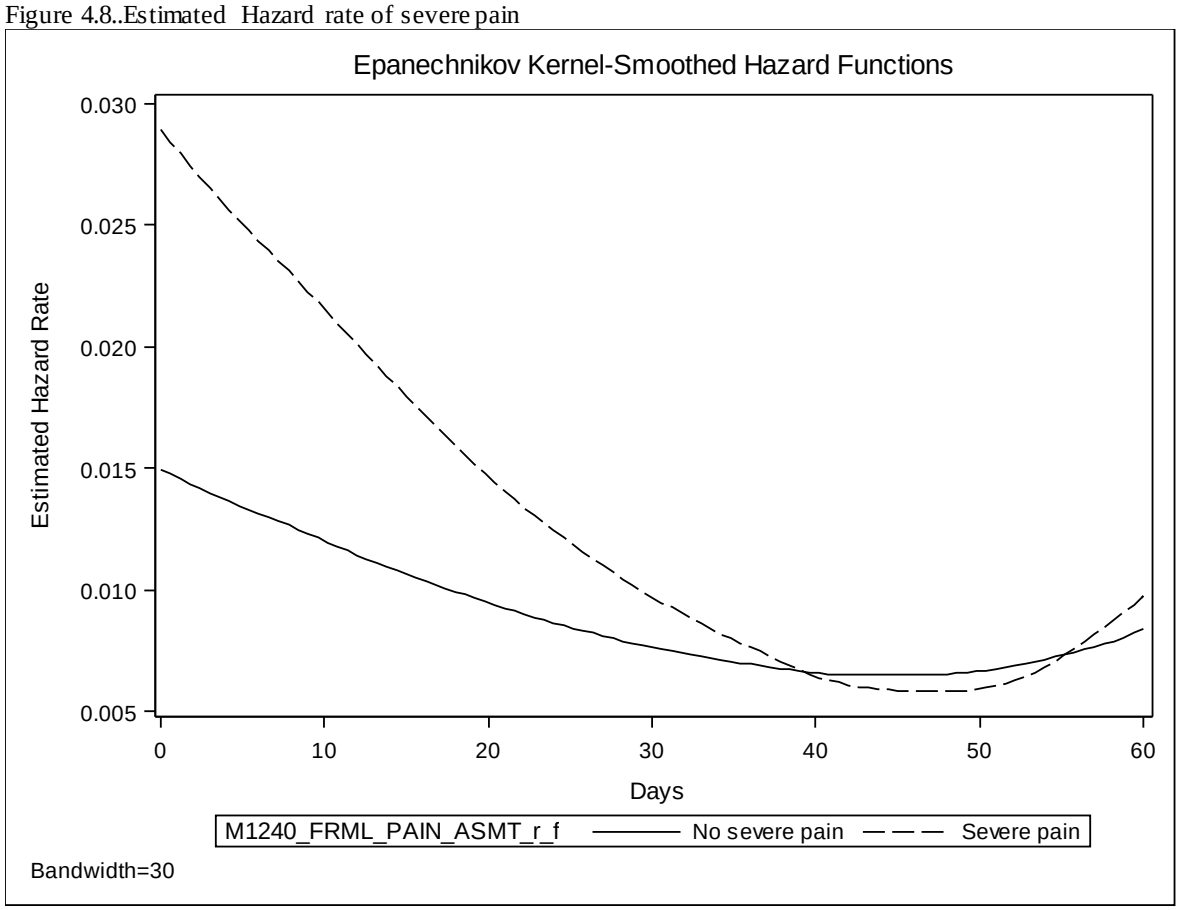


Figure 4.8. shows that subjects who experienced severe pain were at consistently higher risk for rehospitalization compared to those who did not experience severe pain when a standardized assessment tool to evaluate pain was being used. For every 1000 persons-days at the start of care, the expected number of rehospitalizations among subjects with severe pain was approximately 28, while the expected number of rehospitalizations among those without severe pain was 15 at any point in time during the home care episode. Although hazard rate of subjects with severe pain started increasing at

40 days after entering home care, the reliability of the curve becomes very limited when the curves cross.

Figure 4.8..Estimated Hazard rate of severe pain



Note: M1240_FRML_PAIN_ASMT_r_1-results of a formal pain assessment (severe pain :yes/no)

Enabling characteristics

Cox proportional hazards model (see Table 4.22). The risk of being rehospitalized within 60 days after entering home care for subjects who lived with another person(s) was 1.63 times greater than the risk of rehospitalization for those subjects who lived alone or who lived in a congregate situation (p-value=0.007). When subjects had a physician-ordered plan of care including pressure ulcer treatment based on principles of moist wound healing, or orders for treatment based on moist wound healing were requested from the subject's physician, the risk of being rehospitalized was 2.45 times

greater than the risk of reshospitalization for those subjects who did not have pressure ulcers (p-value=0.012). Table 4.23 presents a pairwise comparison of a physician-ordered plan of care including pressure ulcer treatment, between those subjects with a physician's order and without a physician's order, but the difference between the two groups was not significant (p-value=0.305).

Table 4.22. Hazard ratios of subjects' living situation and a physician-ordered plan of care including pressure ulcer treatment

Enabling characteristics	Hazard Ratios	95% confidence interval	p-value
Subjects' living situation(reference: lived alone)	1.63	1.14, 2.33	0.007
Plan of Care Synopsis: pressure ulcer treatment based on principles of moist wound healing ordered or requested			0.012
No	1.41	0.59, 3.41	0.440
Yes	2.45	1.33, 4.51	0.004
No pressure ulcers (reference)	----	----	----

Table 4.23. Pairwise comparison of hazard ratios for subjects with a physician-ordered plan of care including pressure ulcer treatment

Enabling characteristic	Hazard Ratios	95% confidence interval	p-value
Plan of Care Synopsis: pressure ulcer treatment based on principles of moist wound healing ordered or requested			
Yes vs No	1.73	0.61, 4.97	0.305

Kaplan-Meir estimates. Subjects who lived with at least one other person had a higher percent of rehospitalization (30-day: 33%, 60-day: 46%) than subjects who lived alone (21%, 32%, respectively) (see Table 4.24). In terms of physician-ordered plans of care, subjects who had pressure ulcer treatment based on principles of moist wound healing or orders for treatment based on moist wound healing had the highest proportion of rehospitalizations (60%, 66%, respectively) compared to other subject groups.

Table 4.24. Kaplan-Meir survival rates and 95% confidence interval of enabling characteristics

Enabling characteristics	Survival rates (95% confidence interval) at 30 days	Survival rates (95% confidence interval) at 60 days
Patient living situation		
Lived alone	0.79 (0.73, 0.86)	0.68 (0.59, 0.77)

Lived with someone	0.67 (0.62, 0.71)	0.54 (0.49, 0.60)
Plan of Care Synopsis: pressure ulcer treatment based on principles of moist wound healing ordered or requested		
No	0.64 (0.39, 0.89)	0.56 (0.30, 0.83)
Yes	0.40 (0.18, 0.61)	0.34 (0.12, 0.55)
No pressure ulcers	0.71 (0.67, 0.75)	0.59 (0.54, 0.64)

Graphical Representations (The Kaplan-Meir curves and the Epanechnikov Kernel-Smoothed Hazard Functions). Figure 4.9 shows that subjects who lived alone or those who lived in a congregate situation (e.g., assisted living) had a lower probability of rehospitalization compared to those who lived with at least one other person(s) at any point in time during the home care episode.

Figure 4.9. A comparison of probabilities of rehospitalization based on category of subjects' living situation

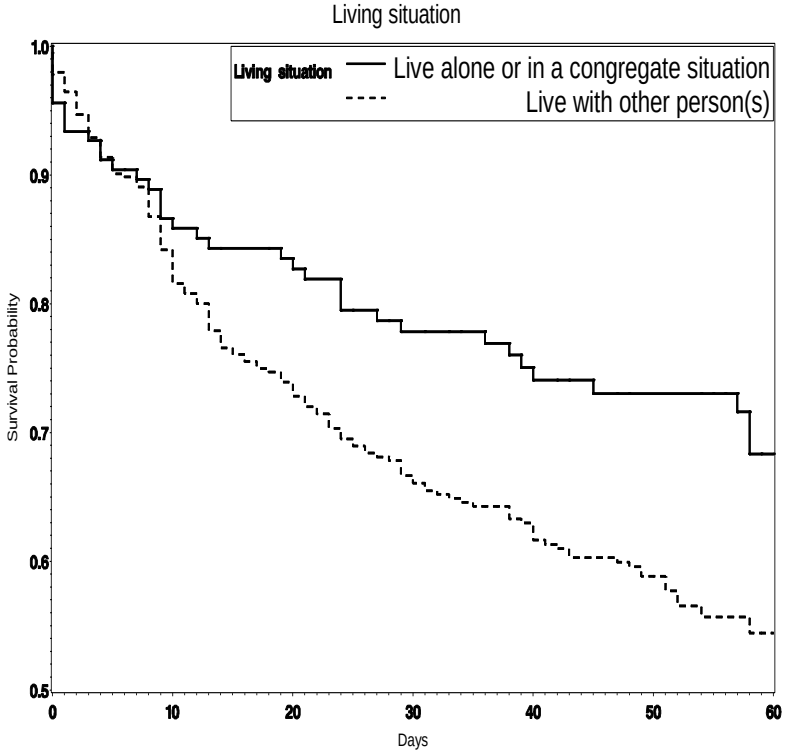
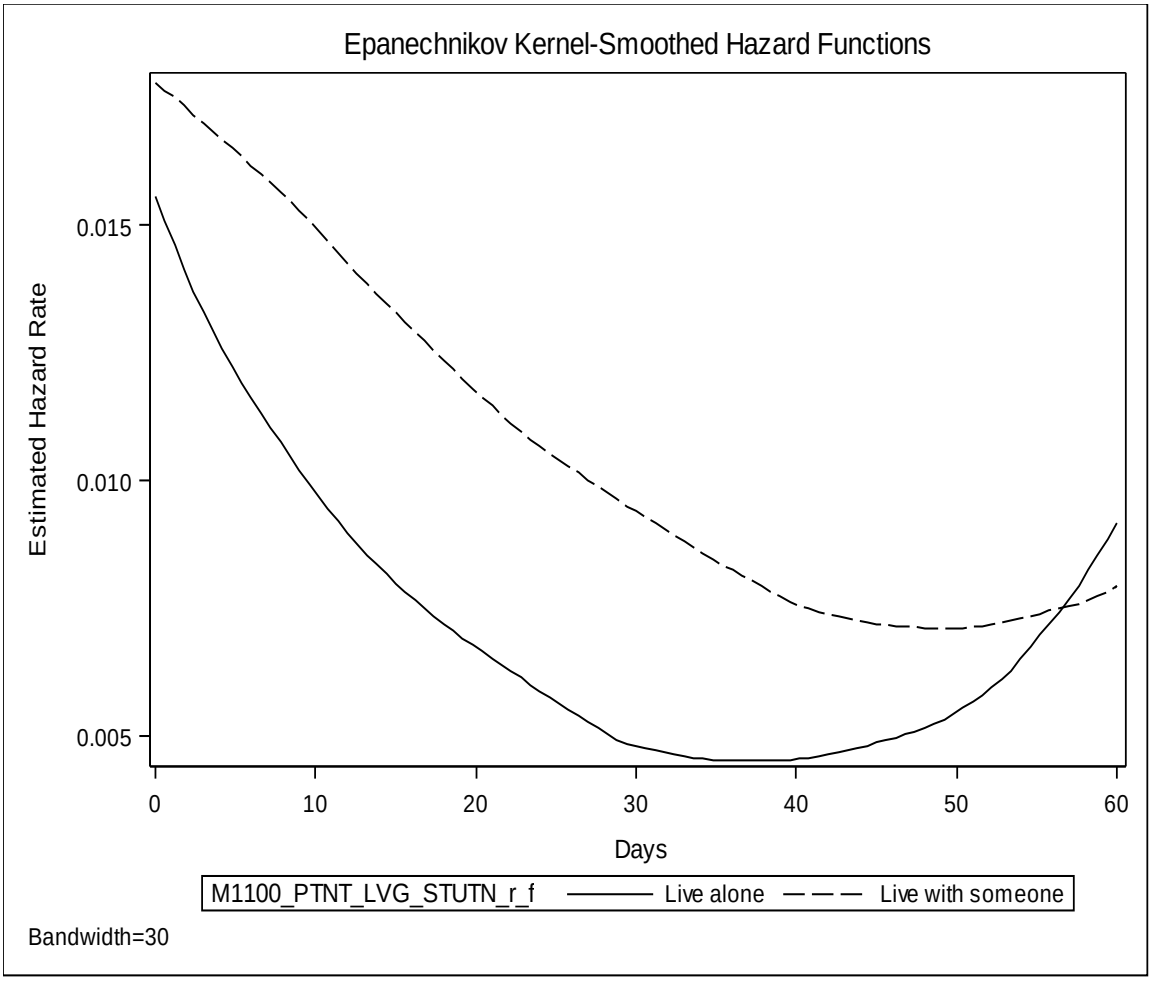


Figure 4.10 demonstrates that subjects who lived with at least one other person(s) were at consistently higher risk for rehospitalization compared to those who lived alone

or those who lived in congregate situations (e.g., assisted living) at any point in time. Specifically, among subjects who lived alone, for every 1000 person-days at the start of care, the expected number of rehospitalizations was 15. Notably, the two curves are reliable until the end of the home care episode.

Figure 4.10.Estimated Hazard rate of subjects' living situation



Note: M1100_PTNT_LVG_STUTN_r_1-subjects' living situation

Figure 4.11 shows that subjects who did not have pressure ulcers with a need for moist wound healing had the lowest probability of rehospitalization among those subjects who had pressure ulcers with a physician-ordered plan of care, or whose home care nurses requested orders including moist wound healing (i.e. plan of care ordered) and

those without the plan of care ordered. In the meantime, although the probability of rehospitalization was stable after a certain number of days in subjects who had pressure ulcers with the plan of care ordered and those without the plan of care ordered, those without the plan of care ordered had a consistently lower probability of rehospitalization compared to those with the plan of care ordered.

Figure 4.11. A comparison of probabilities of rehospitalization among subjects with a physician-ordered plan of care for pressure ulcer treatment

