Urinary Tract Infection(UTI)-related Hospitalization among Elderly Home Healthcare Patients

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ABSTRACT

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In the United States, home health care (HHC) is the most frequently used form of post-acute care services. Majority of the HHC patients are elderly and have known activities of daily living (ADL) dependencies. The role of HHC as a post-acute care provider has been emphasized under the Affordable Care Act (ACA) as it is expected that HHC services will help patients stay in the community and reduce acute care hospitalization. Urinary tract infection (UTI) -related hospitalization is an adverse patient outcome that affects elderly patients in the HHC setting. Studies examining the ADLs of HHC patients are limited. Although dependence in ADLs is a known risk factor for hospitalization, no study has assessed the relationship between ADL dependency and UTI-related hospitalization among HHC patients.

This dissertation describes the ADLs of elderly patients receiving HHC services, and examines risk of UTI-related hospitalization among this population, specifically the potential risk of ADL dependency. In Chapter One, the problems of UTI-related hospitalization and ADL dependency are introduced and their significance is described. In Chapter Two, an integrative review of the literature describing methods of assessing ADLs in skilled nursing facilities (SNF) and HHC are described. In Chapter Three, a cross-sectional study elucidating the risk factors for severe ADL dependency and predictors of ADL improvement among HHC patients is reported. In Chapter Four, the risk factors for UTI-related hospitalization among HHC patients is reported.

In Chapter Five, findings of the three studies are summarized and conclusions are provided including strengths, limitations, and implications for practice and policy.

Andersen's Behavioral Model was the theoretical framework used for this study. The Andersen model posits that health care utilization is a function of patients predisposing (e.g. age, gender, race/ethnicity), enabling (e.g. living alone, insurance status, living condition, primary care giver) and need factors (e.g. ADL dependency level, comorbidity, impaired decision making). This model fits this dissertation because evidence shows that health care utilization (UTI-related hospitalizations) depends on predisposing, enabling and need factors.

This was a retrospective cohort research design study based on secondary analysis of the Outcome and Assessment Information Set (OASIS) data set of 154,801 beneficiaries who received home health care services in 2013. Descriptive statistics, bivariate analysis, and multivariable logistic regression analyses were conducted to examine the effect of each individual variable on the outcomes of interest (severe ADL dependency, ADL improvement and UTI-related hospitalizations).

The study population was elderly (mean age 77 years), mostly female (65%) and white (79.8%). Key findings indicated that, (a) over 60% of patients had severe ADL dependency, and impaired decision making is a strong predictor of severe ADL dependency, (b) Overall, patients experienced ADL improvement from admission to discharge. However, blacks experienced significantly less ADL improvement compared to Whites. Longer HHC length of stay was also associated with ADL improvement, and (c) For the UTI-related hospitalization outcome model, multivariable analysis showed that Medicaid insurance, severe ADL dependency and impaired decision making was associated with increased risk for UTI-related hospitalization.

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Dedication

This dissertation is dedicated to my uncle, late Georgie Ogoegbunam Anuntu.

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Chapter One: Introduction

This chapter presents an overview of the problem and purpose of this dissertation. The background and organization of this dissertation will be explained. Information regarding the current state activity of daily living and Urinary Tract Infection (UTI) in post-acute care settings in the United States is described. Gaps in literature are identified and the research question is stated and the potential significance of the study is discussed**.** The conceptual frameworks that will guide the dissertation are described and definitions of study variables are provided. In conclusion**,** the three manuscripts that address the three research aims will be presented. Each manuscript will be submitted to academic journals to satisfy the requirements of dissertation research set forth by the Graduate School of Arts and Sciences at Columbia University.

Problem Statement

Post-acute care

Post-acute care (PAC) is composed of medical, rehabilitation, and nursing services that aim to restore maximal medical and functional status of patients following an acute hospital stay (David, Sheikh, Mahajan, Greenugh & Bellatoni, 2016). Such care can be received in four distinct settings: 1) skilled nursing facility (SNF); 2) home health care (HHC); 3) inpatient rehabilitation facility; and 4) long term care hospitals (LTCH). The use of PAC services represents a significant burden to the U.S. health care system accounting for more than $62 billion in 2012 expenditures. (Miller, 2013). PAC is currently the fastest growing segment of health care expenditures in the United States (Chandra, Dalton &Holmes, 2013). From 2001 to 2013, annual Medicare spending increased from $12 to $29 billion (7.6% annual growth) for care in SNFs, from $9 billion to $18 billion (5.9% annual growth) for HHC service, and from $4.5 billion to $6.8 billion (3.5% annual growth) for care in inpatient rehabilitation facilities (IRFs)

(Mor, Rahman & McHugh, 2016). SNF and HHC are the most commonly utilized PAC settings (MedPAC, 2011), and as such the focus of this dissertation.

Patients must meet certain criteria to be eligible for services provided in each PAC setting. Up to 100 days of SNF care is covered by Medicare provided the patient needs daily skilled nursing or therapy. SNF also requires at least a three-day inpatient hospital stay in the 30 days prior to a SNF admission (Linehan & Coberly, 2012). For care in the IRF, patients must be expected to benefit from intensive rehabilitation therapy in a hospital environment (MedPAC, 2015b). Patients receiving HHC must be home bound, require skilled nursing care on an intermittent basis or have a continuing need for physical therapy, occupational therapy, or speech language pathology services and receive a physician referral (MedPAC, 2014). HHC differs from other PAC settings in that clinicians work in patients' homes, with administrative support provided from a central office. (Ellenbecker, Samia, Cushman & Alster, 2008).

In the United States, Medicare is the primary payer for PAC; as such PAC services from non-Medicare insurances are modeled on Medicare guidelines. Recent studies found that since the inception of the Affordable Care Act (ACA), discharges to PAC settings rose nearly 50%, resulting in 1.2 million more discharges to PAC settings in 2010 compared with 1996 rates (Burke et al., 2014). Further, it is estimated that nearly 50% of patients discharged from the hospital utilize PAC services (MedPAC, 2015b). Currently under the ACA, hospitals are accountable for certain key factors in the discharge planning process, including whether a patient was discharged to the appropriate PAC setting.

A recent study found that patients with similar characteristics may receive different PAC services depending on the availability of PAC providers (Morley, Bogasky, Gage, Flood & Ingber, 2014). In recognition of this, The Centers for Medicare and Medicaid Services (CMS) is

moving toward a unified system that would align payments to patient characteristics rather than sites of care (Coberly, 2015). CMS initiatives, such as the passage of the *Improving Medicare Post-Acute Care Transformation* (IMPACT) Act of 2014 (CMS, 2015a), mandate the development of functional status (self-care and mobility) data elements that are standardized across PAC settings.

Skilled Nursing Facility and Home Health Care

In 2014, of the 29,000 post-acute care providers, 15,173 were SNFs and 12,461 were HHC agencies (Linehan & Coberly,2012) , making SNF and HHC the most widely utilized types of PAC services among Medicare beneficiaries (MedPAC, 2011), and as such the focus of this research. One important data element collected in SNF and HHC settings is the activities of daily living (ADLs). ADLs include daily self-care activities such as eating, dressing, bathing and toileting (Elsawy & Higgins, 2011) and mobility activities such as, transferring between the bed and a chair (Middleton et al., 2016). Within SNF and HHC, ADL measures constitute one of the domains used to calculate each patient's reimbursement rate (Schlenker, Powell & Goodrich, 2005) and evaluate quality of care (Middleton et al., 2016). A limitation of current ADL data captured using the current mandated assessment instruments in SNF and HHC (Pentz and Wilson, 2001; Fortinsky and Madigan, 2004; Lum, Lin & Kane, 2005) is the variation in the methods of assessment and measurement in both PAC settings (MedPAC, 2014).

Home Health Care

The primary goal of care in HHC is to enable and support patients to self-manage their health and medical conditions, achieve optimal level of functioning and avoid subsequent unscheduled acute care encounters prior to discharge (Buntin et al. 2009). Medicare regulations, the Conditions of Participation (CoPs), require HHC agencies participating in the Medicare or

Medicaid programs to collect standardized patient assessment data on a mandated instrument called the Outcome and Assessment Information Set (OASIS). The OASIS is used for several purposes: reimbursement, to determine quality outcomes for the agency, and to compare services between agencies to inform patient's choice of a HHC provider (Scharpf & Madigan, 2010). Included in the OASIS is evaluation of the patient's cognitive, physical and functional status, living arrangements and availability of supportive assistance, as well as identification of relevant diagnoses (Tullai-McGuiness, Madigan & Fortinsky, 2009). More than 70% of HHC patients are age 65 years and older (National Center for Health Statistics, 2004), and among Medicare beneficiaries receiving HHC services 36% live alone and 29% have major functional limitations (Avalere Health, 2013).

HHC is an increasingly important provider of PAC services in the United States, with an estimate of 3.5 million Medicare users, followed by SNFs with 1.7 million users in 2013 (MedPAC, 2015a). It is estimated that between 2001 and 2012, HHC referrals at hospital discharge increased by 65 percent, and Medicare spending on HHC services more than doubled (Horwitz et al.,2014; Jones, Ginde, Burke, Wald, Masoudi & Boxer, 2015; Med PAC, 2015).