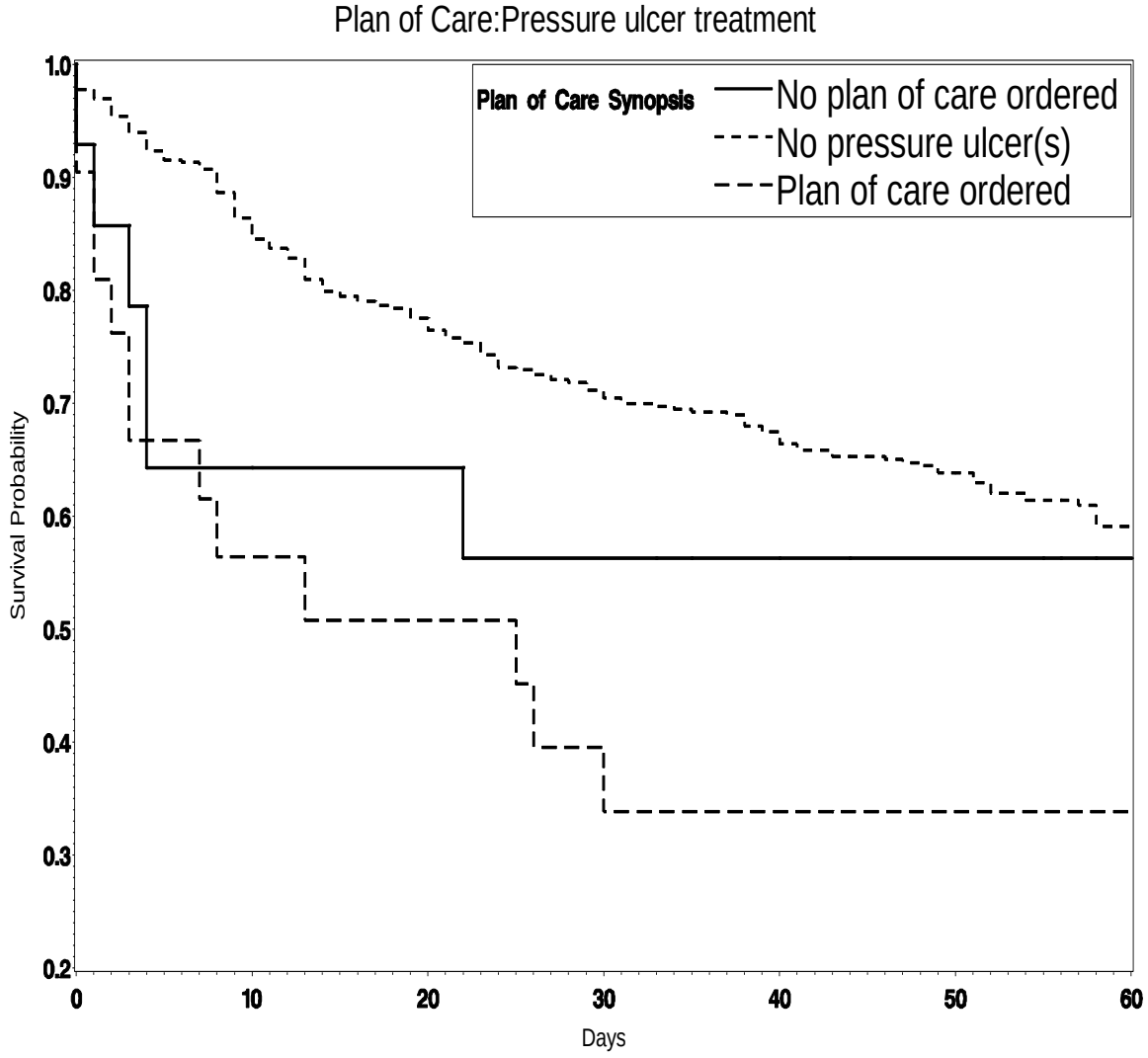
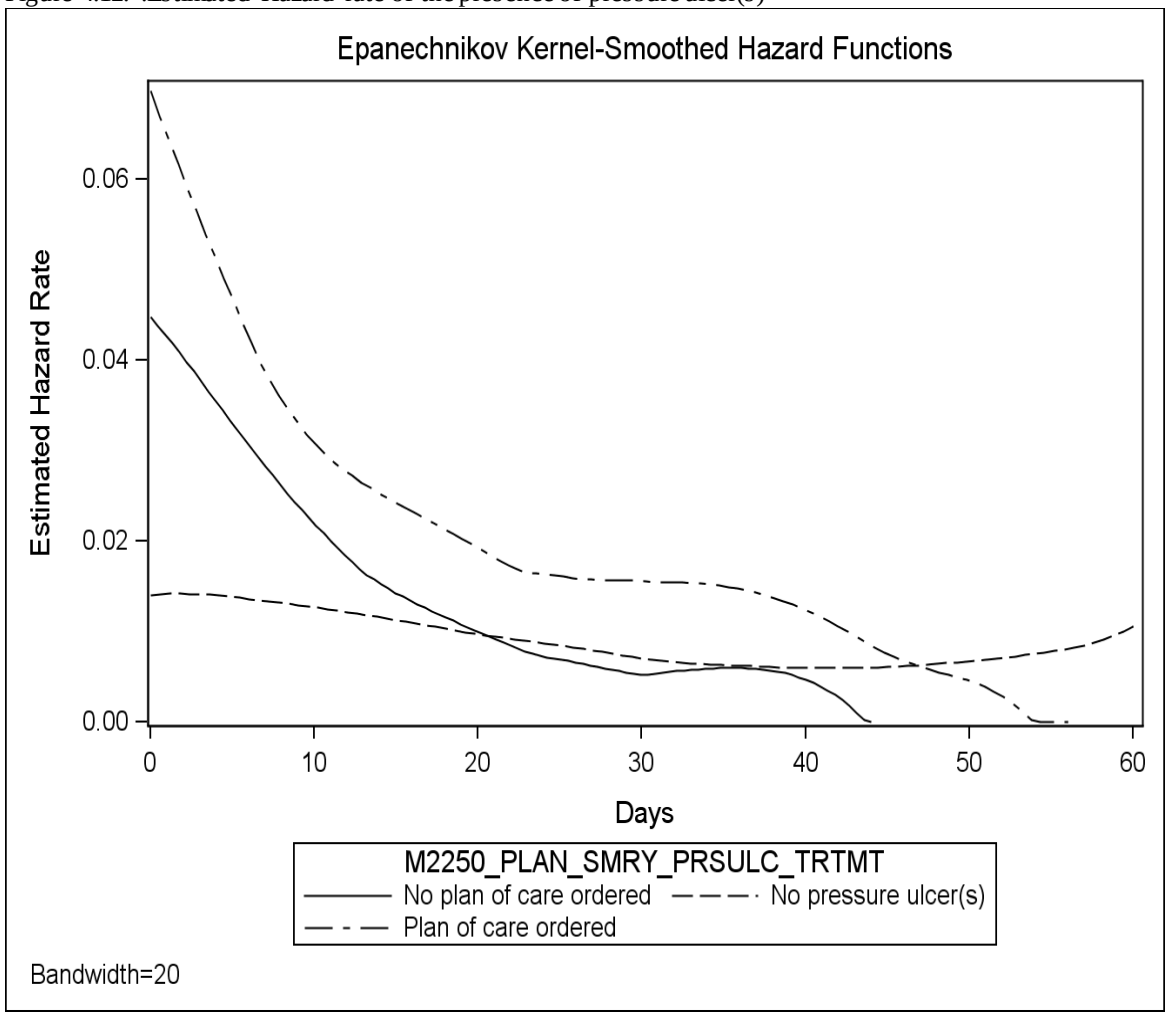


Figure 4.12 shows that subjects who did not have pressure ulcers with a need for moist wound healing had a lower risk of rehospitalization compared to those who had pressure ulcer(s) with physician-ordered or requested pressure ulcer treatment based on

principles of moist wound healing. For every 1000 persons-days at the start of care, the expected number of rehospitalizations among subjects with pressure ulcer(s) requiring moist wound healing was about 50 at any time during the home care episode, while the expected number of rehospitalizations among those without pressure ulcer(s) was slightly more than 10.

Figure 4.12. .Estimated Hazard rate of the presence of pressure ulcer(s)



Note: M2230_PLAN_SMRY_PRSULC_TRTMT-paln of care for pressure ulcer treatment

Need Characteristics

Two need characteristics were associated with time-to-first rehospitalization; frequency of pain interfering with the patient's activity or movement and ability to dress one's lower body.

Cox proportional hazards model (see Table 4.25). The risk of being rehospitalized for subjects who complained of pain interfering with their activity or movement at all times was 1.72 times greater than the risk of rehospitalization in subjects who did not complain of pain. Even among subjects who complained of pain interfering with their activity or movement, the risk of being rehospitalized for subjects who complained of pain interfering at all times was 2.15 times greater than the risk of rehospitalization for those who complained of less frequent or interfering pain.

In terms of ability to dress one's lower body safely, subjects who were assessed as being in either the moderately dependent or the completely dependent groups were at 54% ($p<0.01$) and 35 % ($p=0.04$), respectively, lower risk for rehospitalization than those subjects who were independent in dressing their lower bodies.

Table 4.25. Hazard ratios of need characteristics

Need characteristics	Hazard Ratios	95% confidence interval	p-value
Frequency of pain interfering with patient's activity or movement			0.030
No pain (reference)			
Pain without interfering with activity or occurring less often than daily	0.80	0.53, 1.20	0.284
Daily, but not constantly interfering	1.23	0.89, 1.70	0.217
All of the time	1.72	1.05, 2.82	0.032
Ability to dress lower body			0.011
Independent (reference)	----	------	
Mildly dependent	0.46	0.28, 0.76	0.003
Moderately or completely dependent	0.65	0.43, 0.98	0.040

As shown in Table 4.26, the risk of being rehospitalized for subjects who complained of pain interfering with their activity or movement daily, but not consistently,

was 1.53 times greater than the risk of rehospitalization in subjects who complained of pain that did not interfere with activity or that occurred less often than daily (p-value=0.039). The risk of being rehospitalized for subjects who complained of pain interfering with their activity or movement at all times was 2.15 times greater than the risk of rehospitalization in subjects who complained of pain that did not interfere with activity or that occurred less often than daily (p-value=0.007).

Table 4.26. Pairwise comparison of hazard ratio of frequency of pain interfering with patient's activity or movement and ability to dress lower body

Frequency of pain interfering with patient's activity or movement	Hazard ratios	95% confidence interval	p-value
Daily, but not constantly vs Pain without interfering with activity or occurring less often than daily	1.53	1.02, 2.31	0.039
All of the time vs Pain without interfering with activity or occurring less often than daily	2.15	1.24, 3.73	0.007
Daily, but not constantly vs All of the time	0.71	0.44, 1.17	0.182
Ability to dress one's lower body			
Mildly dependent vs Moderately or completely dependent	1.42	0.97, 2.07	0.072

The Kaplan-Meir estimates (see Table 4.27). In terms of ability to dress one's lower body safely, subjects who were independent and safe in dressing their lower bodies had the highest probability of rehospitalization (35%, 67%) than either those subjects in the moderately dependent or completely dependent groups (33%, 42%, respectively). As expected, subjects who complained of pain interfering with their activity or movement at all times had the highest probability of rehospitalization (51%, 56%, respectively) among the other three groups.

Table 4.27. Kaplan-Meir survival rates and 95% confidence interval of need characteristics

Need characteristics	Survival rates (95% CI) at 30 days	Survival rates (95% CI) at 60 days
Ability to dress one's lower body		
Independent (reference)	0.65 (0.48, 0.77)	0.37 (0.21, 0.53)
Mildly dependent	0.78 (0.69, 0.85)	0.66 (0.55, 0.75)
Moderately or completely dependent	0.68 (0.63, 0.72)	0.58 (0.53, 0.63)

Frequency of pain interfering with activity or movement		
No pain	0.72 (0.65, 0.78)	0.59 (0.50, 0.66)
Pain without interfering with activity or occurring less often than daily	0.78 (0.69, 0.85)	0.67 (0.56, 0.75)
Daily, but not constantly	0.67 (0.59, 0.73)	0.55 (0.47, 0.62)
All of the time	0.49 (0.33, 0.64)	0.44 (0.26, 0.60)

Note: CI- confidence intervals

Graphical Representations (The Kaplan-Meir curves and the Epanechnikov Kernel-Smoothed Hazard Functions). Figure 4.13 shows that subjects who had pain interfering with activity or occurring less often than daily had the lowest probability of rehospitalization compared to subjects in the other three pain assessment groups.

Figure 4.13. Survival probability of Frequency of pain interfering with activity or movement

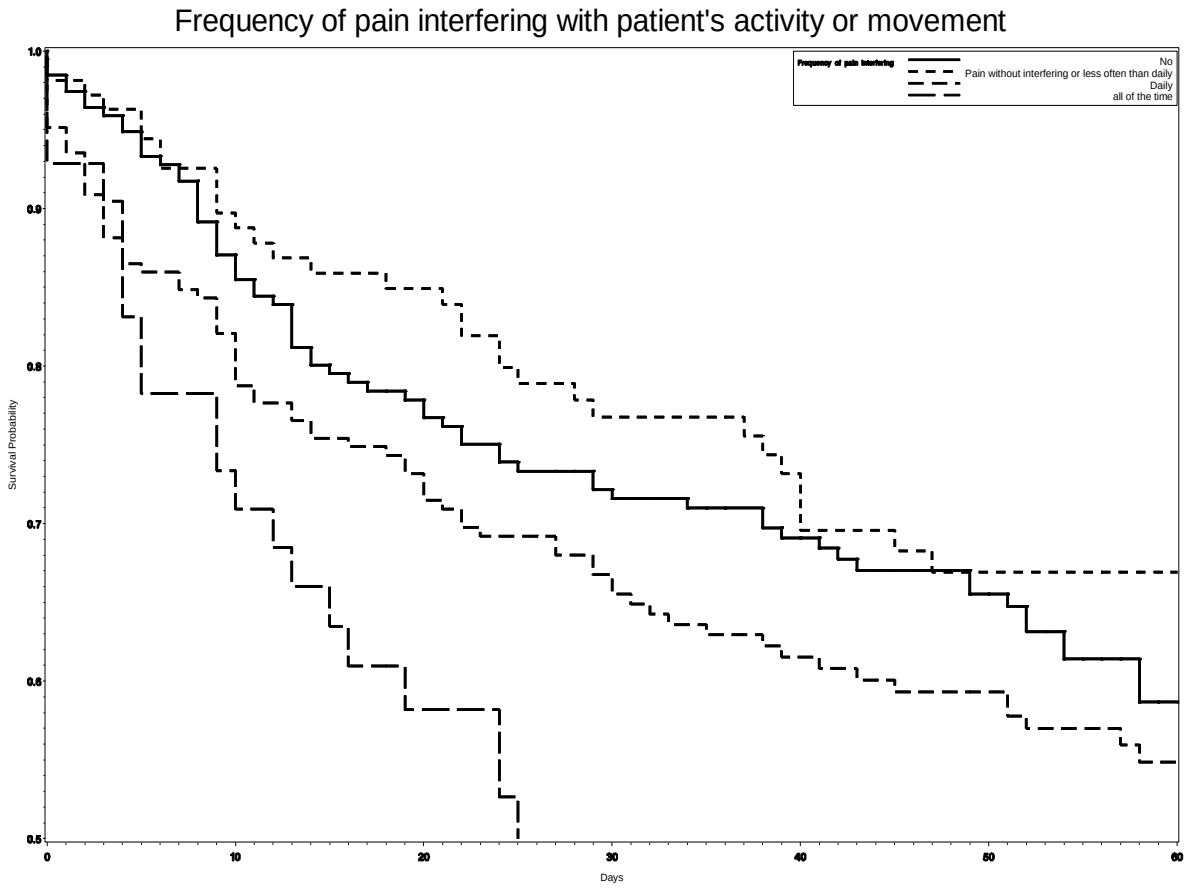
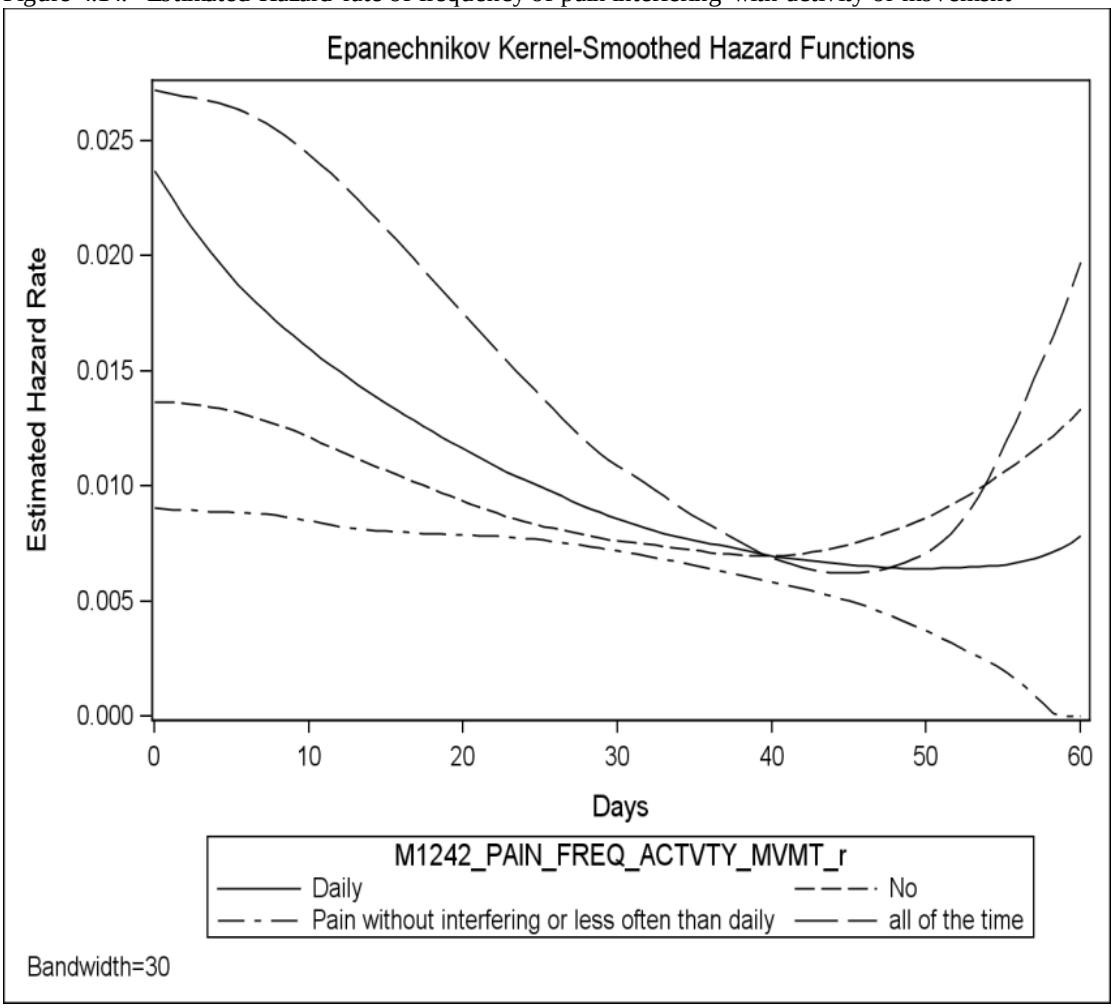


Figure 4.14 shows that subjects who had pain interfering with their movements or activities at all times were at a consistently higher risk of being rehospitalized than those

subjects without pain-related limitations at any point in time, until approximately 40 days into the home care episode. Specifically, for every 1000 person-days at the start of care, the expected number of rehospitalizations in subjects who had pain interfering with their movements or activities at all times was slightly more than 25. In the meantime, for every 1000 person-days at the start of care, the expected number of rehospitalizations in subjects who had pain interfering with activity or occurring less often than daily was approximately 8; the risk of rehospitalization in this group was consistently lower than other groups until the end of the home care episode (i.e. 60 days).

Figure 4.14. Estimated Hazard rate of frequency of pain interfering with activity or movement



Note: M1242_PAIN_FREQ_ACTIVITY_MVMT_r- frequency of pain interfering with activities or movements

The ability to dress one's lower body safely. Figure 4.15 demonstrates that subjects who were independent in dressing their lower bodies had the highest probability of rehospitalization compared to the other two functional groups (i.e. mildly dependent, moderately dependent or completely dependent) at any point in time during the home care episode.

Figure 4.15. .Survival probability of the ability to dress lower body

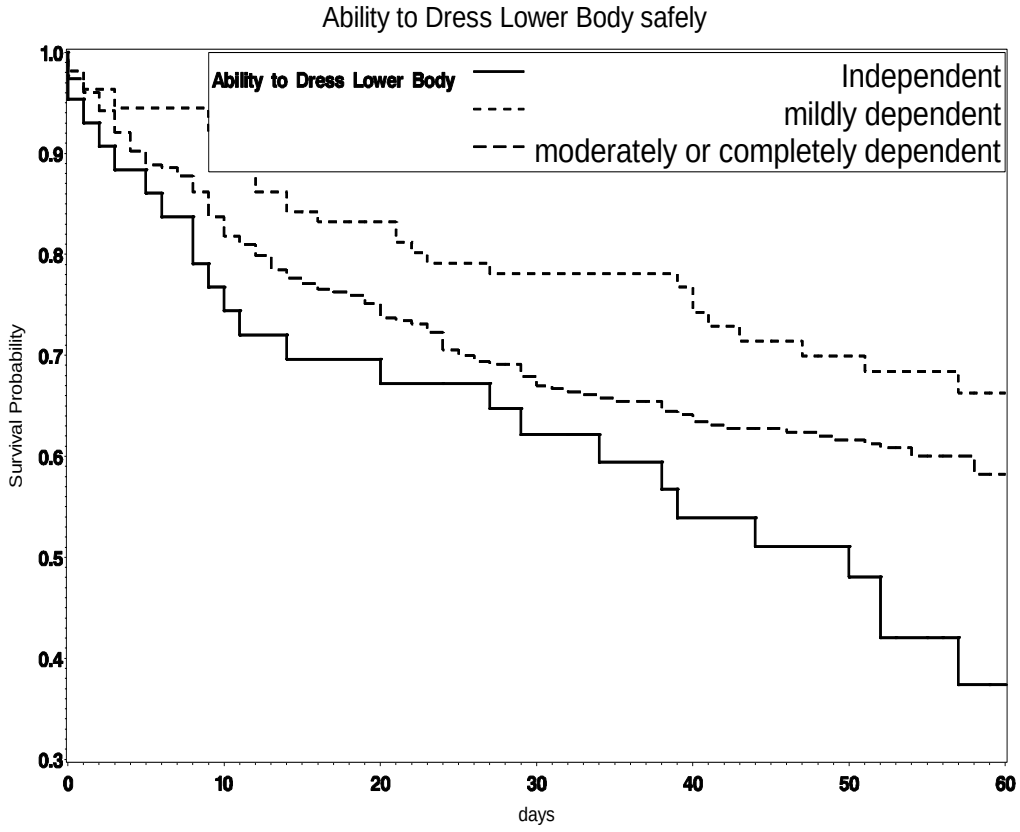
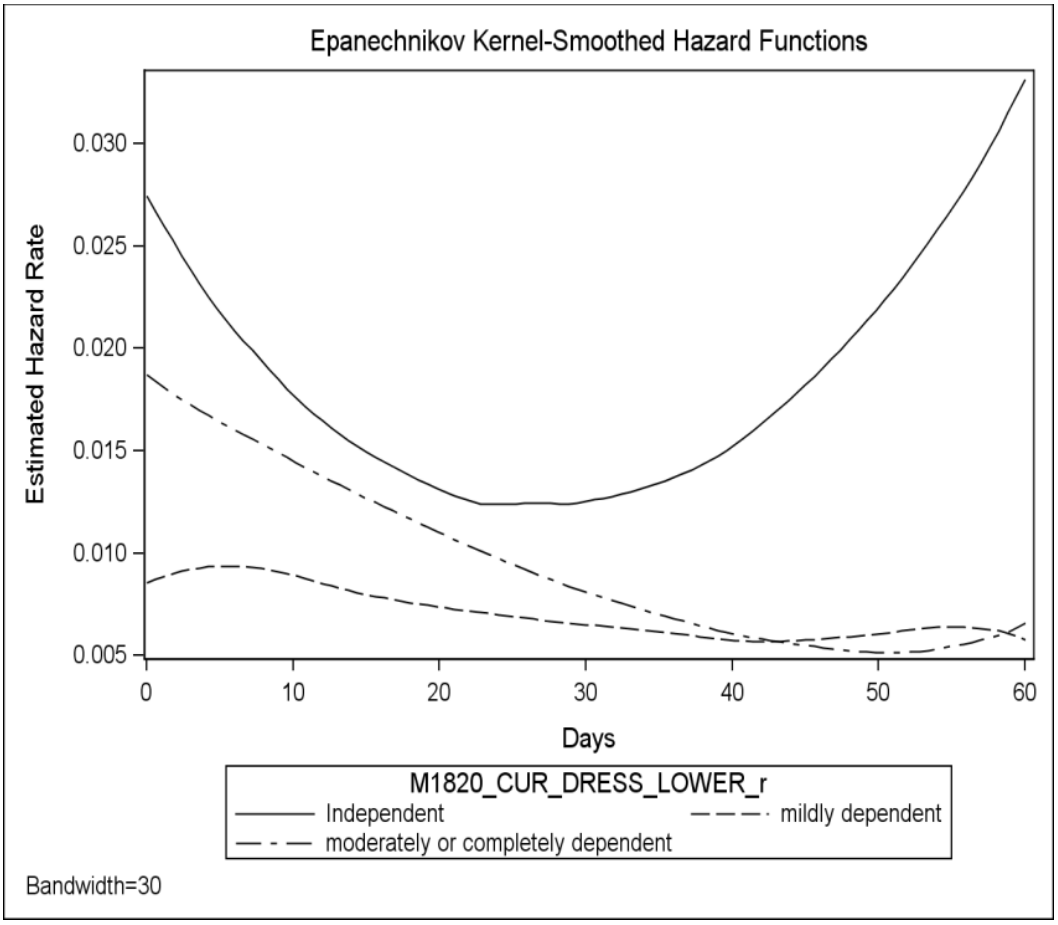


Figure 4.16 shows that subjects who were independent in dressing their lower bodies (i.e. group 0) were at consistently higher risk for rehospitalization compared to the other subject groups, at any point in time during the home care episode. For every 1000 person-days at the start of care, the expected number of rehospitalizations among functionally independent subjects was approximately 27, but the expected number of

rehospitalizations increased during the period from 30 to 60 days. After nearly 45 days, there was no difference in the risk of being rehospitalized between subjects who were mildly dependent and those who were moderately or completely dependent because their curves crossed. However, the curve of independently functional subjects does not cross with the two other curves, which means that they were at risk for rehospitalization until the end of their home care episode. Thus, subjects who were independent to dress their lower bodies had a consistently higher risk of rehospitalizations at any point in time than the dependent subject groups, and they tended to have an increased risk of rehospitalization at the end of the home care episode.

Figure 4.16.Estimated Hazard rate of the ability to dress lower body



Note: M1820_CUR_DRESS_LOWER_R: ability to dress one's lower body safely

Summary

Among ten variables found to be statistically significantly associated with rehospitalization in chi-square, multiple logistic regression and survival analyses, four of these variables were predisposing factors (i.e. a change in urinary incontinence, multiple hospitalizations (i.e. two or more in the past 12 months), subjects' overall health status, and results of a formal pain assessment); two were enabling factors (subjects' living situation and plan of care for pressure ulcer(s)); and four were need factors (frequency of pain interfering with subjects' activities or movements, presence of skin lesion(s) or open wound(s), ability to dress one's lower body safely, and total number of therapy visits combined).

Five of the significant variables are new items in the updated OASIS-C dataset: multiple hospitalizations (i.e. two or more in the past 12 months), subjects' overall health status, results of a formal pain assessment, total number of therapy visits combined, and plan of care for pressure ulcer(s). In particular, subjects' overall health status, results of a formal pain assessment, and the ability to dress one's lower body safely affected rehospitalizations in the final logistic regression model and were associated with time-to-first rehospitalization among telehomecare subjects with HF.

The decision tree analysis using the WEKA program presented similar risk factors as the logistic regression model for rehospitalizations, such as the presence of skin lesions or open wounds, subjects' overall health status, and results of a formal pain assessment, and it provided additional information regarding the interactions among various risk factors instead of simply demonstrating the associations between the outcome of rehospitalization and a single risk factor.

In summary, logistic regression models provided associations between a given risk factor and rehospitalization, while the decision tree analysis presented interactions among all of the identified risk factors for rehospitalization as a global picture of the priority of each risk factor. In addition, survival analysis visually presented the probabilities and risks of rehospitalization over time for different subject groups receiving THC during the 60 days of the home health care episode.

CHAPTER FIVE: DISCUSSION AND CONCLUSION

Introduction

The terms telehomecare (THC) and telehealth are interchangeable, but THC specifically refers to the use of telehealth in home care settings. In general, telehealth is the use of telecommunication or videoconferencing technologies to monitor patients' health status, such as vital signs, weight or blood sugar, on a daily basis, in order to help patients with chronic diseases improve their self-care, self-management skills and outcomes. Over the last two decades, telehealth has been increasingly used for patients with chronic diseases, such as heart failure (HF) (Puskin, Cohen, Ferguson, Krupinski, & Spaulding, 2010). HF among Medicare recipients is responsible for more rehospitalizations in the United States than any other diagnosis (Psotka & Teerlink, 2013).

THC has been proposed as a potential way to provide remote daily monitoring for HF patients in order to reduce rehospitalizations. However, studies on THC conducted in the United States have shown mixed results in the HF population (Madigan et al., 2013). Little is known about the characteristics of patients who are more likely to be rehospitalized while receiving THC. This study aimed to identify patient-related characteristics associated with all-cause rehospitalizations and to identify patient-related

characteristics associated with time-to–first-rehospitalization for all-causes among Medicare recipients with HF receiving THC, within 60 days of the home health care episode.

Most risk factors for rehospitalization reported in the literature on HF patients have been hemodynamic characteristics or biomarkers (i.e. the patient's BNP level or the value of their ejection fraction) obtained using invasive instruments (Hernandez et al., 2010; Myers et al., 2006; Zaya, Phan, & Schwarz, 2012) which are readily available in the in-patient setting. However, it is difficult, expensive, and time-consuming to examine these same values in the home health care setting. Using electronic medical records may be a potentially cost-effective and convenient way to identify risk factors for rehospitalization among patients in home health care settings. This study utilized an existing standardized electronic medical database, which was the latest version of the Outcome and Assessment Information Set, called the OASIS-C dataset.

The remaining discussion sections are presented in the following order:

1. Major findings
2. Socio-demographic characteristics
3. Findings from the decision tree technique
4. Post-hoc assessments
5. The application and evaluation of THC for the HF population in terms of reducing rehospitalization rates
6. The use of OASIS-C to predict the risk of rehospitalization
7. Methodology
8. Implications for Practice, Research and Policy

9. Limitations and methodological considerations

Discussion of Major Findings

Six patient-related characteristics from the OASIS-C dataset were significantly associated with rehospitalizations in this sample of Medicare recipients with HF who received THC during the 60 days of their home care episode. Four risk factors for rehospitalization were also identified using logistic regression modeling, and seven risk factors for rehospitalization were found using survival analysis techniques. Of these proposed risk factors, two variables were particularly significant, as they were consistently identified across all three analyses, and represented somewhat unanticipated findings: results of a formal pain assessment and the ability to dress one's lower body safely. These identified risk factors could be used by home health providers making clinical judgments regarding THC placement for patients with HF while completing required OASIS-C start of care documentation.

Pain (Formal pain assessment and frequency of pain interfering with patient's activities or movements)

In this study, two pain-related items were found to be risk factors for rehospitalization: the results of a formal pain assessment using a standardized pain assessment tool (i.e. with or without severe pain), and the frequency of pain interfering with patients' activities or movements. The presence of severe pain identified by a formal pain assessment affected rehospitalization rates. In addition, patients who had pain interfering with their activities or movements at all times were more likely to be rehospitalized, compared to those without such constant interfering pain. However, there

are no items in the OASIS-C dataset which could be used to identify the sources or types of pain.

In general, pain is not well-understood in the HF population (Goebel et al., 2009); (Evangelista, Sackett, & Dracup, 2009) and it has not been typically reported as a symptom of HF in research studies (Evangelista et al., 2009). The common symptoms associated with HF are shortness of breath, fatigue and edema (Goebel et al., 2009); (Evangelista et al., 2009). However, evidence demonstrates that pain can become a symptom for HF patients due to the presence of multiple comorbidities (Goebel et al., 2009; Evangelista et al., 2009). For example, diabetes is a high risk factor for the development of HF (Nichols, Gullion, Koro, Ephross, & Brown, 2004), and diabetic neuropathy is one of the most common complications of diabetes (Zhong et al., 2014), which is accompanied by symptoms such as extremity pain (Vasudevan, Naik, & Mukaddam, 2014 ;Galer, Gianas, & Jensen, 2000). In the existing literature of telehealth studies on diabetic patients, telehealth was shown to be a successful intervention to improve outcomes (Jennett et al., 2003; Jia, Chuang, Wu, Wang, & Chumbler, 2009; Bowles & Dansky, 2002; Dansky, Vasey, & Bowles, 2008). Perhaps, if patients with HF have diabetes as a comorbidity, home health care providers should evaluate not only patients' vital signs and daily weight through THC, but also glucose and pain levels.

Other evidence demonstrates that the presence of pain can represent an important issue interfering with daily activities for patients in any stage of HF (Goebel et al., 2009; Godfrey, Harrison, Friedberg, Medves, & Tranmer, 2007; Evangelista et al., 2009). Studies suggest that it is essential to increase awareness among home health care providers of the importance of pain as a factor limiting self-management capabilities for

patients with HF during the transitional period after hospital discharge (Godfrey et al., 2007; Evangelista et al., 2009).

From October 2012 to September 2013, the nationwide rate of improvement in pain interfering with daily activities or movement at the time of discharge from home care was 66.8%, according to the OASIS –C based Home Health Agency Patient Outcome, Process and Potentially Avoidable Event Reports (NAHC, 2014). This rate is relatively low compared to other items' improvement rates. The data from this report, as well as the findings from the current study, show that pain management in the home care setting needs to be improved. At a minimum, identifying and documenting pain accurately is important for better pain management, which could ultimately help patients with HF to improve their disease self-management through the use of THC. Perhaps, the Center for Medicare/Medicaid Services (CMS) may need to consider adding items to future versions of the OASIS dataset related to identifying the source and the types of patients' pain. Providing evidence-based guidelines for pain management at the point of care is also suggested.

The Ability to Dress One's Lower Body

The ability to dress one's lower body is one measure of patients' functional status in the OASIS-C dataset, and it reflects patients' ability to perform activities of daily living (Scharpf & Madigan, 2010). Scharpf and colleagues (2010) reported that the ability to dress one's lower body was one of the best indicators of functional dependence in the HF population, followed by the ability to self-bathe (Scharpf & Madigan, 2010). One of this study's unanticipated findings was related to patients' ability to dress their

lower bodies. Thus, patients' ability to dress their lower bodies may require more attention when HF patients are being assessed at the start of care in home care settings.

Subjects who were able to dress their lower bodies safely without assistance (i.e. independent subjects) were more likely to be rehospitalized, and presented a higher risk of rehospitalization compared to those patients with some degree of dependency. In general, it is assumed that if a patient is independent in dressing his or her lower body, then they should also be able to weigh themselves and be capable of recognizing weight gain earlier than other patients. If this is true, recognition of their weight gain may have triggered the more independent patients to return to the hospital earlier, before they began experiencing clinical deterioration. Or, patients who were dependent in any degree might have had a lower probability of rehospitalization because they received more attention from home health care providers since they received more services, such as physical therapy or occupational therapy, than those who were independent.