Home Health Care and Acute Care Hospitalizations

In addition to concerns about the rise in the cost of PAC, there is increasing attention to the outcomes of PAC. Hospitalization rates have been used as one indicator of health care quality in PAC settings including SNFs (Intrator, Zinn & Mor, 2004). Indeed, the role of HHC in decreasing hospitalizations is critical given the priority under the ACA to reduce acute care hospitalizations (Chen, Homan, Carlson, Popoola & Radhakrishnan, 2016). However, a high readmission rate of 29% for Medicare HHC patients in 2010 represented a challenge to the HHC industry to meet the goals of the ACA (MedPAC, 2014b). CMS reports rates of acute care

hospitalization in HHC as a quality indicator on Medicare's Home Health Compare website (Jung, Shea & Warner,2010). This indicator has been targeted for a nation-wide HHC quality improvement campaign (Simon &Feldman, 2007). Factors associated with hospitalization among patients receiving HHC in a large diagnostically heterogeneous population include more functional impairment (Fortinsky, Madigan, Sheehan, Tullai-McGuinness & Fenster, 2006) and history of prior hospitalizations (Madigan, Gordon, Fortinsky, Koroukian, Pina & Riggs, 2012).

Acute care hospitalizations related to infections are an emerging area of concern in the HHC population. In an analysis of 199,462 HHC patients from 8,255 HHC agencies, Shang and colleagues (2015) found that 17 % of hospitalizations from HHC were caused by infections.

Urinary Tract Infections (UTI) Related Hospitalizations in HHC

Infections in all PAC settings are a major concern contributing to morbidity, mortality and substantial indirect health-related costs (Dwyer, Harris-Kojetin, Roberto et al. 2013). UTI-related hospitalizations represent a particularly challenging and costly problem, A population based study conducted from 2006 to 2009 reported an average 2.7 million emergency department visits per year leading to 450,136 hospital admissions (Sammon et al., 2014). UTIs are one of the most commonly diagnosed bacterial infection in older adults (Rao & Patel, 2009; Rowe & Juthani, 2014), and the second most common reason for empirical antibiotic therapy (Gupta, Hooton, Naber et al.,2011; Woodruff & George, 2009).

The development of UTIs during a HHC episode is a Home Health Quality Measure defined as a potentially Avoidable Event (CMS, 2017b). Emerging evidence reveals that UTIs in the community are associated with more severe infections such as sepsis. A recent Centers for Disease Control and Prevention (CDC) evaluation report found that among adults with cases of sepsis, 25% had a UTI prior to hospitalization (Novosad et al., 2016).

Little research exists that identifies patient level characteristics that influence UTI-related hospitalizations in HHC. Using a nationally representative sample of 4,394 HHC patients, Dwyer and colleagues (2010), found that 11.6 % of HHC patients had an infection, and 3.6 were UTIs. Further, 9.2 % patient of HHC patients had a urinary catheter. Despite the importance of UTI related hospitalizations as a negative outcome in the rapidly growing HHC arena, we found no published studies using national data to identify clinically and policy relevant factors that increase risk for UTI-related hospitalization during a HHC episode of care.

IRB Approval

IRB approval for this study was obtained from Columbia University Medical Center (CUMC) Institutional Review Board (IRB).

Dissertation Purpose and Question

The purpose of this dissertation is to describe the ADLs of elderly patients receiving HHC, and to examine the association between ADLs and risk of UTI-related hospitalization among this population.

Aims and Organization of Dissertation

The aims of this dissertation will be addressed in three separate manuscripts that are presented in the next three chapters of this dissertation. Each manuscript will be submitted for publication. Chapter Two is an integrative review of the literature meant to show the gaps in knowledge related to the methods of assessing ADLs in HHC and SNF. Chapter Three is meant to fill a portion of this gap by describing the ADLs of patients receiving HHC using the national OASIS data set. This further informs chapter four, which is meant to describe the characteristics of patients receiving HHC who are admitted to a hospital with urinary tract infections (UTIs) and assess the relationship between ADLs and UTI-related hospitalizations, to address this aim a

retrospective cohort study using national OASIS data will be conducted. Each of these papers is meant to combine with the others to generate a complete image of the assessment of ADLs in PAC, the description of ADLs of patients receiving HHC and ADLs associated with the risk for UTI related hospitalization among HHC patients. The aims for each manuscript and, and the potential target journals are specifically detailed in Table 1.1.

Theoretical Framework

Guided by Andersen Behavioral Model of Health Service Utilization (Andersen,1968) (cite), this study will use data from the comprehensive national OASIS data set. Ronald Andersen, a medical sociologist created the original Andersen Behavioral Model of Health Service Utilization (Andersen, 1968), this was followed by four revisions, in response to expert feedback, health services research, medical sociology, and health policy (Andersen et al., 2007). Andersen's initial model was first developed in the 1960s to explain why families use medical and dental services, this version focused primarily on individual level characteristics that impact families utilization of health services (Andersen, 1968). Andersen (1995) summarizes that the initial behavioral model suggests that people's use of health care services is a function of their predisposition to use services, factors which enable use and their need for care (Andersen, 1968; Andersen & Andersen, 1967).

Over the past few decades, the model has been revised to include external environmental and personal health variables which are referred to as extra -individual level factors that influence an individual's use of health services (Andersen, 1995). Despite the revisions, the basic hypothesis of the behavioral model remains unchanged (Figure 1.1). This model posits that the actual use of health care services is a function of three factors: predisposing, enabling and need factors (Andersen, 1968; Andersen, 1995). Andersen's model has been applied extensively in

the field of health services utilization, including home health care. This dissertation is focused on individual characteristics that predict health services utilization (UTI-related hospitalization), consequently, following the initial Andersen model, patient level factors risk factors will be classified as predisposing, enabling, need variables to portray factors associated with health service utilization (hospitalizations). Using the Andersen model as a conceptual guide, possible predictor variables associated with the outcome were identified based on the literature. Figure 1.1 depicts this model. Individual factors include predisposing (age, race/ethnicity, sex), enabling (social support), and need characteristics (ADLs items and comorbidities).

Predisposing variables

Predisposing variables are individual attributes which are present before the onset of illness and may affect the propensity to use services directly or indirectly. These include demographics, social structure (e.g., education, occupation and ethnicity), and heath beliefs (attitudes, values and knowledge).

Enabling variables

Enabling variables are the social determinants that support or impede an individual's ability to access care once illness has begun, such as income, health insurance and family resources.

Need for care variables

Need for care variables are illness-related variables which refer to health or functional factors that are often the most immediate cause for health service use. Need factors are considered from two perspectives; the patient's perceived need and the clinician evaluated need for care based on ADLs, and co-morbidities

a. The patient- perceived need refers to the patient's judgment of their general health, functional state and illness symptoms,

b. The clinician evaluated need is the professional assessment and objective measurements of patient's health status and need for medical care**.**

Operational Definitions

Variables for this study were selected from the existing literature to be consistent with the conceptual model and based on availability in the existing data set**.** Independent variables for this study are patient predisposing characteristics, enabling resources and need variables.

Predisposing variables: Predisposing patient characteristics are demographics: age, gender, and race/ethnicity (Black/African -American, Hispanic, White and other).

Enabling variables: Three variables are included as enabling resources: dual eligibility, social support and living arrangement.

Dual eligibility**:** Having Medicaid in addition to Medicare insurance is an enabling resource in this dissertation. Dual eligibility means an individual has both Medicare and Medicaid insurance. Individuals with dual eligibility have been cited as the most vulnerable groups in the public insurance system, and have the highest health care expenditure among Medicare beneficiaries (Moon &Shin, 2006). Studies have documented differences in living conditions between dual eligibles and Medicare-only patients in the general population; they are more likely to live alone (Cai, Salmon and Rodgers, 2009; Kelly et al.,2010) and have lower socio economic status (Maritkainen et al.2009). Within PAC settings, SNF studies have also documented difference between dual eligibles compared to the Medicare population. Rahman and colleagues (2014) found that dual eligibles were more likely to be female, minority and reside in a relatively low income neighborhood.

Social Support: The presence of a caregiver other than home care staff is called supportive assistance in the OASIS database.

Living arrangement: This refers to the living situation of patients and the availability of assistance at residence. Living condition is indicated by whether a patient lives in an apartment alone, with other people, or in a communal residence building with onsite assistance (congregate building)

Need variables: Need factors are considered from two perspectives. The clinician evaluated need is represented by the number of co-morbidities, a diagnosis of UTI and functional status assessment (measured as ADL). The patient –perceived need is indicated by patient's self-reported prior level of ADL items available in the OASIS dataset.