In addition, although the risk of rehospitalization among patients in the independent group decreased from the start of care assessment up to 30 days after entering home care, those patients returned to a higher risk of rehospitalization by the end of the home care episode, when compared to their risk at the start of care. It is difficult to explain the reasons for this finding, particularly because the dose of THC and patients' adherence to the THC intervention is unknown in this study.

Patient's Overall Health Status

Home health care providers use their clinical judgments to assign each patient to an overall health status category in the OASIS-C dataset based on the patients' stability, potential for health decline or death. Prior to this, patients' overall health status has not

been reported as a risk factor for adverse events such as rehospitalizations among home care patients, because it is a new item added in the latest version of the OASIS dataset (i.e. OASIS-C). There were three categories of overall health status that were included in this study: stable or mildly sick, moderately sick and sickest subject groups.

In this study, the stable or mildly sick group had the lowest rehospitalization rate of the three categories. Stable subjects were defined as having no heightened risk(s) for serious complications and death (beyond those typical of the patient's age), whereas mildly sick subjects were defined as having a current health risk(s) but a high probability of returning to health (NAHC, 2011).

As expected, the moderately sick group had the highest proportion of rehospitalizations, whereas a subset of subjects who were deemed "the sickest" had a rehospitalization ratesimilar to the moderately sick group. Moderately sick subjects were defined as being in fragile health status with ongoing high risk(s) for serious complications and death, whereas the sickest subjects were defined as having serious progressive conditions that could lead to death within a year (NAHC, 2011).

Based on these definitions and the results of this study, the moderately sick or the sickest subject groups may need additional home care support in addition to the THC intervention, due to their frail conditions. In the meantime, THC appeared to be the most effective for HF patients in the stable or mildly sick group in terms of reducing rehospitalizations. However, the higher rehospitalization rate in each category than the national average (i.e. 25%-28%) suggests that their illness had progressed to the point of instability despite THC, and they may have needed continuous education about HF rehospitalizations or additional intervention.

Several studies have demonstrated that patient education about HF rehospitalizations provided by nurses prior to hospital discharge helped in reducing the occurrence of multiple rehospitalizations, and with patients' ability to recognize early signs and symptoms of clinical deterioration (Stamp, Flanagan, Gregas, & Shindul-Rothschild, 2013;Stromberg, 2005; Manning, 2011). One of the factors that had an influence on decreasing HF rehospitalizations in those studies was more patient information provided either at discharge or during recovery at home, while poor nurse-patient communication was found to increase HF rehospitalization rates (Stamp et al., 2013). Perhaps future strategies for nurse-patient communication could use innovative methods such as videophone (Wakefield et al., 2008), or the use of internet-based technology or interactive information technology for patient education to better engage patients in learning about self-care (Jarvis-Selinger, Bates, Araki, & Lear, 2011; Tiwari, Warren, & Day, 2011; Wakefield et al., 2008).

Plan of Care Ordered for Pressure Ulcers and Presence of Skin Lesion(s) or Open Wound(s)

Among home health care patients, pressure ulcers or skin problems significantly increase risk for hospitalization (Fortinsky, Madigan, Sheehan, Tullai-McGuinness, & Fenster, 2006; Fortinsky, Madigan, Sheehan, Tullai-McGuinness, & Kleppinger, 2014; Rosati, Huang, Navaie-Waliser, & Feldman, 2003; Rosati & Huang, 2007) and constitute an intensive care need (Fortinsky, Madigan, Sheehan, Tullai-McGuinness, & Fenster, 2006). Similarly, this study concurs with previous research that has found that patients with dermatologic issues, such as pressure ulcers, skin lesions or open wounds, are more

likely to be rehospitalized and at higher risk than those patients without dermatologic issues.

In this study, patients who had pressure ulcers with a physician-ordered plan of care or home care nurse-requested orders including moist wound healing (i.e. plan of care ordered) were at higher risk for rehospitalization, compared to those who did not have pressure ulcers or those without a plan of care ordered. It is possible that patients with a plan of care ordered had more attention from their providers because their pressure ulcers were worse than those of patients without a plan of care ordered. Perhaps, those with the plan of care ordered had generalized weakness from immobility due to shortness of breath, or had poor blood circulation because they had pain interfering with their physical activity, such as using THC equipment. Thus, those with a plan of care ordered might have had difficulties using THC equipment due to pain, which may have resulted in patients being unable to detect early signs of worsening symptoms, thereby increasing their probability of rehospitalization. Telehomecare nurses caring for heart failure patients with wounds should be extra vigilant about the relationship among these various clinical characteristics.

Another risk factor for rehospitalization in this study related to dermatologic issues was the presence of skin lesion(s) or open wound(s), such as venous stasis ulcers, which could result from peripheral edema and therefore be a reflection of severe HF. Edema in the extremities is a very common physiological sign of compensatory changes due to decreased cardiac output in HF, which cause increased fluid retention in interstitial spaces and auto-regulation in the vascular system (Cooper, 2011). It is common for patients with severe peripheral edema to have blisters on their extremities, which

subsequently develop into skin lesions or open wounds (Anker & Sharma, 2002). Diabetic patients with skin lesions or open wounds also may need to closely monitor their blood glucose levels because uncontrolled glucose levels delay the wound healing process. Thus, regardless of the stability of their HF, home health care providers may need to be more proactive in caring for patients with skin lesions or open wounds at the start of care.

A Change in Urinary Incontinence

Urinary incontinence is one of the response options for an item in the OASIS-C database asking about pre-existing conditions prior to medical or treatment regimen change, or an in-patient stay within the past 14 days. In general, little is known about the association between the incidence of urinary incontinence and HF (Hwang, Fleischmann, Howie-Esquivel, Stotts, & Dracup, 2011), although HF patients may be at higher risk for urinary incontinence due to the use of diuretics in their treatment (Hwang et al., 2011).

This study revealed that patients who did not have a change in urinary incontinence prior to either their medical or treatment regimen change, or their most recent in-patient stay within the past 14 days, were at higher risk for rehospitalization than those patients who had a change in urinary incontinence. It is difficult to understand the meaning of 'a change' in urinary incontinence because the OASIS-C question does not specify whether the change was for the better or the worse. Therefore, when the OASIS-C dataset is updated in the future, it may be advisable to include an option for reporting changes in patient condition as either improvements or worsening in symptoms.

Multiple Hospitalizations (i.e. more than two times) in the Past 12 Months

As expected based on previous research (Fortinsky, Madigan, Sheehan, Tullai-McGuinness, & Fenster, 2006b; Krumholz et al., 2000; Madigan, Schott, & Matthews, 2001; Madigan et al., 2012; Rosati & Huang, 2007), subjects in this study who were hospitalized more than twice in the past 12 months were at higher risk for rehospitalization compared to subjects with fewer previous hospitalizations, at any point in time during the home care episode. In practice, home health care providers should attempt to identify patients who tend to have multiple hospitalizations for the same condition, because the rehospitalizations may be due to poor self-care management skills or non-adherence to medications (Hwang et al., 2011).

Since those subjects in this study continued to experience more rehospitalizations despite the provision of a THC intervention, these results suggest that patients with multiple hospitalizations need continuous education and instruction on how best to break the cycle of emergency room visits and hospitalization. Previous researchers have realized that patients with HF tend to fail to recognize subtle changes in their conditions (Carlson, Riegel, & Moser, 2001; B. Riegel & Carlson, 2002; B. Riegel, Lee, Dickson, & Medscape, 2011) and misinterpret their symptoms (B. Riegel et al., 2011; B. Riegel et al., 2010)due to decreased pathophysiological changes and complicated treatment regimens (Carlson et al., 2001; Jurgens, 2006; B. Riegel et al., 2009). Those issues result in a delay in seeking help for HF symptoms (Evangelista, Dracup, & Doering, 2000; Friedman, 1997; Parshall et al., 2001; B. Riegel & Carlson, 2002; B. Riegel et al., 2009). Thus, along with continuous THC monitoring, these subjects may need on-going assistance

with identifying symptoms of HF deterioration earlier, and interpreting their symptoms from home.

Patients' Living Situation

Living situation as a risk factor for rehospitalization has been inconsistent in HF studies. Some previous research has shown that living alone is a risk factor for rehospitalization among patients with HF due to lack of support (Richardson, 2003; Rosati, Huang, Navaie-Waliser, & Feldman, 2003; Ross et al., 2008). In contrast, other research has found that patients with HF who live with family were more likely to be rehospitalized (Hamner & Ellison, 2005). Hamner and Ellison assumed that family stress might have caused a worsening of the patient's HF.

In this study, living with other person(s) was a risk factor for rehospitalization throughout the entire home care episode. Perhaps, for patients who lived with other person(s), those individuals received education about THC and they identified early signs and symptoms of deterioration, allowing the patient to be taken to an in-patient facility sooner. It is possible that patients were more likely to be taken to an in-patient facility due to caregiver burden or worry, if the patient was living with a caregiver. Home health care providers should ensure that patients' caregivers are adequately educated and are willing to help patients with HF management or with the effective use of THC monitoring at home. These results could also indicate that those living with someone are more dependent or at risk in other ways not detected by this study.

The Total Number of Necessary Therapy Visits Combined

The total number of necessary therapy visits combined was calculated based on the number of orders for therapy that were present from the start of care nurse's clinical

assessment of the patient. The total number of necessary therapy visits combined (e.g. physical therapy, occupational therapy, speech/language, etc.) was not a predictor of rehospitalization in the final model, but the variable was associated with rehospitalization from the initial chi-square tests (comparing rehospitalized vs. non-rehospitalized patients). That is, patients who had fewer therapy visits were more likely to be rehospitalized. Perhaps these patients were ordered less therapy because it was thought that they could not tolerate more intensive levels of therapy. Without a clear assessment of severity of illness in this dataset, it is difficult to tell.

Socio-Demographic Characteristics

Race, gender and age were not found to be risk factors for rehospitalization among subjects with HF receiving THC, but subjects' living situations were associated with rehospitalizations. The distribution of socio-demographic characteristics among subjects in this study was similar to those reported in previous studies of general or HF home care populations, using an earlier version of the OASIS-C dataset. Specifically, the majority of subjects in those studies (83%-97%) were White (Han, Kim, Storfjell, & Kim, 2013; Madigan et al., 2012; Radhakrishnan, 2011; Scharpf & Madigan, 2010; Westra et al., 2011a; Westra et al., 2011b), the proportion of females was higher than males (Han et al., 2013; Madigan et al., 2012; Radhakrishnan, 2011; Scharpf & Madigan, 2010; Westra et al., 2011a; Westra et al., 2011b), and the proportion of study subjects who lived alone was lower than those who lived with other(s) (Scharpf & Madigan, 2010).

The fact that a much smaller group of non-White subjects experienced similar rehospitalization rates to White subjects in this study raises the question of potential racial disparities in home care services in general, as well as in the provision or utilization

of THC services specifically. Although the proportion of non-Whites was less than 20% of all study subjects in this study, rehospitalization rates within 60 days of entering home care were similar for non-White and White patients. Perhaps acceptance of home care referrals among non-White patients was lower than in White patients, due to a lack of information about home care services or perceived cultural differences between patients and referring health providers. Or, it is possible that race did not make a difference when THC was ordered at the start of care. Since rehospitalization rates for non-Whites and Whites were roughly equivalent, it was difficult to identify other socioeconomic contributors to rehospitalization for home health care patients, because there are no items related to education or income level in the OASIS-C dataset. Thus, socioeconomic and phone connectivity issues may have impacted the uptake of THC.

Findings from Decision Tree

The decision tree analysis presented a set of rules that may be helpful for providers in identifying the most appropriate target population for THC interventions among home care patients with HF. It also provided a more global picture of the associations between, as well as the relative priority among various risk factors for rehospitalization, which otherwise were presented as a set of rules showing associations with single risk factors.

At the start of care, home health care providers have to perform a full patient assessment based on the OASIS-C start of care template, and order a plan of care based on that assessment. Completing the OASIS start of care assessment usually takes approximately 1 ½ to 2 hours. Therefore it would be difficult for home health care providers to spend additional time learning about a patient's ability to use THC, while

also completing their OASIS start of care documentation, as well as reviewing the patient's discharge instructions.

Perhaps, if home health care providers were provided with a set of risk factors that would enable them to recognize high-risk patients at the start of THC services, based on not only each predictor but also the additive effects of a combination of risk factors, they would be able to alert other home health care providers, including therapists, who could become involved in the patient's care and initiate additional interventions early after hospital discharge. This could be an automated decision support tool embedded in the OASIS-C, so that as patients answer the standard start of care questions, the items considered to be risk factors trigger an alert if they match the findings of this study. A decision tree showing providers a global picture of a given patient's risk may aid in better clinical decision-making and more effective communication with other providers and patients, thereby more effectively preventing early rehospitalizations.

Post-hoc Assessments

Post-hoc assessments in this study explored associations between severity of HF symptoms, rehospitalization and socio-demographic characteristics. Examining severity of HF symptoms at the start of care in this study was completed, because the Home Health Resource Grouper (HHRG) score could not be calculated using the available statistical software (CMS, 2014). This study used the start of care OASIS-C dataset to identify risk factors for rehospitalization, and the post-hoc analysis used severity of HF symptoms to partially explore patients' clinical severity, and their associations with rehospitalization and socio-demographic characteristics. However, there were no associations between severity of HF symptoms and either rehospitalization or patients'

socio-demographic characteristics. These results are similar to previous research showing that there is no association between severity of HF and changes in functional status (Riggs et al.,2011).On the other hand, other research has demonstrated that more severe HF symptoms are associated with worse outcomes (Hunt, 2005; Riggs et al.,2011). Thus, further research related to severity of HF symptoms as a potential predictor for rehospitalization or other outcomes, such as changes in functional status, is needed, ideally using OASIS data from home health care patients.

The Application and Evaluation of THC for HF Population in terms of Reducing Rehospitalization Rates

The process for telehealth evaluation has not always been clear, although many lessons have been learned from previous telehealth studies (Puskin, 2009). In particular, the use of THC for HF patients has not been consistently successful in recent research, in terms of reducing rehospitalization rates between THC patients and non-THC patients with HF (Madigan et al., 2013; Bowles et al., 2011). The acute care rehospitalization rate among THC patients with HF in this study was higher than the average national rate of readmission from homecare, as well as the 30-day rehospitalization rate reported for home care patients with HF; the national 30-day rehospitalization rate in home care patients with HF was 26% in 2010, with 42% of those rehospitalizations being related to cardiac diagnoses (Madigan, 2012). In this study it was 36%, with 54% of rehospitalizations related to cardiac diagnoses. Also in this study, HF was the primary cause of rehospitalization among Medicare recipients with HF receiving THC, followed by other diseases and cardiac dysrhythmia. This finding is similar to the findings of other

studies, in which HF was the cause of high rehospitalization rates for Medicare recipients (Psotka & Teerlink, 2013; Jencks, Williams, & Coleman, 2009).

In addition, although most discharge planning for HF has been focused on providing general information, such as diet modifications, medication regimens, or primary care follow-up, there are no standardized guidelines for evaluating readiness for discharge among HF patients (Hernandez et al., 2010), which might include evaluating a patient's ability to perform self- monitoring or the availability of a caregiver to monitor the patient. Thus, providing information about the use of THC to improve or maintain self-management skills, along with discharge instructions to HF patients, may be beneficial before they enter home care.

In summary, it would be helpful for accurate assessment of and communication with patients if home health care providers were given guidance regarding the types of patients who would most benefit from THC, in order to appropriately supplement their clinical judgment at the start of care. Such decision supports would also help providers to initiate additional interventions early, such as providing intensive patient education about self-management skills, consulting a wound care specialist or calling in other therapists. Finally, additional measures may need to be taken to ensure continuation of THC monitoring at a consistent level throughout the home health care episode, regardless of the patients' stage of HF.

The use of OASIS-C to Predict the Risk of Rehospitalization

Earlier versions of the OASIS datasets have been used not only to predict rehospitalizations for general and HF home care patients, but also to evaluate patients' functional status or to identify risk factors for functional capacity changes (Madigan,

Schott, & Matthews, 2001; Rosati, Huang, Navaie-Waliser, & Feldman, 2003; Radhakrishnan & Jacelon, 2012; Scharpf & Madigan, 2010; Monsen, Swanberg, Oancea, & Westra, 2012; Tao & Ellenbecker, 2013). There has been previous testing of the reliability and validity of earlier OASIS datasets (Kinatukara, Rosati, & Huang, 2005; O'Connor & Davitt, 2012; Fortinsky, Madigan, Sheehan, Tullai-McGuinness, & Fenster, 2006; Hittle et al., 2004; Madigan & Fortinsky, 2004; Tullai-McGuinness, Madigan, & Fortinsky, 2009). The findings vary from low to moderate reliability and validity of the OASIS dataset, depending upon the items tested, the methodological approaches used, and the measurement of the outcomes in a given study (O'Connor & Davitt, 2012).

A few studies used the values of the area under the receiver-operating characteristic curve (AUC) from c-statistics to evaluate the predictive ability of models of rehospitalization or hospitalization created using previous versions of the OASIS dataset (Bowles & Cater, 2003a; O'Connor & Davitt, 2012). The AUC is a rank-based test to measure how well a model differentiates between two groups (i.e. those subjects with and without the event, or with and without an intervention) based on the outcome of interest, which reflects the accuracy of the model (Cook, 2007). If the value of the AUC is greater than 0.7, the model is considered accurate; the closer the value is to 1.0, the better the model (Han et al., 2013; Madigan et al., 2012; Radhakrishnan, 2011; Scharpf & Madigan, 2010; Westra et al., 2011; Greiner, 2000; Rosati & Huang, 2007; Kansagara et al., 2011). If the value is less than 0.5, the model lacks predictive accuracy (Greiner, 2000; Rosati & Huang, 2007) and is "no better than chance" (Kansagara et al., 2011).

One previous study compared the effectiveness of predictive models of rehospitalization during the home care episode between the OASIS dataset and the

Probability of Rehospitalization (Pra) instrument, based on the values of the AUC (Bowles & Cater, 2003b). The authors found that the Pra instrument was slightly more effective in identifying patients at high risk of rehospitalization than the OASIS dataset, based on the values of the AUC, which were 0.686 and 0.599, respectively (Bowles & Cater, 2003b). Another study that evaluated two predictive models of rehospitalization using the OASIS dataset showed that the values of the AUC were 0.63 and 0.59, which are considered low (Monsen et al., 2012). These low values could be the result of limitations of the dataset, such as inconsistent documentation (Monsen et al., 2012).

In this study, the AUC values from the logistic regression model and from the decision tree analysis for the OASIS-C were 0.630 and 0.593, respectively, which are similar to Monsen's (2012) study (AUC:0.59-0.63). Although the AUC values from this study do not show that the model generated in this study is ideal, they are consistent with the AUC values from previous studies using prediction models for rehospitalization (Kansagara et al., 2011; Kossovsky et al., 2000; Monsen, Swanberg, Oancea, & Westra, 2012; Ross et al., 2008). Perhaps, the values of the AUC from this analysis of the OASIS-C may be helpful for updating or improving OASIS items in the future.

CMS has already begun the process of updating the current version of the OASIS-C to the OASIS-C1, which will be implemented in October 2014. According to the National Association for Home Care and Hospice, there will be changes on items related to ICD coding (i.e. using ICD-10-CM codes) and in item wording, as well as updating clinical concepts or deleting some items based on literature reviews and expert panel recommendations. Among these changes, CMS is considering incorporation of some evidence-based screening tools as "best practices." (NAHC, 2014). For example, the

number of items reported across all of the time points will decrease, which will slightly reduce the burden of assessment for home care nurses. In terms of updating clinical concepts, items related to the risk of rehospitalization were added or modified based on factors identified in the literature.

The new items are "unintentional weight loss of a total of ten pounds or more in the past 12 months," "multiple emergency department visits (i.e. two or more) in the past six months," and "reported or observed history of difficulty complying with any medical instructions (for example, medications, diet, exercise) in the past three months." These items may help home care providers to assess patients' ability to use THC. Also, the item "taking five or more medications" in the OASIS-C dataset was modified to query whether patients were "currently taking six or more medications," which may reflect an increase in the average severity of illness of patients entering home care. These changes demonstrate that updates of the OASIS dataset are evidence-based. Thus, OASIS-C items can be used as direct and indirect risk factors for rehospitalization, or as a supplement to clinical judgments, in order to help home health care providers to appropriately apply interventions for all patients with HF, including THC patients.

Methodology

Overall, logistic regression and survival analyses have been widely used to identify risk factors for rehospitalization in the home care setting, but decision tree analyses have rarely been used with rehospitalization as an outcome. The decision tree analysis in this study presents interactions among risk factors in predicting rehospitalization, instead of presenting associations within each predictor from the logistic regression and survival analyses. Although a decision tree creates an optimal

threshold for certain categories within one variable, it also visually provides a global picture of potential high-risk patients, and priority of risk factors is shown from the top of the tree. Thus, adding the use of a decision tree along with the logistic regression and survival analysis to identify patient-related characteristics affecting rehospitalization may present more clinically meaningful characteristics from the OASIS-C dataset for easier use in home health care settings.

Implications for Practice, Research and Policy

HF is a chronic, progressive disease that requires comprehensive care in order for patients with HF to maintain their health status at home. Despite numerous interventions spanning several decades, including the use of technology and other strategies for preventing rehospitalization, and improving self-management skills for HF patients across health care settings, the overall rehospitalization rate (29%) did not improve up until 2011 (MedPAC,2014). In addition, results of studies identifying risk factors for rehospitalization using both non-invasive and invasive measures have been inconsistent.

Despite the inconsistency of previous findings, home health care providers may continue utilizing THC as an intervention to prevent rehospitalizations and to improve self-management skills for Medicare recipients with HF, due to research evidence impacting clinical practice guidelines or health policy recommendations. To help home health care providers to better achieve those goals, this study provides suggestions for improving clinical practice, research and health policy on the use of THC for patients with HF.

Clinical Practice

There have previously been inconsistent findings regarding risk factors for rehospitalization among HF patients in home care settings. The lack of easily translated findings may make it difficult for home health care providers to provide appropriate patient care during the transition period to home after hospital discharge. However, it is vital that home health care providers initiate timely interventions for HF patients early after their initial discharge to prevent rehospitalizations, and to help patients improve their self-management skills during the limited duration of the home health care episode, which is only 60 days. If home health care providers were able to identify high-risk patients soon after initiating THC interventions, they might be able to provide more individually tailored and appropriate care.

In particular, admitting home health care providers could apply the decision tree developed in this study as a set of rules for identifying priority patients for THC placement, in addition to the findings from the logistic model and the survival analysis. In such a model, patients with skin lesions or open wounds would need to receive the highest priority because they were placed at the top of the decision tree. In recognition of the fact that patients with skin lesions or open wounds are more likely to have diabetes, glucose management may need to become a part of THC for those patient sub-populations with diabetes. Also, home health care providers could identify multiple issues influencing rehospitalizations in a short time by using the decision tree that provides one global picture of patient risk.

From the logistic regression model in this study, patients who presented with constant severe pain at the start of care were found to be at-risk for rehospitalization

among patients with HF. However, there is no place in the current OASIS-C start of care dataset for documenting the source of patients' pain or the types of pain they are experiencing. Therefore, it may be critical for the admitting home health care providers to find alternate means to communicate about patients' pain management with other home health care providers, such as through care planning.

Research

This study's findings may suggest that THC may be used consistently and longer for patients HF, especially for those patients who have skin lesions or open wounds, diabetes as comorbidity, or severe pain. For diabetic patients, previous evidence has shown that telehealth interventions were effective in preventing rehospitalizations during the follow-up period (Jia, Chuang, Wu, Wang, & Chumbler, 2009; Shea & IDEATel Consortium, 2007). Thus, diabetic patients with HF may need further study in order to optimize the use of telehealth services, in order to provide higher quality and better continuity of care.

In addition to further investigation of diabetic patients with HF, patients with HF who also present with pain may require further study in order to identify the source or cause of pain, such as specific, treatable comorbidities. Since there are no items in the OASIS-C dataset questioning the details of the patient's pain, understanding the relationships between pain and HF in home health care settings may provide useful information to better care for HF patients who have complex conditions.

This study suggests that adding decision tree analyses to the available methodologies for assessing large datasets, such as the national OASIS-C data, may provide valuable visualizations of the interactions among various risk factors for

rehospitalization. Home health care providers may find a more global picture of the relative contributions of multiple risk factors more intuitive to apply in caring for HF patients, because HF is a complex condition and presents many challenges for providers attempting to deliver appropriate, evidence-based care.

In addition, Monsen (2012) suggested that using large datasets may be helpful for developing clinical decision support systems (Monsen et al., 2012). In general, clinical decision support research may be useful in creating or updating practice guidelines. Thus, using a decision tree analysis with the large OASIS-C dataset as an instrument for evaluating risk for rehospitalizations among Medicare recipients with HF may serve as an important first step in creating guidelines or recommendations for the optimal placement of THC patients with HF.

Health Policy

In order for researchers to use the large OASIS-C dataset, they have relied upon national OASIS-C data sampling, but it is difficult to know which patients used THC from the national data due to a lack of items concerning the use of THC. Adding an OASIS code for identifying THC patients within the transfer or discharge OASIS-C data may be helpful for researchers to evaluate potential risk factors for rehospitalization among THC patients with HF when using the national OASIS dataset.

Utilizing the OASIS-C dataset for research purposes may provide useful insights for improving OASIS items in future datasets. One possible improvement to the OASIS-C is to move the overall health status items to the end of the OASIS-C assessment, to allow home health care providers more time for making an accurate assessment of the patient's overall health. The new OASIS-C1 will be released in October, 2014. Therefore,

it is highly likely that the findings of this study and other future research using the OASIS-C will contribute to improving the structure and function of the OASIS database, for example, by adding items related to the sources and types of patients' pain, or items specifically measuring how the use of technology, such as THC, may influence rehospitalizations.

Limitations and Methodological Considerations

One of the limitations of this study was that the data were not collected for the specific purpose of this research, and that the dataset was limited to Medicare patients only. Although the OASIS-C data was essential for assessment of home health care patients, it did not provide detailed information related to socioeconomic status or patients' ability to use THC. In addition, there was little detail to explain the patient conditions that led to rehospitalizations, because this study used variables from an existing dataset.

Potential confounders were not included in OASIS-C dataset, such as home visit frequency by visiting nurses, the dosage of telehomecare, or agency characteristics, such as its size, location or staffing. There was potential for selection bias in the sampling scheme of this study, and the findings of this study may not be generalizable because the sample was limited to patients with a completed OASIS-C assessment from one home health care company. Although this dataset contained data from multiple agencies under one home heath care company, the specific characteristics of the providers in those agencies were unknown. In addition, home health care providers might not have documented rehospitalizations, if patients did not inform them of a brief hospitalization

between home visits. Lastly, home health care providers might have performed incorrect assessments, due to a lack of time for completing the start of care OASIS-C file.

Conclusion

This study revealed a number of novel and somewhat unexpected patient-related characteristics affecting rehospitalizations that were drawn from an analysis of the OASIS-C dataset. The study findings also provide preliminary evidence for the potential role of the proposed set of risk factors in driving rehospitalization. These potential risk factors should be leveraged as a tool for more effective THC placement, as well as referrals for additional interventions, among high-risk Medicare recipients with HF. For example, although a patient may be assessed by a home care nurse at the start of care as being independent in dressing his or her lower body, or as a member of the healthy patient group, he or she still may need THC services provided at a consistent dose for the full 60 days of the home care episode to help with improving HF self-management skills.

Furthermore, not only assessing associations with single risk factors but also recognizing associations among multiple risk factors captured in the OASIS-C dataset may be helpful for home health care providers assessing patients with HF at the start of care, or for discharge planners in in-patient settings developing comprehensive discharge plans. For example, early education during the in-patient discharge process may be prioritized for patients who have skin lesion(s) or open wound(s) from diabetes or edema. Thus, the discharging nurse in the in-patient setting or admitting home health care providers in the post-discharge setting may utilize this set of predictive factors to identify patients' needs for more intensive and appropriate teaching regarding THC services.

Future research using the national OASIS-C dataset is needed to validate the findings of this study. In particular, policy makers ought to consider adding a THC variable to the OASIS-C dataset to assist researchers to identify those patients receiving THC interventions. This would help home health care providers to be more aware of the need to examine Such changes would improve the accuracy of future studies on THC in HF patients by assisting the examination of patient-related characteristics that could be risk factors for rehospitalization in those patients receiving THC. With more conclusive research findings, the guidelines for identifying the ideal patients for THC would be evidence-based. This would lead to more effective utilization of THC for patients with HF who are at high risk for rehospitalization.

APPENDIX 1

Home Health Patient Tracking Sheet

(M0010) C M S Certification Number: __ __ __ __ __ __

(M0014) Branch State: __ __

(M0016) Branch I D Number: __ __ __ __ __ __ __ __ __ __

(M0018) National Provider Identifier (N P I) for the attending physician who has signed the plan of care**:**

__ __ __ __ __ __ __ __ __ __ ☐ **UK – Unknown or Not Available**

(M0020) Patient I D Number: __

(M0030) Start of Care Date: __ __/__ __/__ __ __ __
month / day / year

(M0032) Resumption of Care Date: __ __/__ __/__ __ __ __ ☐ **NA - Not Applicable**
month / day / year

(M0040) Patient Name:

__ __
(First) (M I) (Last) (Suffix)

(M0050) Patient State of Residence: __ __

(M0060) Patient Zip Code: __ __ __ __ __ __ __ __ __

(M0063) Medicare Number: __ __ __ __ __ __ __ __ __ __ __ __ ☐ **NA – No Medicare**
(including suffix)

(M0064) Social Security Number: __ __ __ - __ __ - __ __ __ __ ☐ **UK – Unknown or Not Available**

(M0065) Medicaid Number: __ __ __ __ __ __ __ __ __ __ __ __ __ __ ☐ **NA – No Medicaid**

(M0066) Birth Date: __ __/__ __/__ __ __ __
month / day / year

(M0069) Gender:

- ☐ 1 - Male
- ☐ 2 - Female

(M0140) Race/Ethnicity: (Mark all that apply.)

- ☐ 1 - American Indian or Alaska Native
- ☐ 2 - Asian
- ☐ 3 - Black or African-American
- ☐ 4 - Hispanic or Latino
- ☐ 5 - Native Hawaiian or Pacific Islander
- ☐ 6 - White

(M0150) Current Payment Sources for Home Care: (Mark all that apply.)

- ☐ 0 - None; no charge for current services
- ☐ 1 - Medicare (traditional fee-for-service)
- ☐ 2 - Medicare (HMO/managed care/Advantage plan)
- ☐ 3 - Medicaid (traditional fee-for-service)
- ☐ 4 - Medicaid (HMO/managed care)
- ☐ 5 - Workers' compensation
- ☐ 6 - Title programs (e.g., Title III, V, or XX)
- ☐ 7 - Other government (e.g., TriCare, VA, etc.)
- ☐ 8 - Private insurance
- ☐ 9 - Private HMO/managed care
- ☐ 10 - Self-pay
- ☐ 11 - Other (specify) _____
- ☐ UK - Unknown

Outcome and Assessment Information Set

Items to be Used at Specific Time Points

Start of Care	M0010-M0030, M0040- M0150, M1000-M1036, M1100-M1242, M1300-M1302, M1306, M1308-M1324, M1330-M1350, M1400, M1410, M1600-M1730, M1740-M1910, M2000, M2002, M2010, M2020-M2250
Start of care—further visits planned	
Resumption of Care	M0032, M0080-M0110, M1000-M1036, M1100-M1242, M1300-M1302, M1306, M1308-M1324, M1330-M1350, M1400, M1410, M1600-M1730, M1740-M1910, M2000, M2002, M2010, M2020-M2250
Resumption of care (after inpatient stay)	
Follow-Up	M0080-M0100, M0110, M1020-M1030, M1200, M1242, M1306, M1308, M1322-M1324, M1330-M1350, M1400, M1610, M1620, M1630, M1810-M1840, M1850, M1860, M2030, M2200
Recertification (follow-up) assessment	
Other follow-up assessment	
Transfer to an Inpatient Facility	M0080-M0100, M1040-M1055, M1500, M1510, M2004, M2015, M2300-M2410, M2430-M2440, M0903, M0906
Transferred to an inpatient facility—patient not discharged from an agency	
Transferred to an inpatient facility—patient discharged from agency	
Discharge from Agency — Not to an Inpatient Facility	
Death at home	M0080-M0100, M0903, M0906
Discharge from agency	M0080-M0100, M1040-M1055, M1230, M1242, M1306-M1350, M1400-M1620, M1700-M1720, M1740, M1745, M1800-M1890, M2004, M2015-M2030, M2100-M2110, M2300-M2420, M0903, M0906

CLINICAL RECORD ITEMS

(M0080) Discipline of Person Completing Assessment:

☐ 1-RN ☐ 2-PT ☐ 3-SLP/ST ☐ 4-OT

(M0090) Date Assessment Completed: __ __ /__ __ /__ __ __ __
month / day / year

(M0100) This Assessment is Currently Being Completed for the Following Reason:

Start/Resumption of Care

☐ 1 – Start of care—further visits planned
☐ 3 – Resumption of care (after inpatient stay)

Follow-Up

☐ 4 – Recertification (follow-up) reassessment **[** ***Go to M0110*** **]**
☐ 5 – Other follow-up **[** ***Go to M0110*** **]**

Transfer to an Inpatient Facility

☐ 6 – Transferred to an inpatient facility—patient not discharged from agency **[** ***Go to M1040*** **]**
☐ 7 – Transferred to an inpatient facility—patient discharged from agency **[** ***Go to M1040*** **]**

Discharge from Agency — Not to an Inpatient Facility

☐ 8 – Death at home **[** ***Go to M0903*** **]**
☐ 9 – Discharge from agency **[** ***Go to M1040*** **]**

(M0102) Date of Physician-ordered Start of Care (Resumption of Care): If the physician indicated a specific start of care (resumption of care) date when the patient was referred for home health services, record the date specified.