Co-morbidities: This is defined in this study as the number of primary and secondary diagnoses listed in the OASIS. One study of Medicare beneficiaries found that patients with higher Medicare expenditure had more co-morbid conditions (Zhang, Rathouz & Chin,, 2003)

Significance of the Study

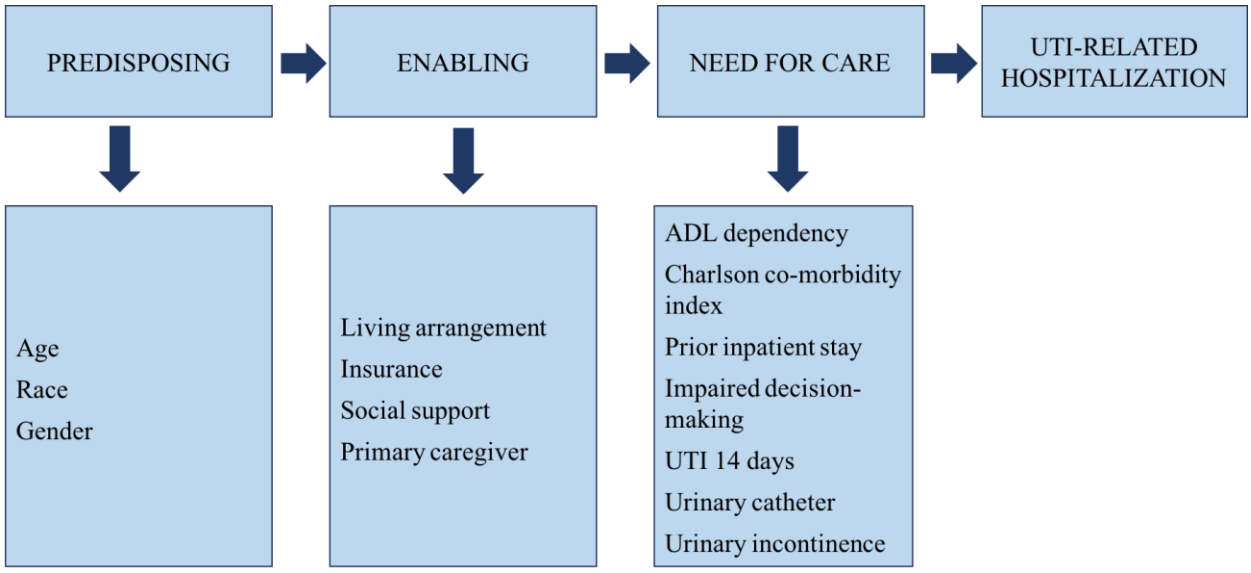
There is growing interest in the role of HHC in preventing hospitalization, in part in response to the recent release of the final rule for the Hospital Readmissions Reduction Program (Carey & Lin, 2016; Zuckerman, Sheingold, Orav, Ruhter, & Epstein, 2016). This dissertation investigates patient level HHC factors that put patients at risk for UTI-related hospitalizations and hospital readmissions. Managing these high-risk patients more effectively in the outpatient setting may prevent unnecessary hospitalizations and reduce associated health care costs and poor health outcomes among elderly patients in HHC. This dissertation examines three important quality measures in HHC: functional status (ADLs), development of UTIs, and acute care hospitalizations (CMS, 2016b). ADLs are examined in the context of functional domains

identified in the recent IMPACT mandate for PAC settings. To our knowledge, no research has examined the impact of ADLs in UTI-related hospitalizations among elderly HHC patients with relevance to current health policy under the ACA. Findings from this study could also inform how patient ADL can be used to develop intervention programs to reduce re-hospitalization across the continuum of acute and post-acute care.

Table 1.1 Potential Target Journals for Each Chapter of the Dissertation

Chapter	Title	Aim	Potential Target Journals
2	Assessment of Activities of Daily Living in Home Health Care (HHC) and Skilled Nursing Facility (SNF): An integrative review of the literature	1. To describe methods used to assess activities of daily living (ADLs) among elderly patients in skilled nursing facilitates (SNF) and home health care (HHC).	1.Home Health Care Now 2. Home Health Care Nurse 3.Journal of Nursing Scholarship
3	Activities of daily living (ADLs) of patients in HHC: Results from national Outcome and Information Data Set	2. To describe the ADLs of patients in HHC	1.Home Health Care Services Quarterly 2.Journal of Post-Acute and Long Term Care Medicine (JAMDA) 3.Home Health Care Nurse
4	UTI-related Hospitalizations among Elderly Home Health Care Patients: An Analysis of national Outcome and Information Data Set	3. To describe the characteristics of patients receiving HHC who are admitted to a hospital with urinary tract infection (UTI) and assess the relationship between ADLs and UTI-related hospitalizations	1. American Journal of Infection Control. 2. Home Health Care Services Quarterly 3.Journal of Post-Acute and Long Term Care Medicine (JAMDA)

Figure 1.1 Andersen Model of Health Service Utilization (1968)



Chapter Two: Assessment of Activities of Daily Living among Elderly Patients in Post-Acute Care Settings: An Integrative Review of the Literature

Chapter two of this dissertation will address aim one, to synthesize the peer-reviewed, published research to describe the methods of assessing activities of daily living (ADLs) in HHC and SNF. To satisfy this aim, an integrative review of the literature was conducted between April 2016 and November 2016. This manuscript is published in a peer reviewed journal, Home Health Care Now.

Citation

Osakwe, Z. T., Larson, E., Agrawal, M., & Shang, J. (2017). Assessment of activity of daily living among older adult patients in home healthcare and skilled nursing facilities: An integrative review. *Home Healthcare Now*, *35*(5), 258-267.

Abstract

Introduction: Older adult's ability to self-manage their illness is dependent on their ability to perform ADLs. Forty-five percent of those older than 65 years will have ongoing clinical needs after hospital discharge and require post-acute care (PAC) services in settings such as home health care (HHC) and skilled nursing facilities (SNF). Current variations exist in the methods of assessing ADLs in SNF and HHC. The Improving Medicare Post-Acute Care Transformation Act of 2014 requires PAC providers to begin collecting and reporting ADL data to build a coordinated approach to payment and standardize patient assessments and quality measurement. We sought to describe and compare the methods of assessing ADLs in HHC to SNF. **Methods:** The authors followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement to ensure that the results were reported systematically**.** With the help of a university medical librarian, the first author conducted scientific literature searches without date restriction within the PubMed and Cumulative Index of Nursing and Allied Health Literature (CINAHL) databases**.** Search results were limited to "English-language," "humans" and "age +65 years". Study inclusion included (1) original research (2) observational study (4) sample age ≥ 65 (4) valid measure of ADLs (5) HHC or SNF setting. Two independent investigators assessed study quality using the quality appraisal instrument developed by Kmet and colleagues. Study quality ranged from 94.5% to 100%. **Results:**

Of the 18749 articles identified by the search, 8 met inclusion criteria: 1 quasi experimental study, 1 prospective cohort study, 1 retrospective cohort study, and 5 observational studies. 4 tools were identified that are used to assess ADLs in SNF and HHC. Although SNF and HHC collect similar ADL information, the range of content covered, item definitions, scoring, and psychometrics are not comparable across settings. **Conclusion:** Findings suggest inconsistent

assessment of ADLs in PAC setting. Objective methods of assessing ADLs in HHC that include a patient's self-performance are warranted to ensure that clinician assessment accurately captures a patient's ADLs.

Key words: Activity of daily living(ADL), functional status, IMPACT Act, home healthcare, post-acute care, skilled nursing facility. Outcome and Assessment Information Set(OASIS).

Introduction

Over the past two decades, there has been a substantial increase in the use of post-acute care (PAC) services in the United States (Ackerly & Grabowski, 2014; Mechanic, 2014). Recent studies associate this growth with a corresponding decrease in hospital length of stay (Burke, Juarez-Colunga, Levy et al., 2015). PAC services represent a range of rehabilitative or skilled nursing services that patients may receive after inpatient hospitalization (Boutwell, Silber, Nguyen et al.2014). Such services are covered by Medicare, and are provided in skilled nursing facilities (SNF), inpatient rehabilitation facilities (IRF), and home health care (HHC). Nearly 50 per cent of hospitalized Medicare patients use PAC after discharge, accounting for more than $62 billion in 2012 expenditures (Miller, 2013). Currently, HHC and SNF are the two most common PAC settings to which patients are discharged following their hospital stay (Tian, 2016). Within these settings, CMS requires patients to be evaluated using setting-specific patient assessment instruments for clinical assessment, payment, and quality assurance – The Minimum Data Set (MDS) (Mor, 2004) in SNFs, and the Outcome and Assessment Information Set (OASIS) in HHC (Shaughnessy, Criskler, & Schlenker, 1998).