__ __ /__ __ /__ __ __ __ *[Go to M0110, if date entered]*
month / day / year

☐ NA –No specific SOC date ordered by physician

(M0104) Date of Referral: Indicate the date that the written or verbal referral for initiation or resumption of care was received by the HHA.

__ __ /__ __ /__ __ __ __
month / day / year

(M0110) Episode Timing: Is the Medicare home health payment episode for which this assessment will define a case mix group an "early" episode or a "later" episode in the patient's current sequence of adjacent Medicare home health payment episodes?

☐ 1 - Early
☐ 2 - Later
☐ UK - Unknown
☐ NA - Not Applicable: No Medicare case mix group to be defined by this assessment.

PATIENT HISTORY AND DIAGNOSES

(M1000) From which of the following **Inpatient Facilities** was the patient discharged during the past 14 days? **(Mark all that apply.)**

☐ 1 - Long-term nursing facility (NF)
☐ 2 - Skilled nursing facility (SNF / TCU)
☐ 3 - Short-stay acute hospital (IPPS)
☐ 4 - Long-term care hospital (LTCH)
☐ 5 - Inpatient rehabilitation hospital or unit (IRF)
☐ 6 - Psychiatric hospital or unit
☐ 7 - Other (specify) _____
☐ NA - Patient was not discharged from an inpatient facility **[*Go to M1016*]**

(M1005) Inpatient Discharge Date (most recent):

__ __ /__ __ /__ __ __ __
month / day / year

☐ UK - Unknown

(M1010) List each **Inpatient Diagnosis** and ICD-9-C M code at the level of highest specificity for only those conditions treated during an inpatient stay within the last 14 days (no E-codes, or V-codes):

	Inpatient Facility Diagnosis	ICD-9-C M Code
a.	_____	__ __ __ . __ __
b.	_____	__ __ __ . __ __
c.	_____	__ __ __ . __ __
d.	_____	__ __ __ . __ __
e.	_____	__ __ __ . __ __
f.	_____	__ __ __ . __ __

(M1012) List each **Inpatient Procedure** and the associated ICD-9-C M procedure code relevant to the plan of care.

	Inpatient Procedure	Procedure Code
a.	_____	__ __ . __ __
b.	_____	__ __ . __ __
c.	_____	__ __ . __ __
d.	_____	__ __ . __ __

☐ NA - Not applicable

☐ UK - Unknown

(M1016) Diagnoses Requiring Medical or Treatment Regimen Change Within Past 14 Days: List the patient's Medical Diagnoses and ICD-9-C M codes at the level of highest specificity for those conditions requiring changed medical or treatment regimen within the past 14 days (no surgical, E-codes, or V-codes):

	Changed Medical Regimen Diagnosis	ICD-9-C M Code
a.	_____	__ __ __ . __ __
b.	_____	__ __ __ . __ __
c.	_____	__ __ __ . __ __
d.	_____	__ __ __ . __ __
e.	_____	__ __ __ . __ __
f.	_____	__ __ __ . __ __

☐ NA - Not applicable (no medical or treatment regimen changes within the past 14 days)

(M1018) Conditions Prior to Medical or Treatment Regimen Change or Inpatient Stay Within Past 14 Days: If this patient experienced an inpatient facility discharge or change in medical or treatment regimen within the past 14 days, indicate any conditions which existed prior to the inpatient stay or change in medical or treatment regimen. **(Mark all that apply.)**

☐ 1 - Urinary incontinence

☐ 2 - Indwelling/suprapubic catheter

☐ 3 - Intractable pain

☐ 4 - Impaired decision-making

☐ 5 - Disruptive or socially inappropriate behavior

☐ 6 - Memory loss to the extent that supervision required

☐ 7 - None of the above

☐ NA - No inpatient facility discharge and no change in medical or treatment regimen in past 14 days

☐ UK - Unknown

(M1020/1022/1024) Diagnoses, Symptom Control, and Payment Diagnoses: List each diagnosis for which the patient is receiving home care (Column 1) and enter its ICD-9-C M code at the level of highest specificity (no surgical/procedure codes) (Column 2). Diagnoses are listed in the order that best reflect the seriousness of each condition and support the disciplines and services provided. Rate the degree of symptom control for each condition (Column 2). Choose one value that represents the degree of symptom control appropriate for each diagnosis: V-codes (for M1020 or M1022) or E-codes (for M1022 only) may be used. ICD-9-C M sequencing requirements must be followed if multiple coding is indicated for any diagnoses. If a V-code is reported in place of a case mix diagnosis, then optional item M1024 Payment Diagnoses (Columns 3 and 4) may be completed. A case mix diagnosis is a diagnosis that determines the Medicare P P S case mix group. Do not assign symptom control ratings for V- or E-codes.

Code each row according to the following directions for each column:

Column 1: Enter the description of the diagnosis.

Column 2: Enter the ICD-9-C M code for the diagnosis described in Column 1;
Rate the degree of symptom control for the condition listed in Column 1 using the following scale:
0 - Asymptomatic, no treatment needed at this time
1 - Symptoms well controlled with current therapy
2 - Symptoms controlled with difficulty, affecting daily functioning; patient needs ongoing monitoring
3 - Symptoms poorly controlled; patient needs frequent adjustment in treatment and dose monitoring
4 - Symptoms poorly controlled; history of re-hospitalizations
Note that in Column 2 the rating for symptom control of each diagnosis should not be used to determine the sequencing of the diagnoses listed in Column 1. These are separate items and sequencing may not coincide. Sequencing of diagnoses should reflect the seriousness of each condition and support the disciplines and services provided.

Column 3: (OPTIONAL) If a V-code is assigned to any row in Column 2, in place of a case mix diagnosis, it may be necessary to complete optional item M1024 Payment Diagnoses (Columns 3 and 4). See OASIS-C Guidance Manual.

Column 4: (OPTIONAL) If a V-code in Column 2 is reported in place of a case mix diagnosis that requires multiple diagnosis codes under ICD-9-C M coding guidelines, enter the diagnosis descriptions and the ICD-9-C M codes in the same row in Columns 3 and 4. For example, if the case mix diagnosis is a manifestation code, record the diagnosis description and ICD-9-C M code for the underlying condition in Column 3 of that row and the diagnosis description and ICD-9-C M code for the manifestation in Column 4 of that row. Otherwise, leave Column 4 blank in that row.

(Form on next page)

(M1020) Primary Diagnosis & (M1022) Other Diagnoses		(M1024) Payment Diagnoses (OPTIONAL)	
Column 1	Column 2	Column 3	Column 4
Diagnoses (Sequencing of diagnoses should reflect the seriousness of each condition and support the disciplines and services provided.)	ICD-9-C M and symptom control rating for each condition. Note that the sequencing of these ratings may not match the sequencing of the diagnoses	Complete if a V-code is assigned under certain circumstances to Column 2 in place of a case mix diagnosis.	Complete **only if** the V-code in Column 2 is reported in place of a case mix diagnosis that is a multiple coding situation (e.g., a manifestation code).
Description	ICD-9-C M / Symptom Control Rating	Description/ ICD-9-C M	Description/ ICD-9-C M
(M1020) Primary Diagnosis a. _____	**(V-codes are allowed)** a. (__ __ __ . __ __) ☐0 ☐1 ☐2 ☐3 ☐4	**(V- or E-codes NOT allowed)** a._____ (__ __ __ . __ __)	**(V- or E-codes NOT allowed)** a._____ (__ __ __ . __ __)
(M1022) Other Diagnoses b. _____	**(V- or E-codes are allowed)** b. (__ __ __ __ . __ __) ☐0 ☐1 ☐2 ☐3 ☐4	**(V- or E-codes NOT allowed)** b._____ (__ __ __ . __ __)	**(V- or E-codes NOT allowed)** b._____ (__ __ __ . __ __)
c. _____	c. (__ __ __ __ . __ __) ☐0 ☐1 ☐2 ☐3 ☐4	c._____ (__ __ __ . __ __)	c._____ (__ __ __ . __ __)
d. _____	d. (__ __ __ __ . __ __) ☐0 ☐1 ☐2 ☐3 ☐4	d._____ (__ __ __ . __ __)	d._____ (__ __ __ . __ __)
e. _____	e. (__ __ __ __ . __ __) ☐0 ☐1 ☐2 ☐3 ☐4	e._____ (__ __ __ . __ __)	e._____ (__ __ __ . __ __)
f. _____	f. (__ __ __ __ . __ __) ☐0 ☐1 ☐2 ☐3 ☐4	f._____ (__ __ __ . __ __)	f._____ (__ __ __ . __ __)

(M1030) Therapies the patient receives at home: **(Mark all that apply.)**

- ☐ 1 - Intravenous or infusion therapy (excludes TPN)
- ☐ 2 - Parenteral nutrition (TPN or lipids)
- ☐ 3 - Enteral nutrition (nasogastric, gastrostomy, jejunostomy, or any other artificial entry into the alimentary canal)
- ☐ 4 - None of the above

(M1032) Risk for Hospitalization: Which of the following signs or symptoms characterize this patient as at risk for hospitalization? **(Mark all that apply.)**

- ☐ 1 - Recent decline in mental, emotional, or behavioral status
- ☐ 2 - Multiple hospitalizations (2 or more) in the past 12 months
- ☐ 3 - History of falls (2 or more falls - or any fall with an injury - in the past year)
- ☐ 4 - Taking five or more medications
- ☐ 5 - Frailty indicators, e.g., weight loss, self-reported exhaustion
- ☐ 6 - Other
- ☐ 7 - None of the above

(M1034) Overall Status: Which description best fits the patient's overall status? **(Check one)**

- ☐ 0 - The patient is stable with no heightened risk(s) for serious complications and death (beyond those typical of the patient's age).
- ☐ 1 - The patient is temporarily facing high health risk(s) but is likely to return to being stable without heightened risk(s) for serious complications and death (beyond those typical of the patient's age).
- ☐ 2 - The patient is likely to remain in fragile health and have ongoing high risk(s) of serious complications and death.
- ☐ 3 - The patient has serious progressive conditions that could lead to death within a year.
- ☐ UK - The patient's situation is unknown or unclear.

(M1036) Risk Factors, either present or past, likely to affect current health status and/or outcome: **(Mark all that apply.)**

- ☐ 1 - Smoking
- ☐ 2 - Obesity
- ☐ 3 - Alcohol dependency
- ☐ 4 - Drug dependency
- ☐ 5 - None of the above
- ☐ UK - Unknown

(M1040) Influenza Vaccine: Did the patient receive the influenza vaccine from your agency for this year's influenza season (October 1 through March 31) during this episode of care?

- ☐ 0 - No
- ☐ 1 - Yes **[** ***Go to M1050*** **]**
- ☐ NA - Does not apply because entire episode of care (SOC/ROC to Transfer/Discharge) is outside this influenza season. **[** ***Go to M1050*** **]**

(M1045) Reason Influenza Vaccine not received: If the patient did not receive the influenza vaccine from your agency during this episode of care, state reason:

- ☐ 1 - Received from another health care provider (e.g., physician)
- ☐ 2 - Received from your agency previously during this year's flu season
- ☐ 3 - Offered and declined
- ☐ 4 - Assessed and determined to have medical contraindication(s)
- ☐ 5 - Not indicated; patient does not meet age/condition guidelines for influenza vaccine
- ☐ 6 - Inability to obtain vaccine due to declared shortage
- ☐ 7 - None of the above

(M1050) Pneumococcal Vaccine: Did the patient receive pneumococcal polysaccharide vaccine (PPV) from your agency during this episode of care (SOC/ROC to Transfer/Discharge)?

- ☐ 0 - No
- ☐ 1 - Yes **[** ***Go to M1500 at TRN***; ***Go to M1230 at DC*** **]**

(M1055) Reason PPV not received: If patient did not receive the pneumococcal polysaccharide vaccine (PPV) from your agency during this episode of care (SOC/ROC to Transfer/Discharge), state reason:

- ☐ 1 - Patient has received PPV in the past
- ☐ 2 - Offered and declined
- ☐ 3 - Assessed and determined to have medical contraindication(s)
- ☐ 4 - Not indicated; patient does not meet age/condition guidelines for PPV
- ☐ 5 - None of the above

LIVING ARRANGEMENTS

(M1100) Patient Living Situation: Which of the following best describes the patient's residential circumstance and availability of assistance? **(Check one box only.)**

Living Arrangement	Availability of Assistance				
	Around the clock	Regular daytime	Regular nighttime	Occasional / short-term assistance	No assistance available
a. Patient lives alone	☐ 01	☐ 02	☐ 03	☐ 04	☐ 05
b. Patient lives with other person(s) in the home	☐ 06	☐ 07	☐ 08	☐ 09	☐ 10
c. Patient lives in congregate situation (e.g., assisted living)	☐ 11	☐ 12	☐ 13	☐ 14	☐ 15

SENSORY STATUS

(M1200) Vision (with corrective lenses if the patient usually wears them):

☐ 0 - Normal vision: sees adequately in most situations; can see medication labels, newsprint.

☐ 1 - Partially impaired: cannot see medication labels or newsprint, but can see obstacles in path, and the surrounding layout; can count fingers at arm's length.

☐ 2 - Severely impaired: cannot locate objects without hearing or touching them or patient nonresponsive.

(M1210) Ability to hear (with hearing aid or hearing appliance if normally used):

☐ 0 - Adequate: hears normal conversation without difficulty.

☐ 1 - Mildly to Moderately Impaired: difficulty hearing in some environments or speaker may need to increase volume or speak distinctly.

☐ 2 - Severely Impaired: absence of useful hearing.

☐ UK - Unable to assess hearing.

(M1220) Understanding of Verbal Content in patient's own language (with hearing aid or device if used):

☐ 0 - Understands: clear comprehension without cues or repetitions.

☐ 1 - Usually Understands: understands most conversations, but misses some part/intent of message. Requires cues at times to understand.

☐ 2 - Sometimes Understands: understands only basic conversations or simple, direct phrases. Frequently requires cues to understand.

☐ 3 - Rarely/Never Understands

☐ UK - Unable to assess understanding.

(M1230) Speech and Oral (Verbal) Expression of Language (in patient's own language):

☐ 0 - Expresses complex ideas, feelings, and needs clearly, completely, and easily in all situations with no observable impairment.

☐ 1 - Minimal difficulty in expressing ideas and needs (may take extra time; makes occasional errors in word choice, grammar or speech intelligibility; needs minimal prompting or assistance).

☐ 2 - Expresses simple ideas or needs with moderate difficulty (needs prompting or assistance, errors in word choice, organization or speech intelligibility). Speaks in phrases or short sentences.

☐ 3 - Has severe difficulty expressing basic ideas or needs and requires maximal assistance or guessing by listener. Speech limited to single words or short phrases.

☐ 4 - Unable to express basic needs even with maximal prompting or assistance but is not comatose or unresponsive (e.g., speech is nonsensical or unintelligible).

☐ 5 - Patient nonresponsive or unable to speak.

(M1240) Has this patient had a formal **Pain Assessment** using a standardized pain assessment tool (appropriate to the patient's ability to communicate the severity of pain)?

- ☐ 0 - No standardized assessment conducted
- ☐ 1 - Yes, and it does not indicate severe pain
- ☐ 2 - Yes, and it indicates severe pain

(M1242) **Frequency of Pain Interfering** with patient's activity or movement:

- ☐ 0 - Patient has no pain
- ☐ 1 - Patient has pain that does not interfere with activity or movement
- ☐ 2 - Less often than daily
- ☐ 3 - Daily, but not constantly
- ☐ 4 - All of the time

INTEGUMENTARY STATUS

(M1300) **Pressure Ulcer Assessment:** Was this patient assessed for **Risk of Developing Pressure Ulcers**?

- ☐ 0 - No assessment conducted **[** ***Go to M1306*** **]**
- ☐ 1 - Yes, based on an evaluation of clinical factors, e.g., mobility, incontinence, nutrition, etc., without use of standardized tool
- ☐ 2 - Yes, using a standardized tool, e.g., Braden, Norton, other

(M1302) Does this patient have a **Risk of Developing Pressure Ulcers**?

- ☐ 0 - No
- ☐ 1 - Yes

(M1306) Does this patient have at least one **Unhealed Pressure Ulcer at Stage II or Higher** or designated as "unstageable"?

- ☐ 0 - No **[** ***Go to M1322*** **]**
- ☐ 1 - Yes

(M1307) The **Oldest Non-epithelialized Stage II Pressure Ulcer** that is present at discharge

- ☐ 1 - Was present at the most recent SOC/ROC assessment
- ☐ 2 - Developed since the most recent SOC/ROC assessment: record date pressure ulcer first identified: __ __/__ __/____ __ __
  month / day / year
- ☐ NA - No non-epithelialized Stage II pressure ulcers are present at discharge

(M1308) Current Number of Unhealed (non-epithelialized) Pressure Ulcers at Each Stage: (Enter "0" if none; excludes Stage I pressure ulcers)

	Column 1 Complete at SOC/ROC/FU & D/C	Column 2 Complete at FU & D/C
Stage description – unhealed pressure ulcers	Number Currently Present	Number of those listed in Column 1 that were present on admission (most recent SOC / ROC)
a. **Stage II:** Partial thickness loss of dermis presenting as a shallow open ulcer with red pink wound bed, without slough. May also present as an intact or open/ruptured serum-filled blister.	____	____
b. **Stage III:** Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon, or muscles are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunneling.	____	____
c. **Stage IV:** Full thickness tissue loss with visible bone, tendon, or muscle. Slough or eschar may be present on some parts of the wound bed. Often includes undermining and tunneling.	____	____
d.1 Unstageable: Known or likely but unstageable due to non-removable dressing or device	____	____
d.2 Unstageable: Known or likely but unstageable due to coverage of wound bed by slough and/or eschar.	____	____
d.3 Unstageable: Suspected deep tissue injury in evolution.	____	____

Directions for M1310, M1312, and M1314: If the patient has one or more unhealed (non-epithelialized) Stage III or IV pressure ulcers, identify the **Stage III or IV pressure ulcer with the largest surface dimension (length x width)** and record in centimeters. If no Stage III or Stage IV pressure ulcers, go to M1320.

(M1310) Pressure Ulcer Length: Longest length "head-to-toe" | ___ | ___ | . | ___ | (cm)

(M1312) Pressure Ulcer Width: Width of the same pressure ulcer; greatest width perpendicular to the length

| ___ | ___ | . | ___ | (cm)

(M1314) Pressure Ulcer Depth: Depth of the same pressure ulcer; from visible surface to the deepest area

| ___ | ___ | . | ___ | (cm)

(M1320) Status of Most Problematic (Observable) Pressure Ulcer:

☐ 0 - Newly epithelialized
☐ 1 - Fully granulating
☐ 2 - Early/partial granulation
☐ 3 - Not healing
☐ NA - No observable pressure ulcer

(M1322) Current Number of Stage I Pressure Ulcers: Intact skin with non-blanchable redness of a localized area usually over a bony prominence. The area may be painful, firm, soft, warmer or cooler as compared to adjacent tissue.

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more

(M1324) Stage of Most Problematic Unhealed (Observable) Pressure Ulcer:

☐ 1 - Stage I
☐ 2 - Stage II
☐ 3 - Stage III
☐ 4 - Stage IV
☐ NA - No observable pressure ulcer or unhealed pressure ulcer

(M1330) Does this patient have a **Stasis Ulcer**?

☐ 0 - No **[** ***Go to M1340*** **]**
☐ 1 - Yes, patient has BOTH observable and unobservable stasis ulcers
☐ 2 - Yes, patient has observable stasis ulcers ONLY
☐ 3 - Yes, patient has unobservable stasis ulcers ONLY (known but not observable due to non-removable dressing) **[** ***Go to M1340*** **]**

(M1332) Current Number of (Observable) Stasis Ulcer(s):

☐ 1 - One
☐ 2 - Two
☐ 3 - Three
☐ 4 - Four or more

(M1334) Status of Most Problematic (Observable) Stasis Ulcer:

☐ 0 - Newly epithelialized
☐ 1 - Fully granulating
☐ 2 - Early/partial granulation
☐ 3 - Not healing

(M1340) Does this patient have a **Surgical Wound?**

☐ 0 - No **[** ***Go to M1350*** **]**
☐ 1 - Yes, patient has at least one (observable) surgical wound
☐ 2 - Surgical wound known but not observable due to non-removable dressing **[** ***Go to M1350*** **]**

(M1342) Status of Most Problematic (Observable) Surgical Wound:

☐ 0 - Newly epithelialized
☐ 1 - Fully granulating
☐ 2 - Early/partial granulation
☐ 3 - Not healing

(M1350) Does this patient have a **Skin Lesion** or **Open Wound,** excluding bowel ostomy, other than those described above that is receiving intervention by the home health agency?

☐ 0 - No
☐ 1 - Yes

RESPIRATORY STATUS

(M1400) When is the patient dyspneic or noticeably **Short of Breath**?

- ☐ 0 - Patient is not short of breath
- ☐ 1 - When walking more than 20 feet, climbing stairs
- ☐ 2 - With moderate exertion (e.g., while dressing, using commode or bedpan, walking distances less than 20 feet)
- ☐ 3 - With minimal exertion (e.g., while eating, talking, or performing other ADLs) or with agitation
- ☐ 4 - At rest (during day or night)

(M1410) **Respiratory Treatments** utilized at home: **(Mark all that apply.)**

- ☐ 1 - Oxygen (intermittent or continuous)
- ☐ 2 - Ventilator (continually or at night)
- ☐ 3 - Continuous / Bi-level positive airway pressure
- ☐ 4 - None of the above

CARDIAC STATUS

(M1500) **Symptoms in Heart Failure Patients:** If patient has been diagnosed with heart failure, did the patient exhibit symptoms indicated by clinical heart failure guidelines (including dyspnea, orthopnea, edema, or weight gain) at any point since the previous OASIS assessment?

- ☐ 0 - No **[** ***Go to M2004 at TRN; Go to M1600 at DC*** **]**
- ☐ 1 - Yes
- ☐ 2 - Not assessed **[** ***Go to M2004 at TRN; Go to M1600 at DC*** **]**
- ☐ NA - Patient does not have diagnosis of heart failure **[** ***Go to M2004 at TRN; Go to M1600 at DC*** **]**

(M1510) **Heart Failure Follow-up:** If patient has been diagnosed with heart failure and has exhibited symptoms indicative of heart failure since the previous OASIS assessment, what action(s) has (have) been taken to respond? **(Mark all that apply.)**

- ☐ 0 - No action taken
- ☐ 1 - Patient's physician (or other primary care practitioner) contacted the same day
- ☐ 2 - Patient advised to get emergency treatment (e.g., call 911 or go to emergency room)
- ☐ 3 - Implemented physician-ordered patient-specific established parameters for treatment
- ☐ 4 - Patient education or other clinical interventions
- ☐ 5 - Obtained change in care plan orders (e.g., increased monitoring by agency, change in visit frequency, telehealth, etc.)

ELIMINATION STATUS

(M1600) Has this patient been treated for a **Urinary Tract Infection** in the past 14 days?

- ☐ 0 - No
- ☐ 1 - Yes
- ☐ NA - Patient on prophylactic treatment
- ☐ UK - Unknown **[Omit "UK" option on DC]**

(M1610) Urinary Incontinence or Urinary Catheter Presence:

- ☐ 0 - No incontinence or catheter (includes anuria or ostomy for urinary drainage) **[** ***Go to M1620*** **]**
- ☐ 1 - Patient is incontinent
- ☐ 2 - Patient requires a urinary catheter (i.e., external, indwelling, intermittent, suprapubic) **[** ***Go to M1620*** **]**

(M1615) When does **Urinary Incontinence** occur?

- ☐ 0 - Timed-voiding defers incontinence
- ☐ 1 - Occasional stress incontinence
- ☐ 2 - During the night only
- ☐ 3 - During the day only
- ☐ 4 - During the day and night

(M1620) Bowel Incontinence Frequency:

- ☐ 0 - Very rarely or never has bowel incontinence
- ☐ 1 - Less than once weekly
- ☐ 2 - One to three times weekly
- ☐ 3 - Four to six times weekly
- ☐ 4 - On a daily basis
- ☐ 5 - More often than once daily
- ☐ NA - Patient has ostomy for bowel elimination
- ☐ UK - Unknown **[Omit "UK" option on FU, DC]**

(M1630) Ostomy for Bowel Elimination: Does this patient have an ostomy for bowel elimination that (within the last 14 days): a) was related to an inpatient facility stay, or b) necessitated a change in medical or treatment regimen?

- ☐ 0 - Patient does not have an ostomy for bowel elimination.
- ☐ 1 - Patient's ostomy was not related to an inpatient stay and did not necessitate change in medical or treatment regimen.
- ☐ 2 - The ostomy was related to an inpatient stay or did necessitate change in medical or treatment regimen.

NEURO/EMOTIONAL/BEHAVIORAL STATUS

(M1700) Cognitive Functioning: Patient's current (day of assessment) level of alertness, orientation, comprehension, concentration, and immediate memory for simple commands.

- ☐ 0 - Alert/oriented, able to focus and shift attention, comprehends and recalls task directions independently.
- ☐ 1 - Requires prompting (cuing, repetition, reminders) only under stressful or unfamiliar conditions.
- ☐ 2 - Requires assistance and some direction in specific situations (e.g., on all tasks involving shifting of attention), or consistently requires low stimulus environment due to distractibility.
- ☐ 3 - Requires considerable assistance in routine situations. Is not alert and oriented or is unable to shift attention and recall directions more than half the time.
- ☐ 4 - Totally dependent due to disturbances such as constant disorientation, coma, persistent vegetative state, or delirium.

(M1710) When Confused (Reported or Observed Within the Last 14 Days):

- ☐ 0 - Never
- ☐ 1 - In new or complex situations only
- ☐ 2 - On awakening or at night only
- ☐ 3 - During the day and evening, but not constantly
- ☐ 4 - Constantly
- ☐ NA - Patient nonresponsive

(M1720) When Anxious (Reported or Observed Within the Last 14 Days):

- ☐ 0 - None of the time
- ☐ 1 - Less often than daily
- ☐ 2 - Daily, but not constantly
- ☐ 3 - All of the time
- ☐ NA - Patient nonresponsive

(M1730) Depression Screening: Has the patient been screened for depression, using a standardized depression screening tool?

- ☐ 0 - No
- ☐ 1 - Yes, patient was screened using the PHQ-2©***** scale. (Instructions for this two-question tool: Ask patient: "Over the last two weeks, how often have you been bothered by any of the following problems")

PHQ-2©*	Not at all 0 - 1 day	Several days 2 - 6 days	More than half of the days 7 – 11 days	Nearly every day 12 – 14 days	N/A Unable to respond
a) Little interest or pleasure in doing things	☐0	☐1	☐2	☐3	☐na
b) Feeling down, depressed, or hopeless?	☐0	☐1	☐2	☐3	☐na

- ☐ 2 - Yes, with a different standardized assessment-and the patient meets criteria for further evaluation for depression.
- ☐ 3 - Yes, patient was screened with a different standardized assessment-and the patient does not meet criteria for further evaluation for depression.

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(M1740) Cognitive, behavioral, and psychiatric symptoms that are demonstrated <u>at least once a week</u> (Reported or Observed): **(Mark all that apply.)**

- ☐ 1 - Memory deficit: failure to recognize familiar persons/places, inability to recall events of past 24 hours, significant memory loss so that supervision is required
- ☐ 2 - Impaired decision-making: failure to perform usual ADLs or IADLs, inability to appropriately stop activities, jeopardizes safety through actions
- ☐ 3 - Verbal disruption: yelling, threatening, excessive profanity, sexual references, etc.
- ☐ 4 - Physical aggression: aggressive or combative to self and others (e.g., hits self, throws objects, punches, dangerous maneuvers with wheelchair or other objects)
- ☐ 5 - Disruptive, infantile, or socially inappropriate behavior (**excludes** verbal actions)
- ☐ 6 - Delusional, hallucinatory, or paranoid behavior
- ☐ 7 - None of the above behaviors demonstrated

(M1745) Frequency of Disruptive Behavior Symptoms (Reported or Observed) Any physical, verbal, or other disruptive/dangerous symptoms that are injurious to self or others or jeopardize personal safety.

☐ 0 - Never
☐ 1 - Less than once a month
☐ 2 - Once a month
☐ 3 - Several times each month
☐ 4 - Several times a week
☐ 5 - At least daily

(M1750) Is this patient receiving **Psychiatric Nursing Services** at home provided by a qualified psychiatric nurse?

☐ 0 - No
☐ 1 - Yes

ADL/IADLs

(M1800) **Grooming:** Current ability to tend safely to personal hygiene needs (i.e., washing face and hands, hair care, shaving or make up, teeth or denture care, fingernail care).

☐ 0 - Able to groom self unaided, with or without the use of assistive devices or adapted methods.
☐ 1 - Grooming utensils must be placed within reach before able to complete grooming activities.
☐ 2 - Someone must assist the patient to groom self.
☐ 3 - Patient depends entirely upon someone else for grooming needs.

(M1810) Current **Ability to Dress Upper Body** safely (with or without dressing aids) including undergarments, pullovers, front-opening shirts and blouses, managing zippers, buttons, and snaps:

☐ 0 - Able to get clothes out of closets and drawers, put them on and remove them from the upper body without assistance.
☐ 1 - Able to dress upper body without assistance if clothing is laid out or handed to the patient.
☐ 2 - Someone must help the patient put on upper body clothing.
☐ 3 - Patient depends entirely upon another person to dress the upper body.

(M1820) Current **Ability to Dress Lower Body** safely (with or without dressing aids) including undergarments, slacks, socks or nylons, shoes:

☐ 0 - Able to obtain, put on, and remove clothing and shoes without assistance.
☐ 1 - Able to dress lower body without assistance if clothing and shoes are laid out or handed to the patient.
☐ 2 - Someone must help the patient put on undergarments, slacks, socks or nylons, and shoes.
☐ 3 - Patient depends entirely upon another person to dress lower body.

(M1830) Bathing: Current ability to wash entire body safely. **Excludes grooming (washing face, washing hands, and shampooing hair).**

☐ 0 - Able to bathe self in shower or tub independently, including getting in and out of tub/shower.

☐ 1 - With the use of devices, is able to bathe self in shower or tub independently, including getting in and out of the tub/shower.

☐ 2 - Able to bathe in shower or tub with the intermittent assistance of another person:
(a) for intermittent supervision or encouragement or reminders, OR
(b) to get in and out of the shower or tub, OR
(c) for washing difficult to reach areas.

☐ 3 - Able to participate in bathing self in shower or tub, but requires presence of another person throughout the bath for assistance or supervision.

☐ 4 - Unable to use the shower or tub, but able to bathe self independently with or without the use of devices at the sink, in chair, or on commode.

☐ 5 - Unable to use the shower or tub, but able to participate in bathing self in bed, at the sink, in bedside chair, or on commode, with the assistance or supervision of another person throughout the bath.

☐ 6 - Unable to participate effectively in bathing and is bathed totally by another person.

(M1840) Toilet Transferring: Current ability to get to and from the toilet or bedside commode safely and transfer on and off toilet/commode.

☐ 0 - Able to get to and from the toilet and transfer independently with or without a device.

☐ 1 - When reminded, assisted, or supervised by another person, able to get to and from the toilet and transfer.

☐ 2 - Unable to get to and from the toilet but is able to use a bedside commode (with or without assistance).

☐ 3 - Unable to get to and from the toilet or bedside commode but is able to use a bedpan/urinal independently.

☐ 4 - Is totally dependent in toileting.

(M1845) Toileting Hygiene: Current ability to maintain perineal hygiene safely, adjust clothes and/or incontinence pads before and after using toilet, commode, bedpan, urinal. If managing ostomy, includes cleaning area around stoma, but not managing equipment.

☐ 0 - Able to manage toileting hygiene and clothing management without assistance.

☐ 1 - Able to manage toileting hygiene and clothing management without assistance if supplies/implements are laid out for the patient.

☐ 2 - Someone must help the patient to maintain toileting hygiene and/or adjust clothing.

☐ 3 - Patient depends entirely upon another person to maintain toileting hygiene.

(M1850) Transferring: Current ability to move safely from bed to chair, or ability to turn and position self in bed if patient is bedfast.

☐ 0 - Able to independently transfer.

☐ 1 - Able to transfer with minimal human assistance or with use of an assistive device.

☐ 2 - Able to bear weight and pivot during the transfer process but unable to transfer self.

☐ 3 - Unable to transfer self and is unable to bear weight or pivot when transferred by another person.

☐ 4 - Bedfast, unable to transfer but is able to turn and position self in bed.

☐ 5 - Bedfast, unable to transfer and is unable to turn and position self.

(M1860) Ambulation/Locomotion: Current ability to walk safely, once in a standing position, or use a wheelchair, once in a seated position, on a variety of surfaces.

☐ 0 - Able to independently walk on even and uneven surfaces and negotiate stairs with or without railings (i.e., needs no human assistance or assistive device).

☐ 1 - With the use of a one-handed device (e.g. cane, single crutch, hemi-walker), able to independently walk on even and uneven surfaces and negotiate stairs with or without railings.