The OASIS was implemented as a standardized assessment instrument for HHC in 1999. Several versions of the OASIS have been developed, refined and implemented since it was introduced in 1999. The first major update since its inception was the OASIS-C in 2010. This update included revision to OASIS items to improve clarity and to align OASIS items with evidence based process measures (Deitz, Dowell, Madigan, & Richard, 2010). In 2010, OASIS-C1, which is the current version of the OASIS data set was developed from the OASIS-C to accommodate the transition to the ICD-10 diagnosis coding system (CMS, 2015b). Similarly, the MDS 2.0 has been actively used to create quality measures since its inception in 1990 (Mor,

2004; Morris et al., 1990; Zimmerman, Karon, Arling & Clark, 1995), and in 2010, CMS implemented version 3.0 of the MDS (MDS 3.0) (Wysocki et al., 2015). The update from the 2.0 version was primarily because of concerns about the reliability, validity, and clinical relevance of its assessment items (Rahman & Applebaum, 2009)

One important data element collected in PAC settings is the activities of daily living (ADLs). ADLs include daily self-care activities such as eating, dressing, bathing and toileting (Elsawy & Higgins, 2011) and mobility activities such as, transferring between the bed and a chair (Middleton et al., 2016). Difficulty in performing these activities is associated with reduced independence and health related quality of life (Covinsky et al.,1999; Giebel et al.,2014; Tseng & Wang, 2001), increased acute care hospitalizations (Ostir, Volpato, Kasper, Ferrucci & Guralnik,2001) and increased mortality (Millan-Callenti et al., 2010). The prevalence of ADL limitations increases with advancing age (Wiener, Hanley & Van Nostrand, 1990). Approximately 25% of people 65 years and older have difficulty with at least one ADL (Hennessey et al., 2015).

In PAC settings, such as SNF and HHC, ADL measures constitute one of the domains used to calculate each patient's reimbursement rate (Schlenker, Powell & Goodrich, 2005) and evaluate quality of care (Middleton et al., 2016). However, researchers have commented on the limitations of current ADL data captured using the current assessment instruments in SNF and HHC (Fortinsky & Madigan, 2004; Lum, Lin & Kane, 2005). One such limitation is the variation in the methods of assessing ADLs in both settings (MedPAC, 2014). Comparative information on the assessment methods and psychometric properties of ADL instruments used in SNF and HHC would be useful to develop standardized ADL measures across both settings. Furthermore, objective, consistent and reliable assessments of ADL are requisite to plan and evaluate the

effectiveness of interventions in all PAC settings. Therefore, the purpose of this integrative review is to describe and compare methods used to assess ADLs among elderly patients in SNF and HHC.

Methods

This integrative review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement to ensure that the results were reported systematically (Moher, Liberti, Tetlaff, Altman, & The Prism Group, 2009).

Search Strategy

Appropriate search terminology and keywords reviewed by two authors (J.S and Z.A) are listed in Table 2.1. With guidance from an information specialist, the first author conducted scientific literature searches without date restriction using two electronic databases: PubMed and Cumulative Index of Nursing and Allied Health Literature (CINAHL). Criteria for inclusion of articles were quantitative and qualitative primary research studies published in English through April 21, 2016.

The following inclusion criteria were used to identify relevant studies: a) original research published in English, b) included patients age 65 years or older, and c) used a standardized ADL instrument in either HHC or SNF. We only included studies of nursing homes with individuals who had a length of stay of 100 days or less and who had a hospitalization prior to their nursing home stay (Linehan & Coberly, 2012; Mor et al., 2010). Editorials, commentaries and unpublished dissertations were excluded. Additional articles were obtained by hand searching reference lists of relevant articles identified while reviewing the abstracts.

Results

The original search returned 18,749 articles (18,307 from PubMed database and 442 from the CINHAL database). After title review, 18,416 were removed because of duplicates and non-eligible titles, leaving 333 articles for abstract review. Two additional studies identified from the hand search of reference lists of the 333 articles were included, yielding 335 studies. As summarized in Figure 2.1, 253 abstracts were subsequently excluded for the following reasons: studies conducted in non PAC settings (n=103), had no ADL measure described (n=45), other long term care population (n=37), PAC settings were not HHC or SNF (n=34), focused on chronic disease self-management programs (n=15), studies that combined ADLs and instrumental ADLs measures (n=5), hospice (n=2), literature reviews (n=6), case studies (n=3), quality improvement projects(n=2), only measured ADL of feeding (n=1),. After excluding the non-eligible abstracts, the remaining 82 articles underwent full-text review. Another 74 articles were excluded for reasons summarized in the figure, leaving 8 articles for the integrative review.

Characteristics of Included Studies (Table 2.2)

Among the eight reviewed articles, five were cross sectional studies (Lee, 2006; Leland et al. 2015; Madigan et al., 2012; Scharpf & Madigan, 2010; Wysocki, Thomas & Mor,2015), one quasi experimental study (Tinetti, Charpentier, Gottschalk & Baker.,2012), one prospective cohort study (Thygesen, Saevereid, Linstrom, Nygaard & Engedal, 2009) and one retrospective cohort study (Jung, Trivedi, Grabowski et al.,2016). Four of the studies were conducted in HHC settings (Thygesen et al., 2009; Scharpf et al., 2010; Madigan et al., 2012 & Tinetti et al., 2012) and four in SNF (Lee, 2006; Wysocki et al., 2015; Leland et al., 2015 & Jung et al., 2016). Of the 4 HHC studies, one was conducted in a single site (Tinetti et al., 2012), one in a multi city HHC in Norway (Thygesen et al., 2009), and 2 used large representative samples from the

United States (Madigan et al. 2012; Scharpf, et al. 2010). Of the 4 studies conducted in SNF, 3 used large national data sets (Jung et al., 2016; Leland et al.,2015 &Wysocki et al., 2015), and one was a single site study (Lee, 2006). Two studies used the Andersen Model of Health Services Utilization (Madigan et al., 2012; Thygesen et al., 2009) to guide the analyses. Study sample sizes ranged from 131 to 1,023,036. The average ages of patients were between 77.1 and 84.9 years and most were white and female when reported.

All SNF studies (Lee.2006; Madigan et al., 2012; Tinetti et al., 2012; Tao et al., 2012 & Wysocki et al., 2015) and one HHC study (Tinetti et al.,2012) focused on Medicare patients only. Two HHC studies (Scharpf et al., 2010; Madigan et al., 2012) included Medicaid and Medicare patients.

While the OASIS was used to assess ADLs in all three HHC studies in the U.S., the Barthel Index was used in the Norwegian study. Different tools were used to assess ADLs in SNF: the MDS 2.0 was used in two studies (Jung et al., 2016; Leland et al., 2015), MDS 3.0 in one study (Wyscoki et al., 2015), and Functional Independence Measure-Function Related Group (FIM-FRG) was used in one study (Lee, 2006). Only two studies reported on the reliability and validity of ADL items, both conducted in the HHC setting (Madigan et al., 2012; Scharpf et al., 2010). One HHC study discussed the reliability of the Barthel Index specific to the stroke population (Thygesen et al.,2009) and one SNF study addressed the validity of the ADL Self Performance items in the MDS (Wysocki et al.,2015).

Although the OASIS is not designed for scoring (Fortinsky, Garcia, Sheehan, Madigan, &Tullai-McGuiness, 2003), Madigan and colleagues used the corrected Likert approach where each response is divided by the highest value possible for that ADL. Individually adjusted items were then summed for a total functional capacity score ranging from 0 to 8. This study found

that the strongest influence on the change score for improvement in functional capacity was better admission functional status. Using the same approach, Scharpf and colleagues (2010) found that 70% of HHC patients with heart failure improved while receiving HHC services.

Five studies examined the associations between ADLs and patient outcomes and found that poor ADL ability is associated with poor health outcomes (Lee et al., 2006; Leland et al., 2015; Madigan et al., 2011; Thygesen et al., 2009 &Tinetti et al., 2012). More specifically, Tinetti and colleagues (2012) reported that the restorative model of HHC focused on improving ADL ability was associated with approximately one–third fewer admissions than usual care. Using national MDS data, Leland and colleagues (2015) examined the outcomes of SNF patients who experienced a fall and subsequent hip fracture during their first SNF stay and found that patients who experienced a hip fracture and still achieved successful community discharge were higher functioning, indicated by a lower ADL score.

Quality Assessment

Two independent investigators (ZA and MA) assessed study quality using the quality appraisal instrument developed by Kmet and colleagues (Kmet, Lee &Cook, 2004). This is a validated tool which is comprised of separate checklists for qualitative and quantitative studies. Using this tool, a summary score was calculated for each study by summing the total score and dividing it by the total possible score. Consistent with the guidelines, studies with a quality score ranging from 55% (liberal) to 75% (conservative) and above were included (Kmet et al.,2004). Disagreements between the two reviewers were discussed and resolved by consensus after referring to eligibility criteria and guidelines of the appraisal instrument

Comparison of ADL Measures in SNF and HHC

This review identified five instruments that assessed ADLs in SNF (Table 2.3) and HHC (Table 2.4). The Barthel Index and OASIS were used in HHC studies, while the MDS 2.0, MDS 3.0, and The Functional Independent Measure Functional Related Group (FIM-FRG) were used for studies in SNF settings. Each tool varies in terms of whether the assessment is judging ADL ability levels on the day of assessment or for some prior period. The varied approaches lead to subjective recordings or direct observation at the time of assessment. Each tool relies on different items to elicit some ADLs. For example, while the FIM-FRG, Barthel Index and OASIS B have specific ADL items of grooming and bathing, the MDS 2.0 and MDS 3.0 uses a generic term of personal hygiene. However, the five tools share some similarities: they all assess eating, dressing, toileting, ambulation/walking and transferring.