☐ 2 - Requires use of a two-handed device (e.g., walker or crutches) to walk alone on a level surface and/or requires human supervision or assistance to negotiate stairs or steps or uneven surfaces.

☐ 3 - Able to walk only with the supervision or assistance of another person at all times.

☐ 4 - Chairfast, unable to ambulate but is able to wheel self independently.

☐ 5 - Chairfast, unable to ambulate and is unable to wheel self.

☐ 6 - Bedfast, unable to ambulate or be up in a chair.

(M1870) Feeding or Eating: Current ability to feed self meals and snacks safely. Note: This refers only to the process of eating, chewing, and swallowing, not preparing the food to be eaten.

☐ 0 - Able to independently feed self.

☐ 1 - Able to feed self independently but requires:
(a) meal set-up; OR
(b) intermittent assistance or supervision from another person; OR
(c) a liquid, pureed or ground meat diet.

☐ 2 - Unable to feed self and must be assisted or supervised throughout the meal/snack.

☐ 3 - Able to take in nutrients orally and receives supplemental nutrients through a nasogastric tube or gastrostomy.

☐ 4 - Unable to take in nutrients orally and is fed nutrients through a nasogastric tube or gastrostomy.

☐ 5 - Unable to take in nutrients orally or by tube feeding.

(M1880) Current **Ability to Plan and Prepare Light Meals** (e.g., cereal, sandwich) or reheat delivered meals safely:

☐ 0 - (a) Able to independently plan and prepare all light meals for self or reheat delivered meals; OR
(b) Is physically, cognitively, and mentally able to prepare light meals on a regular basis but has not routinely performed light meal preparation in the past (i.e., prior to this home care admission).

☐ 1 - Unable to prepare light meals on a regular basis due to physical, cognitive, or mental limitations.

☐ 2 - Unable to prepare any light meals or reheat any delivered meals.

(M1890) Ability to Use Telephone: Current ability to answer the phone safely, including dialing numbers, and effectively using the telephone to communicate.

☐ 0 - Able to dial numbers and answer calls appropriately and as desired.

☐ 1 - Able to use a specially adapted telephone (i.e., large numbers on the dial, teletype phone for the deaf) and call essential numbers.

☐ 2 - Able to answer the telephone and carry on a normal conversation but has difficulty with placing calls.

☐ 3 - Able to answer the telephone only some of the time or is able to carry on only a limited conversation.

☐ 4 - Unable to answer the telephone at all but can listen if assisted with equipment.

☐ 5 - Totally unable to use the telephone.

☐ NA - Patient does not have a telephone.

(M1900) Prior Functioning ADL/IADL: Indicate the patient's usual ability with everyday activities prior to this current illness, exacerbation, or injury. Check only **one** box in each row.

Functional Area	Independent	Needed Some Help	Dependent
a. Self-Care (e.g., grooming, dressing, and bathing)	☐0	☐1	☐2
b. Ambulation	☐0	☐1	☐2
c. Transfer	☐0	☐1	☐2
d. Household tasks (e.g., light meal preparation, laundry, shopping)	☐0	☐1	☐2

(M1910) Has this patient had a multi-factor **Fall Risk Assessment** (such as falls history, use of multiple medications, mental impairment, toileting frequency, general mobility/transferring impairment, environmental hazards)?

☐ 0 - No multi-factor falls risk assessment conducted.

☐ 1 - Yes, and it does not indicate a risk for falls.

☐ 2 - Yes, and it indicates a risk for falls.

MEDICATIONS

(M2000) Drug Regimen Review: Does a complete drug regimen review indicate potential clinically significant medication issues, e.g., drug reactions, ineffective drug therapy, side effects, drug interactions, duplicate therapy, omissions, dosage errors, or noncompliance?

☐ 0 - Not assessed/reviewed **[** ***Go to M2010*** **]**

☐ 1 - No problems found during review **[** ***Go to M2010*** **]**

☐ 2 - Problems found during review

☐ ☠✌ 🗅🏳♋♦♓♏■♦ ♓♦ ■☐♦ ♦♋&♓■♑ ♋■🖂 ❍♏♎♓♍♋♦♓☐■♦ **[** ***Go to M2040*** **]**

(M2002) Medication Follow-up: Was a physician or the physician-designee contacted within one calendar day to resolve clinically significant medication issues, including reconciliation?

☐ 0 - No

☐ 1 - Yes

(M2004) Medication Intervention: If there were any clinically significant medication issues since the previous OASIS assessment, was a physician or the physician-designee contacted within one calendar day of the assessment to resolve clinically significant medication issues, including reconciliation?

☐ 0 - No

☐ 1 - Yes

☐ NA - No clinically significant medication issues identified since the previous OASIS assessment

(M2010) Patient/Caregiver High Risk Drug Education: Has the patient/caregiver received instruction on special precautions for all high-risk medications (such as hypoglycemics, anticoagulants, etc.) and how and when to report problems that may occur?

☐ 0 - No

☐ 1 - Yes

☐ NA - Patient not taking any high risk drugs OR patient/caregiver fully knowledgeable about special precautions associated with all high-risk medications

(M2015) Patient/Caregiver Drug Education Intervention: Since the previous OASIS assessment, was the patient/caregiver instructed by agency staff or other health care provider to monitor the effectiveness of drug therapy, drug reactions, and side effects, and how and when to report problems that may occur?

☐ 0 - No

☐ 1 - Yes

☐ NA - Patient not taking any drugs

(M2020) Management of Oral Medications: Patient's current ability to prepare and take all oral medications reliably and safely, including administration of the correct dosage at the appropriate times/intervals. **Excludes injectable and IV medications. (NOTE: This refers to ability, not compliance or willingness.)**

☐ 0 - Able to independently take the correct oral medication(s) and proper dosage(s) at the correct times.

☐ 1 - Able to take medication(s) at the correct times if:
(a) individual dosages are prepared in advance by another person; OR
(b) another person develops a drug diary or chart.

☐ 2 - Able to take medication(s) at the correct times if given reminders by another person at the appropriate times

☐ 3 - Unable to take medication unless administered by another person.

☐ [illegible]

(M2030) Management of Injectable Medications: Patient's current ability to prepare and take all prescribed injectable medications reliably and safely, including administration of correct dosage at the appropriate times/intervals. **Excludes IV medications.**

☐ 0 - Able to independently take the correct medication(s) and proper dosage(s) at the correct times.

☐ 1 - Able to take injectable medication(s) at the correct times if:
(a) individual syringes are prepared in advance by another person; OR
(b) another person develops a drug diary or chart.

☐ 2 - Able to take medication(s) at the correct times if given reminders by another person based on the frequency of the injection

☐ 3 - Unable to take injectable medication unless administered by another person.

☐ NA - No injectable medications prescribed.

(M2040) Prior Medication Management: Indicate the patient's usual ability with managing oral and injectable medications prior to this current illness, exacerbation, or injury. Check only **one** box in each row.

Functional Area	Independent	Needed Some Help	Dependent	Not Applicable
a. Oral medications	☐0	☐1	☐2	☐na
b. Injectable medications	☐0	☐1	☐2	☐na

CARE MANAGEMENT

(M2100) Types and Sources of Assistance: Determine the level of caregiver ability and willingness to provide assistance for the following activities, if assistance is needed. (Check only **one** box in each row.)

Type of Assistance	No assistance needed in this area	Caregiver(s) currently provide assistance	Caregiver(s) need training/ supportive services to provide assistance	Caregiver(s) not likely to provide assistance	Unclear if Caregiver(s) will provide assistance	Assistance needed, but no Caregiver(s) available
a. **ADL assistance** (e.g., transfer/ ambulation, bathing, dressing, toileting, eating/feeding)	☐0	☐1	☐2	☐3	☐4	☐5
b. **IADL assistance** (e.g., meals, housekeeping, laundry, telephone, shopping, finances)	☐0	☐1	☐2	☐3	☐4	☐5
c. **Medication administration** (e.g., oral, inhaled or injectable)	☐0	☐1	☐2	☐3	☐4	☐5
d. **Medical procedures/ treatments** (e.g., changing wound dressing)	☐0	☐1	☐2	☐3	☐4	☐5
e. **Management of Equipment** (includes oxygen, IV/infusion equipment, enteral/ parenteral nutrition, ventilator therapy equipment or supplies)	☐0	☐1	☐2	☐3	☐4	☐5
f. **Supervision and safety** (e.g., due to	☐0	☐1	☐2	☐3	☐4	☐5

cognitive impairment)						
g. **Advocacy or facilitation** of patient's participation in appropriate medical care (includes transporta-tion to or from appointments)	☐0	☐1	☐2	☐3	☐4	☐5

(M2110) How Often does the patient receive **ADL or IADL assistance** from any caregiver(s) (other than home health agency staff)?

☐ 1 - At least daily
☐ 2 - Three or more times per week
☐ 3 - One to two times per week
☐ 4 - Received, but less often than weekly
☐ 5 - No assistance received
☐ UK - Unknown **[Omit "UK" option on DC]**

THERAPY NEED AND PLAN OF CARE

(M2200) Therapy Need: In the home health plan of care for the Medicare payment episode for which this assessment will define a case mix group, what is the indicated need for therapy visits (total of reasonable and necessary physical, occupational, and speech-language pathology visits combined)? **(Enter zero ["000"] if no therapy visits indicated.)**

(__ __ __) Number of therapy visits indicated (total of physical, occupational and speech-language pathology combined).

☐ NA - Not Applicable: No case mix group defined by this assessment.

(M2250) Plan of Care Synopsis: (Check only **one** box in each row.) Does the physician-ordered plan of care include the following:

Plan / Intervention	No	Yes	Not Applicable	
a. Patient-specific parameters for notifying physician of changes in vital signs or other clinical findings	☐0	☐1	☐na	Physician has chosen not to establish patient-specific parameters for this patient. Agency will use standardized clinical guidelines accessible for all care providers to reference
b. Diabetic foot care including monitoring for the presence of skin lesions on the lower extremities and patient/caregiver education on proper foot care	☐0	☐1	☐na	Patient is not diabetic or is bilateral amputee
c. Falls prevention interventions	☐0	☐1	☐na	Patient is not assessed to be at risk for falls
d. Depression intervention(s) such as medication, referral for other treatment, or a monitoring plan for current treatment	☐0	☐1	☐na	Patient has no diagnosis or symptoms of depression

e.	Intervention(s) to monitor and mitigate pain	☐0	☐1	☐na	No pain identified
f.	Intervention(s) to prevent pressure ulcers	☐0	☐1	☐na	Patient is not assessed to be at risk for pressure ulcers
g.	Pressure ulcer treatment based on principles of moist wound healing OR order for treatment based on moist wound healing has been requested from physician	☐0	☐1	☐na	Patient has no pressure ulcers with need for moist wound healing

EMERGENT CARE

(M2300) Emergent Care: Since the last time OASIS data were collected, has the patient utilized a hospital emergency department (includes holding/observation)?

☐ 0 - No **[** ***Go to M2400*** **]**
☐ 1 - Yes, used hospital emergency department WITHOUT hospital admission
☐ 2 - Yes, used hospital emergency department WITH hospital admission
☐ UK - Unknown **[** ***Go to M2400*** **]**

(M2310) Reason for Emergent Care: For what reason(s) did the patient receive emergent care (with or without hospitalization)? **(Mark all that apply.)**

☐ 1 - Improper medication administration, medication side effects, toxicity, anaphylaxis
☐ 2 - Injury caused by fall
☐ 3 - Respiratory infection (e.g., pneumonia, bronchitis)
☐ 4 - Other respiratory problem
☐ 5 - Heart failure (e.g., fluid overload)
☐ 6 - Cardiac dysrhythmia (irregular heartbeat)
☐ 7 - Myocardial infarction or chest pain
☐ 8 - Other heart disease
☐ 9 - Stroke (CVA) or TIA
☐ 10 - Hypo/Hyperglycemia, diabetes out of control
☐ 11 - GI bleeding, obstruction, constipation, impaction
☐ 12 - Dehydration, malnutrition
☐ 13 - Urinary tract infection
☐ 14 - IV catheter-related infection or complication
☐ 15 - Wound infection or deterioration
☐ 16 - Uncontrolled pain
☐ 17 - Acute mental/behavioral health problem
☐ 18 - Deep vein thrombosis, pulmonary embolus
☐ 19 - Other than above reasons
☐ UK - Reason unknown

DATA ITEMS COLLECTED AT INPATIENT FACILITY ADMISSION OR AGENCY DISCHARGE ONLY

(M2400) Intervention Synopsis: (Check only **one** box in each row.) Since the previous OASIS assessment, were the following interventions BOTH included in the physician-ordered plan of care AND implemented?

Plan / Intervention	No	Yes	Not Applicable	
a. Diabetic foot care including monitoring for the presence of skin lesions on the lower extremities and patient/caregiver education on proper foot care	☐0	☐1	☐na	Patient is not diabetic or is bilateral amputee
b. Falls prevention interventions	☐0	☐1	☐na	Formal multi-factor Fall Risk Assessment indicates the patient was not at risk for falls since the last OASIS assessment
c. Depression intervention(s) such as medication, referral for other treatment, or a monitoring plan for current treatment	☐0	☐1	☐na	Formal assessment indicates patient did not meet criteria for depression AND patient did not have diagnosis of depression since the last OASIS assessment
d. Intervention(s) to monitor and mitigate pain	☐0	☐1	☐na	Formal assessment did not indicate pain since the last OASIS assessment
e. Intervention(s) to prevent pressure ulcers	☐0	☐1	☐na	Formal assessment indicates the patient was not at risk of pressure ulcers since the last OASIS assessment
f. Pressure ulcer treatment based on principles of moist wound healing	☐0	☐1	☐na	Dressings that support the principles of moist wound healing not indicated for this patient's pressure ulcers OR patient has no pressure ulcers with need for moist wound healing

(M2410) To which **Inpatient Facility** has the patient been admitted?

☐ 1 - Hospital **[** ***Go to M2430*** **]**

☐ 2 - Rehabilitation facility **[** ***Go to M0903*** **]**

☐ 3 - Nursing home **[** ***Go to M2440*** **]**

☐ 4 - Hospice **[** ***Go to M0903*** **]**

☐ NA - No inpatient facility admission **[Omit "NA" option on TRN]**

(M2420) Discharge Disposition: Where is the patient after discharge from your agency? **(Choose only one answer.)**

☐ 1 - Patient remained in the community (without formal assistive services)

☐ 2 - Patient remained in the community (with formal assistive services)

☐ 3 - Patient transferred to a non-institutional hospice

☐ 4 - Unknown because patient moved to a geographic location not served by this agency

☐ UK - Other unknown

[***Go to M0903*** **]**

(M2430) Reason for Hospitalization: For what reason(s) did the patient require hospitalization? **(Mark all that apply.)**

☐ 1 - Improper medication administration, medication side effects, toxicity, anaphylaxis
☐ 2 - Injury caused by fall
☐ 3 - Respiratory infection (e.g., pneumonia, bronchitis)
☐ 4 - Other respiratory problem
☐ 5 - Heart failure (e.g., fluid overload)
☐ 6 - Cardiac dysrhythmia (irregular heartbeat)
☐ 7 - Myocardial infarction or chest pain
☐ 8 - Other heart disease
☐ 9 - Stroke (CVA) or TIA
☐ 10 - Hypo/Hyperglycemia, diabetes out of control
☐ 11 - GI bleeding, obstruction, constipation, impaction
☐ 12 - Dehydration, malnutrition
☐ 13 - Urinary tract infection
☐ 14 - IV catheter-related infection or complication
☐ 15 - Wound infection or deterioration
☐ 16 - Uncontrolled pain
☐ 17 - Acute mental/behavioral health problem
☐ 18 - Deep vein thrombosis, pulmonary embolus
☐ 19 - Scheduled treatment or procedure
☐ 20 - Other than above reasons
☐ UK - Reason unknown

[***Go to M0903*** **]**

(M2440) For what **Reason(s)** was the patient **Admitted** to a **Nursing Home**? **(Mark all that apply.)**

☐ 1 - Therapy services
☐ 2 - Respite care
☐ 3 - Hospice care
☐ 4 - Permanent placement
☐ 5 - Unsafe for care at home
☐ 6 - Other
☐ UK - Unknown

[***Go to M0903*** **]**

(M0903) Date of Last (Most Recent) Home Visit:

__ __ / __ __ / __ __ __ __
month / day / year

(M0906) Discharge/Transfer/Death Date: Enter the date of the discharge, transfer, or death (at home) of the patient.

__ __ / __ __ / __ __ __ __
month / day / year

APPENDIX 2

Honeywell HomMed Monitor Telemonitoring Kit Checklist

	Equipment
1	Sentry/Genesis monitor (S/N #_____)
	1A. Monitor power supply
2.	Scale (S/N #_____)
	2A. Scale attachment cable
3.	Adult I, II, III (standard) or IV blood pressure cuff
4.	SpO2 finger probe
	4A. Oximeter adapter cable (Genesis only)

Monitor & Peripherals

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