ADL Measures in SNF

The Functional Independent Measure Functional Related Group (FIM-FRG)

One study used the FIM –FRG to describe physical function of patients in a SNF (Lee, 2006). The FIM-FRG items are components of the IRF Patient Assessment Instrument (IRF-PAI). This tool was designed specifically for the inpatient rehabilitation population. The FIM-FRG includes 18 items rated on a 7-point scale based on the level of independence demonstrated during the performance of each activity (1=total assistant, 7=complete independence). This scale measures degree of dependence and frequency of need for assistance/supervision. All items are scored for their highest levels of dependence during the three prior days for an admission and discharge assessment. Studies have found that its ADL items lack sufficient variation to be used across the range of PAC settings (Jette, Haley & Pengsheng, 2003).

MDS 2.0. Under the MDS, nurses assess a resident's performance over a 7-day period. Physical function is evaluated according to the ability to perform each of seven activities of daily living (Table 2.3). Each activity is rated from 0 to 4 points: 0 indicates independence, 1 the need for supervision, 2 the need for limited assistance, 3 the need for extensive assistance, and 4 dependence. The scores on this tool range from 0 to 28 points, lower scores represent higher levels of performance.

The weighted kappas for the seven component activities have been reported to be greater than 0.75, indicating excellent reliability, internal consistency of the scale is also high (alpha = 0.94) (Morris, Fried and Morris, 1999). Validity studies of the MDS focus on criterion validity consistently found scores on the ADL subscales to correlate with other instruments commonly used in home care and nursing homes including the Barthel Index of Activities of Daily Living (Landi et al., 2000).

MDS 3.0 (ADL Self Performance items). The unique feature of ADL Self Performance items under the MDS 3.0, is that each activity must occur 3 or more times within the previous 7 days to be coded on a scale of 0 (independent) to 4 (total dependence). If the activity occurred 2 or fewer times within the previous 7 days, the item is coded 7 (occurred only once or twice) or 8 (activity did not occur). Unlike the MDS 2.0, MDS 3.0 requires ADL assessments to also be completed on discharge.

The MDS 3.0 and MDS 2.0 measures remain the same, however, some definitions within the tool have changed. Within the MDS 3.0, "bed mobility" now includes "alternate sleep furniture" for residents who sleep in chairs. Dressing is no longer specific to street clothes as in MDS 2.0 but includes any clothing. In assessing the ADL of Eating, the MDS 3.0 instructs the

clinician not to consider eating or drinking during medication administration. MDS 3.0 also specifies that toileting does not include emptying of bedpans, urinals, bedside commodes, or ostomy or catheter bags.

ADL Measures in HHC

The Barthel Index. One study conducted outside of the U.S. used the Barthel Index to assess ADLs (Thygesen et al., 2009). In this study clinicians assess patients based on their ability to perform each activity over a 24-48-hour period. The Barthel Index uses different response metrics for various items (Table 2.4). ADL ability is rated by level of assistance needed with each task, this yields a maximum score of 100 points.

The OASIS B ADL. Under the OASIS B, for all ADLs a value of 0 indicates complete independence and is the best score possible. The number of response categories varies from item to item and the response categories differ across the eight ADL items, making comparisons difficult. Each ADL item is organized according to whether a person can conduct the activity independently, with the use of an assistive device or human supervision, with the help of another person, or cannot do the activity at all. OASIS data for ADLs are only collected on admission and discharge. ADLs are not assessed when a patient's clinical status changed during the HHC stay, or is transferred to an acute care hospital. Therefore, it is not possible to collect data on ADL change during HHC stay prior to hospitalization.

Discussion

The purpose of this paper was to examine published research that describes methods used to assess ADLs in HHC and SNF. The most common instruments were the MDS and OASIS, which is not surprising because the MDS and OASIS are mandated instruments in SNF and HHC

in the U.S. Although the OASIS C1 was already used during the publication period of two HHC studies (Scharpf et al., 2010; Tinetti et al., 2012), neither of the studies utilized the OASIS C1, probably because of the time lag between conduct of study and publication. Using national MDS 3.0 data, one SNF study found that 99 % of ADL self-performance items at admission and discharge were complete (Wysocki et al., 2015).

While there are some similarities between the assessments of ADLs using MDS and OASIS, they are different in a few ways. First, the approach to assessing ADLs in the OASIS varies from the MDS. While MDS 3.0 mandates observation of a patient's performance of ADLs with 3 observations over a 7-day period, OASIS relies on the self-report from patient or proxy interview to assess patient's ADLs. According to the OASIS guidance described by CMS, the intent of the ADL items in the OASIS is to identify a patient's ability to safely perform ADLs (CMS, 2013a). In practice, self-report and proxy interview methods of ADL assessment are frequently used by HHC clinicians, particularly during the lengthy initial assessment process. This approach may be less accurate, especially when individuals have poor insight into their ADL ability (Jekel et al., 2015). Recent studies found that in the assessment of ADL abilities, proxy reports tend to overestimate ADL limitations (Li, Harris & Lu, 2015).

Second, within the OASIS the meaning of the numerical score for each ADL also varies from task to task. For example, human assistance is at Level 1 for Transferring, but at Level 2 for Feeding/Eating, Grooming, Ability to dress upper body and Ability to dress lower body. The use of a device moves from Level 0 for Grooming to Level 1 for Bathing and Ambulation/Locomotion. Within the MDS, all ADL items are coded on a scale of 0 to 4.

Finally, in HHC the initial assessment can be completed by a registered nurse or physical therapist, but the MDS must be completed by a nurse. A previous review found that ADL assessments conducted by nurses differ from assessments conducted by therapists (O'Connor & Davitt, 2015). Such variation can lead to different levels of ADL dependence, patient case mix and consequently reimbursement for the episode of care.

The need to standardize assessment of ADL items across SNF and HHC is a clear priority to improve quality of care and decrease variation in PAC spending. The fragmentation under the current system has limited our ability to describe the characteristics of patients treated under each setting and compare the outcomes of patients across PAC settings. Increasing concerns over the growth and wide variation in PAC spending and the lack of standardized patient assessments to measure quality prompted the enactment of the *Improving Medicare Post-Acute Care Transformation* (IMPACT) Act of 2014 (CMS, 2015a; Miller, 2014). This Act mandates the development of standardized self-care and mobility ADL data elements in PAC settings.

Researchers have relied on clinicians to collect standardized ADL data. Of note is that additional data collection with the implementation of IMPACT can be a burden added to the work of clinicians. In 2017, HHC will implement a new version of the OASIS, Version C-2 which will include a few more items that are expected to address the IMPACT mandates for ADL self-care and mobility domains (CMS, 2016a). Beyond the need to ensure uniformity in the ADL measures in SNF and HHC, the approach employed by clinicians to assessing ADLs in both settings must also be standardized to accurately capture a patient's ADL ability at start of care.

Furthermore, increased investment must be directed at the training of clinicians in SNF and HHC settings to ensure that the approach to assessing ADLs is consistent, standardized, reliable and reflective of a patient's ability on start of care. Others have also suggested that in both HHCs and SNFs, more attention must be directed to training the staff who are conducting the MDS and OASIS assessments to assure high-quality data (Fortinsky & Madigan, 2004; Pentz & Wilson, 2001).

Limitations

This integrative review has limitations. Publication bias may have affected the findings because the search was limited to peer reviewed literature. Grey literature, unpublished reports, dissertations were not included. Articles published in languages other than English were also not included. Studies published outside the U.S. posed a challenged to screen because of variations in the definitions of SNF patients, (for example, home for the aged, long term care residential facilities). None of the HHC studies were conducted with the current OASIS C1, which limits the generalizability of these findings to current practice.

Conclusions and Recommendations

This review adds to the growing body of evidence to evaluate ADL measures across PAC settings to ensure efficiency of health care expenditure and standardization of assessment. There is substantial variation in the ADL measures of self-care and mobility in SNF and HHC. To address this, uniform ADL terminology and measures are needed, and standardized training is warranted for clinicians assessing ADLs. This is particularly important in HHC where registered nurses or physical therapist can conduct OASIS assessment. Additional research is needed particularly on the reliability and validity of ADL measures using OASIC-C1.

Figure 2.1 Literature Search Flowchart

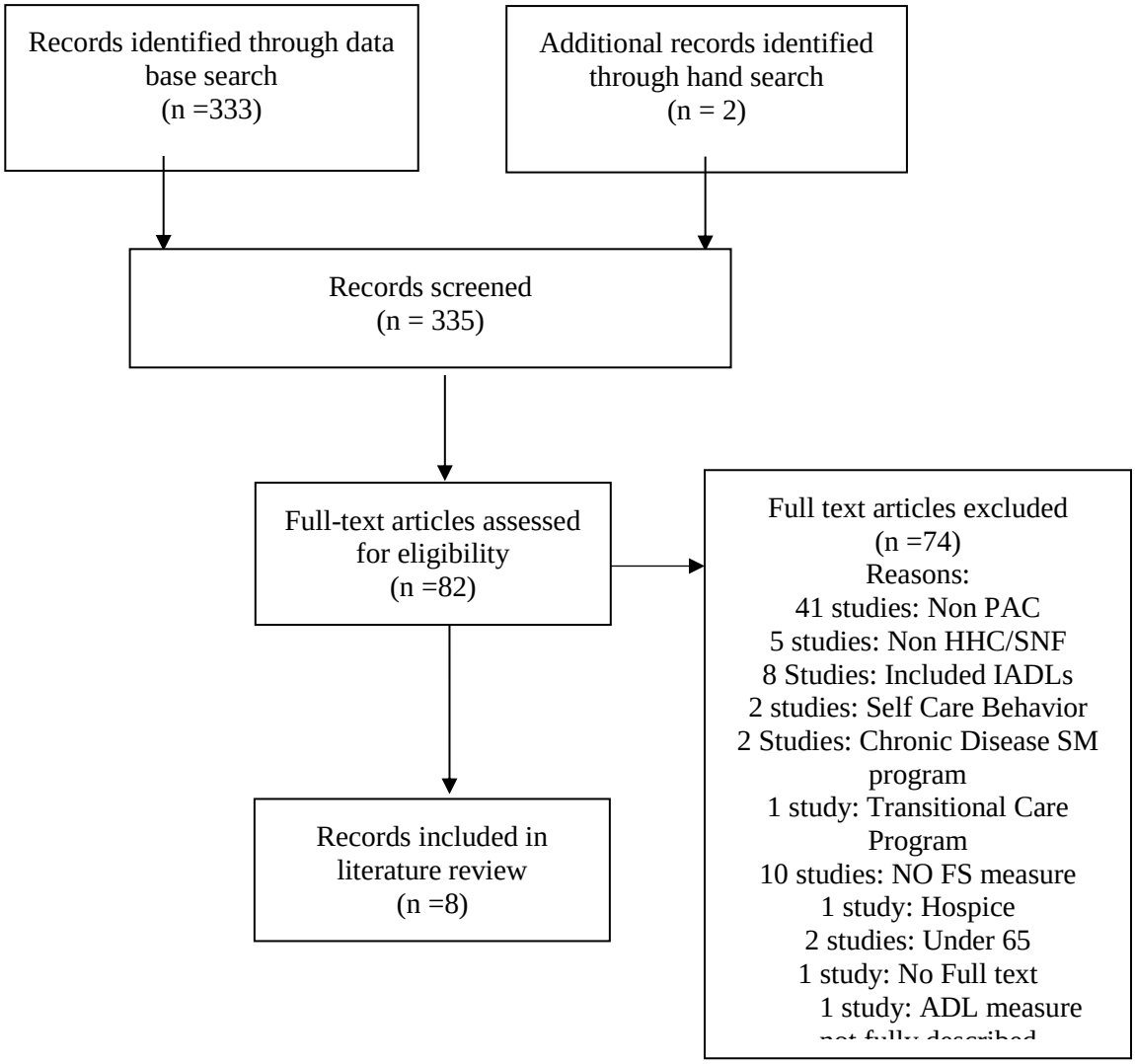


Table 2.1 Database Search Strategy

PubMed	
#1	"Self Care"[Mesh] OR self care[tiab] OR self cares[tiab] OR self caring[tiab] OR self manage[tiab] OR self management[tiab] OR self managing[tiab] OR self managed[tiab] OR self monitor[tiab] OR self monitoring[tiab] OR self monitored[tiab] OR self monitors[tiab] OR "Recovery of Function"[Mesh] OR recovery of function[tiab] OR functional recovery[tiab] OR recovery of functions[tiab] OR functional status[tiab] OR functional statuses[tiab]
#2	"Activities of Daily Living"[Mesh] OR activities of daily living[tiab] OR ADL[tiab] OR ADLs[tiab] OR daily living activities[tiab] OR daily living activity[tiab] OR physical function[tiab] OR physical functioning[tiab] OR "Health Status"[Mesh] OR health status[tiab] OR health statuses[tiab]
#3	#1 OR #2
#4	"Home Care Agencies"[Mesh] OR "Home Care Services"[Mesh] OR "Community Health Services"[Mesh] OR "Health Services for the Aged"[Mesh] OR home[tiab] OR home-based[tiab] OR homes[tiab] OR "Nursing Homes"[Mesh] OR nursing home[tiab] OR nursing homes[tiab] OR skilled nursing facility[tiab] OR skilled nursing facilities[tiab] OR extended care facility[tiab] OR extended care facilities[tiab] OR post acute[tiab] OR postacute[tiab] OR community health[tiab]
#5	#3 AND #4
#6	#4, Filters: English, Aged
	Key: [MeSH]: Medical Subject Heading; [tiab]: Title/Abstract fields
Cumulative Index of Nursing and Allied Health Literature (CINAHL).	
#1	"Self Care"[Mesh] OR self care[tiab] OR self cares[tiab] OR self caring[tiab] OR self manage[tiab] OR self management[tiab] OR self managing[tiab] OR self managed[tiab] OR self monitor[tiab] OR self monitoring[tiab] OR self monitored[tiab] OR self monitors[tiab] OR "Recovery of Function"[Mesh] OR recovery of function[tiab] OR functional recovery[tiab] OR recovery of functions[tiab] OR functional status[tiab] OR functional statuses[tiab]
#2	"Activities of Daily Living"[Mesh] OR activities of daily living[tiab] OR ADL[tiab] OR ADLs[tiab] OR daily living activities[tiab] OR daily living activity[tiab] OR physical function[tiab] OR physical functioning[tiab] OR "Health Status"[Mesh] OR health status[tiab] OR health statuses[tiab]
#3	#1 OR #2

#4	"Home Care Agencies"[Mesh] OR "Home Care Services"[Mesh] OR "Community Health Services"[Mesh] OR "Health Services for the Aged"[Mesh] OR home[tiab] OR home-based[tiab] OR homes[tiab] OR "Nursing Homes"[Mesh] OR nursing home[tiab] OR nursing homes[tiab] OR skilled nursing facility[tiab] OR skilled nursing facilities[tiab] OR extended care facility[tiab] OR extended care facilities[tiab] OR post acute[tiab] OR postacute[tiab] OR community health[tiab]
#5	#3 AND #4
#6	#4, Filters: English, Aged
	Key: [MeSH]: Medical Subject Heading; [tiab]: Title/Abstract fields

Table 2.2 Characteristics of Included Studies

Study, Year	Data Period	Study Design	Sample and Setting	ADL Instrument	ADL Measures Assessed	Results
Lee et al, (2006)	Jan-Dec 2002	Cross sectional	SNF n=131patients mean age 77.1 White =70.2 % Female=74.8% Medicare Fee-for-Service	Functional Independence Measure -Function Related Groups (FIM-FRG)	Eating, grooming, bathing, dressing upper, dressing lower, toileting, bladder mgt, bowel mgt, bed/chair/chair/wheelchair mobility/transfer, toilet mobility/transfer, tub or shower mobility/transfer, walking or wheelchair locomotion, ascending/descending stairs	Physical function defined as ADL on admission was the strongest predictor of physical function (ADL) at discharge.
Thygesen et al, (2009) *Norway*	Baseline data 1998-2001	Prospective Cohort	HHC n=208 patients mean age=84.5 no race reported Insurance=tax funded	Barthel ADL-Index	Bowel and bladder function, feeding, grooming, dressing, transfer from bed to chair, toilet use, mobility, walking stairs and bathing	Cognitive impairments and physical disabilities affecting ADLs predict nursing home admission
Scharpf et al, (2010)	2005	Cross sectional	HHC n =95,048 patients mean age 80.9 White=83% Medicare & Medicaid	OASIS B ADL Tool	Grooming, dressing upper body, dressing lower body, toileting, bathing, transferring, ambulation, and feeding/eating	ADL change index score provided the most comprehensive analysis of functional status change

Madigan et al, (2012)	2005	Cross sectional	HHC n= 82 080 patients with a diagnosis of HF Mean age 81.0 White=83% Medicare & Medicaid	OASIS B ADL Tool	Grooming, dressing upper body, dressing lower body, bathing, toileting, transferring, ambulation/locomotion, and feeding or eating	Strongest influence on ADL change score for improvement in functional capacity was admission functional status(ADL) score
Tinetti et al., (2012)	2012	Quasi experimental	HHC n=770 patients Mean age 77.4 Medicare 15% NotWhite, 47%Male	OASIS B ADL Tool	Grooming, dressing upper body, dressing lower body, bathing, toileting, transferring, ambulation/locomotion, and feeding or eating	Restorative model of care was associated with on third fewer readmissions thank usual care
Wysocki et al., (2015)	July 2011-June 2012	Cross sectional	SNF n =1,023,036 mean age=77.4 Medicare FFS 15.8 Not White,64.4 female	MDS 3.0 ADL Self Performance items	Bed mobility, transfer, walk in room, walk in corridor, locomotion on unit, locomotion off unit, dressing, eating, toilet use, personal hygiene	MDS 3.0 ADL self-performance items are complete at admission and discharge. SNFs are completing ADL assessments at discharge fulfilling new requirement

Leland et al.,2015	1999-2007	Cross sectional	n=27,305 SNF Mean age=84.9 White=94.0% Female=70.8% Medicare	MDS Long form	Transfer Locomotion on unit Locomotion of unit Walking in Room Walk in corridor Bed Mobility	Duration of hip fracture acute care hospitalization was 6.8 days. SNF patients that experienced a hip fracture and still had successful discharge to community were higher functioning as indicated by lower ADL Scores
Jung et al.,2016	2000-2009	Retrospective Cohort	n=481 908 SNF Mean age=94.8% Men=22.8% Medicare	MDS Long form	Transfer Locomotion on unit Locomotion of unit Walking in Room Walk in corridor Bed Mobility	Secondary analysis stratified by RUG category observed a positive relationship between increased therapy and discharge home

Table 2.3 Description of ADL Instruments in SNF

Instruments	**MDS 3.0** ADL self-performance items	**MDS 2.0** **MDS ADL-Long Form**	(**FIM-FRG)** **Motor sub scale of FIM**
Number of items	10 items	7 items	13 items
ADL categories/domains	Bed mobility Transfer Walk in room Walk in corridor Locomotion on unit Locomotion off unit Dressing Eating Toilet use Personal hygiene	Bed mobility Transfer Locomotion Dressing Eating Toilet use Personal hygiene	***Self care:*** Eating Grooming Bathing Dressing upper Dressing lower Toileting ***Sphincter control***: Bladder management Bowel management **Transfers:** Bed/chair/wheelchair mobility/transfer mobility/transfer Toilet mobility/transfer Tub or shower ***Locomotion:*** Mobility/transfer Walking or wheelchair Ascending/descending stair

Response	Frequency of activity needed for each activity at least 3 times in 7 days	Frequency of activity needed for each activity	7-point ordinal scale
Method of Assessment	Minimum of 3 observations for each activity within the past 7 days required	Observation proxy respondent Self-reported	Observation Caregiver/nurse interview Self-reported
ADL Independence	No help or staff oversight at any time	No help or oversight or help/oversight provided 1 to 2 times during last 7 days	All task which compose the activity are performed safely, within a reasonable time, and without modification, assistive devices or help from another person
ADL dependence	Staff oversight, supervision, encouragement, cueing, staff assistance in non-weight bearing or weight bearing activity over a 7 day period	Staff oversight, supervision, encouragement, cueing, staff assistance in non-weight bearing or weight bearing activity over a 7 day period or / full staff performance of activity	Patient requires assistive device or activity takes more than reasonable tome to perform or there are safety considerations

Table 2.4 Description of ADL Instruments in HHC

	OASIS ADL Tool	**Barthel Index**
No. of items	6 items	10 items
ADL items	Grooming, Dressing/upper, dressing/lower, Bathing, toileting, transferring, Ambulation/locomotion	Feeding Grooming Dressing Bowel and bladder function Transfer from bed to chair Toilet use Mobility Walking stairs and bathing
Response	For all ADLs, a value of 0 indicates complete independence and is the best possible score Items have different level of scoring, from (0 to 5) or (0 to 3)	0-5 Bathing and Grooming 0-10 Feeding, dressing, continence and toilet use 0-15 Transfers and Mobility
Method of Assessment	Data obtained from medical record Direct Observation Self-reported proxy respondent	Data obtained from medical record Direct Observation Interview Proxy respondent

		Self-reported
ADL Independence	No assistance required to perform a task	Does not require any help, physical or verbal assistance
ADL Dependence	Assistance required to perform a task	The need for supervision renders the patient not independent.

Chapter Three: Activities of Daily Living Levels of Home Health Care Patients

Chapter three will address aim two of this dissertation using 2015 OASIS data, which is to describe the ADLs of patients receiving HHC.

Abstract

Introduction: ADLs are an increasingly important measure of the quality of care provided in the HHC setting. Very few studies describe the ADLs of HHC patients. The objectives of this study were to (1) describe the types and levels of ADL dependency among patients receiving HHC, (2) identify the risk factors for severe ADL dependency at admission and (3) to identify the predictors of ADL improvement during HHC stay. **Methods:** This was a secondary data analysis of a 5% random sample (n=105,654) of the national Outcome and Assessment Information Set (OASIS) for the year 2013**.** The dependent variables were severe ADL dependency level at admission and ADL improvement from admission to discharge. **Results:** 65% of HHC patients (n = 99,991) had severe ADL dependency (dependence in 7 or more ADLs) at admission. Increasing age (OR = 1.02, 95 % CI= 1.01-1.02), female gender (OR = 1.14, 95% CI = 1.11-1.16) and with impaired decision-making (OR = 3.51; 95% CI = 3.39-3.63) were associated with severe ADL dependency on admission to HHC services. Of the 105,654 HHC patients, 58.1% (n = 89,997) experienced ADL improvement. ADL improvement was associated increasing HHC LOS (OR =1.01, 95% CI = 1.01-1.01), being female (OR = 1.07, 95% CI = 1.03-1.11) and prior inpatient stay (Hospital: OR = 1.97, 95% CI = 1.89-2.05), (SNF: OR = 2.20, 95% CI = 2.08-2.32) Conclusions**:** This study identifies patient characteristics associated with ADL improvement. HHC clinicians, policy makers and agencies could focus on such characteristics to achieve the goal of ADL improvement.

Key words: Activities of daily living (ADL), functional status, home health care, Outcome and Assessment Information Set (OASIS)

Introduction

Interest in examining the characteristics of patients receiving home health care (HHC) has increased over the years (Fortinsky, Madigan &Sheehan, Tullai-McGuiness & Kleppinger, 2014; Fout, Plotzke & Christain, 2016; Waxman et al., 2016; MedPAC, 2016a), perhaps because of the rise in the use and costs associated with HHC as a site for post-acute care (PAC) (Jones et al., 2016; Kim & Norton, 2015). The ability to perform activities of daily living (ADLs) is a key patient characteristic that has drawn attention to the utilization and outcomes of HHC (MedPAC, 2016a; Nuccio, Richard & Hittle, 2011; Scharpf & Madigan, 2010). The importance of ADLs is reflected in the passage of the Improving Medicare Post-Acute Care Transformation (IMPACT) Act of 2014 (CMS, 2015a) which mandates the standardization of functional status measures across all post-acute care (PAC) settings, including HHC. Under the IMPACT Act, functional status is represented by self-care and mobility ADLs (Middleton et al., 2016).

ADLs are basic self-care tasks which include toileting, dressing, bathing or showering, getting in/out of bed or chairs, and walking (Burman et al., 2011, World Health Organization, 2001). Among older adults, ADL ability is an important component of quality of life and essential to living independently in the community (Covinsky, Hilton, Lindquist & Dudley, 2006; Fried & Guralnik, 1997). Low ADLs are strongly associated with poor outcomes such as higher rates of hospitalizations (Kumar et al. 2016; Kim et al.,2014), higher cost of medical care (Chuang et al.,2003), increased mortality (Stineman et al.,2012), and increased risk of admission to a nursing home (Millan-Callenti, Tubio, Pita-Fernandex et al., 2010).

In HHC, ADLs are one required measure of the quality of care provided (Pollack & Madigan, 2012) and determine reimbursement for HHC services (Shih, Temkin-Greener, Votava

& Friedman, 2014). More importantly, ADLs form the core of "home bound criterion" that restricts HHC services to only those who have substantial difficulty leaving their homes (MedPAC, 2011). Studies have found that home bound status is prevalent among people with low ADL ability (Celeiro, Santos-del-Riego & Garcia, 2016; McNulty & Fisher, 2013). ADL status is used to determine the care needs of PAC patients and to ensure that patients with various levels of acuity receive appropriate services in the right setting (Gage et al., 2012).

Information about ADLs of HHC patients is essential to planning the care needs of this population, analyzing rehabilitative utilizations patterns, and informing health policy affecting the HHC sector. Currently, however, very little is known about the status of ADLs among HHC patients. Although ADLs change, and ADL outcomes among HHC patients have been previously evaluated (Asiri et al.,2014; Madigan et al.,2012; Scharpf & Madigan,2010), the levels of ADLs among HHC patients have not been well characterized. Caffrey and colleagues (2011) reported that 84% HHC patients have at least 1 limitation in ADLs. Their study, however, did not indicate which specific ADLs were limited or the levels of dependency. Previous studies have examined ADL changes using OASIS data, they have not examined the impact of HHC LOS on ADL improvement (Scharpf & Madigan, 2010), been confined to sub populations such as heart failure or stroke (Madigan, Gordon, Fortinsky et al.,2011; Scharpf & Madigan,2010; Asiri et al.,2014), or not used a nationally representative data set (Chase, Huang, Russell, Hanlon, O'Connor et al; Asiri et al.,2014).

Therefore, using national data from the mandated assessment tool for HHC called the Outcome and Assessment Information data set (OASIS), the aims of this study were to (1) describe the types and levels of ADL dependency among patients receiving HHC, (2) identify

the risk factors for severe ADL dependency at admission and (3) To identify the predictors of ADL improvement during HHC stay.

Methods

Study Design and Data Source

This was a secondary data analysis of a 5% random sample of the national 2013 OASIS data set, which is the patient assessment instrument mandated by CMS since 1999. Medicare certified HHC agencies are required to conduct patient assessments at specific time points during a HHC episode (Pollack-Scharpf & Madigan, 2010). These OASIS assessments are completed by a registered nurse (RN) or physical therapist (PT). A comprehensive assessment is required on admission and discharge from HHC, and ADLs are only assessed at those two-time points. Abridged versions of OASIS data are collected when the patient is transferred to an acute care hospital, resumption of care following a hospital stay, change in medical status, or death, and every 60 days if HHC services continue (O'Connor &Davitt, 2012). OASIS is used for several purposes: to measure patient health status outcomes, to monitor the quality of care provided by HHC agencies, and to certify HHC agencies for reimbursement purposes (Mor, 2005). The dataset contains patients' socio-demographic status, environment, support systems, health status, functional status and behavioral status data. Multiple versions of the OASIS have been validated and implemented since 1999; the OASIS-C that was released in 2010 was used in this study (Deitz, Dowell, Madigan & Richard, 2010).

Several inter-rater reliability studies have reported a Cohen's kappa of 0.60 or higher on most OASIS items, which suggest adequate reliability (Hittle et al., 2003; Madigan & Fortinsky, 2000; Schlenker, Powell, Goodrich& Kaehny, 2000). Madigan and colleagues (2004) tested

inter rater reliability of OASIS items by using HHC staff as raters, and all ADL items had kappa values above 0.70 except the feeding or eating item which had a score of 0.67. Researchers who have compared the OASIS ADL domains to existing instruments have reported that the ADL items are sufficiently valid, and correlate highly with the Katz Index of Independence in Activities of Daily of Living (Tullai-McGuiness et al., 2009).

Sample

The sample for these analyses was limited to HHC patients with ADL data at start of care and discharge OASIS in 2013. Individual who completed their HHC episode without a discharge, such as patients who were hospitalized or died were therefore excluded (n=49,147). This left us with a final sample of 105,654.

Outcomes

The outcome measures in this study were ADL dependency levels at admission and ADL change. ADLs were assessed using the 9 items in the OASIS-C that measures a patient's ability in the following activities: ambulation/locomotion, bathing, dressing upper body, dressing lower body, eating, grooming, toileting/hygiene, toilet transferring and transferring. The individual ADL items have various levels of scoring—for example, ambulation/locomotion ranges from 0 to 6, while dressing upper body ranges from 0 to 3, and transferring ranges from 0 to 5. Each ADL item is scored on an ordinal scale where lower scores represents independence in the performance of the ADL and the higher score represents dependence.

ADL dependency measure: We first sought to examine the level of dependency in ADLs at HHC admission. To achieve this, first, each respective raw ADL score was dichotomized into 0 or 1, in which 0 indicating total independence, and 1 indicating some level of dependence.

Using this method, any individual raw ADL score >0 will be converted as 1. Next, we generated a variable to identify the total number of ADL functions that needs assistance (meaning individual ADL scores higher than 0), ranging from 0-9 with 0 indicating independence in all functions and 9 indicating dependence in all ADL functions. Finally, from this summed score, a dichotomous ADL dependency level variable was created, categorized as non-severe ADL dependency and severe (assistance needed in 7 or more ADLs).

ADL improvement: To assess ADL improvement from admission to discharge from HHC, first an ADL change score was created using the corrected Likert approach (Peng et al., 2003; Scharpf & Madigan, 2010). Each individual ADL response was divided by the highest value possible for that ADL. This approach converted all the individual ADLs to the same scale, ranging from 0 to 1, with lower scores indicating better ADL ability. Next, the ADL composite score was computed by summing the individually adjusted items. The composite ADL score ranges from 0 to 9 with 9 indicating total dependence, and 0 indicating complete independence**.** The ADL change score for each patient was calculated by subtracting the summed ADL admission score from the summed ADL discharge score. In the change score, zero indicates that there was no change across all 9 ADLs; a negative score indicates ADL improvement; while positive scores indicate ADL decline. (Madigan, Gordon, Fortinsky, Koroukian, Pina & Riggs,2012; Scharpf & Madigan,2010). Based on the ADL change score, a dichotomous ADL outcome measure was created (Scharpf & Madigan, 2010). This score was used to measure whether a patient experienced an improvement in the summed score coded as yes or no. A negative ADL change score indicated overall ADL improvement (Madigan et al., 2012), while a

score of zero or larger was defined as no change or decline, accordingly patients with no change were collapsed with patients who declined.

Covariates: The following variables were identified as covariates for this study based on the literature.

Age was classified as a continuous variable on a scale of 0-100.

Race was categorized into 4 categories (Black/African American, Hispanic, White, and other minority race/ethnicity).

Living condition: This was measured by an item on the OASIS form (M1100) that identifies whether the patient lives alone or with others.

Insurance Status: Dual eligible status was selected as the best available proxy measure of patients' socioeconomic status, as measures such as educational attainment and income level are not on the OASIS. Dual eligibility is denoted by whether a patient has Medicaid insurance as well as Medicare coverage.

Length of Stay: Home Healthcare Length of stay (HHC LOS) was defined as the number of days between date of admission and date of discharge from HHC.

Prior inpatient stay: Prior inpatient stay was included as a covariate using the OASIS item that identifies whether the patient had been discharged from an inpatient facility within 14 days prior to HHC admission, including in a skilled nursing facility (SNF), acute care hospital or other inpatient units such as LTACH (Long Term Acute Care Hospital), IRF (Intensive Rehabilitation Facility), long term nursing facility or psychiatric hospital unit prior to admission for HHC services.

Comorbidities: The weighted Charlson Comorbidity Index (CCI) was used to identify co-morbidities at HHC admission (Monsen, Swanson, Oancea & Westra, 2012). This score was based on ICD-9-CM codes within the OASIS assessments. The ICD-9 codes used to compute the Charlson Comorbidity Index from the OASIS were generated from the following 18 OASIS fields: primary diagnosis (n = 1), secondary diagnoses (n = 5), reasons for inpatient treatment (n = 2), reasons for treatment change (n = 4), and payment diagnoses for Medicare patients (n = 2).

Impaired decision making: Defined based on the OASIS question (M1740) which asks if a patient displays cognitive, behavioral and psychiatric symptoms at least once a week.

Statistical Analysis

Aim 1: Types and levels of ADL dependency among patients receiving HHC

Descriptive statistics were generated for all study variables to describe the types and levels of ADL dependency at HHC admission. Differences in the proportion of people who were independent or dependent were also compared using chi square test and t-test as appropriate. To examine differences in the distribution of independent variables by severe or non-severe ADL dependency levels, we also used the Student t-test for continuous variables and chi-squared test for categorical variables. Change in individual ADLs between admission and discharge were assessed using a paired t-test.

Aims 2: Identify the risk factors for severe ADL dependency at admission

A multivariable logistic regression was utilized to identify factors associated with severe ADLs dependence at admission. Variables that were associated with the outcome of interest (severe ADLs dependence) according to the literature and in our bivariate analysis were entered

to the model. They include age, gender, race, insurance, living condition, prior inpatient stay, impaired decision making, and comorbidities.

Aim 3: Identify the predictors of ADL change during HHC stay.

A multivariable logistic regression was also used to identify the predictors of ADL improvement from admission to discharge. In this analysis, to examine if LOS had an impact on ADL improvement, HHC LOS was added to covariates listed above.

Adjusted odds ratios (OR) and 95% confidence intervals are reported for regression analyses in both Aims 2 & 3. Statistical significance was set at $P < 0.05$. All analyses were conducted using IBM SPSS Statistics Version 24.0.

Results

Aim 1: Types and levels of ADL dependency among patients receiving HHC

Table 3.1 summarizes characteristics of the sample of 154,801 patients; bivariate associations between sample characteristics and ADL dependency level are also shown. The overall sample was predominantly female (64.7%), and the mean age was 77.06 (SD = 11.8) years. About eighty percent (79.8%) of the sample was White, 11.4% was Black, and 6.6% were Hispanic. A majority of the patients (73.4%) lived with others in their household. Most patients had Medicare (96.2%), nearly one percent had Medicaid (0.9%) and 2.8% were dually eligible. Of the 68.7% patients who had a prior inpatient stay within 14 days, 43% were from the hospital, followed by 16.3% from a SNF (Table 3.1) and the remainder had a discharge from a LTACH, IRF or inpatient psych facility, 31.4% had no recorded recent inpatient stay. Nearly 20% (19.4%) had impaired decision making. The mean CCI for the overall sample was 0.89 (SD = 1.2).

About 65% of HHC patients (n = 99,991) had severe ADL dependency at admission. Compared to HHC patients who had non-severe ADL dependency, those with severe ADL dependency were older (mean age 77.9 vs. 75.5), more likely to be female (65.5% vs. 63.2), and less likely to be White (78.7% vs. 82%). Patients with severe dependency were more likely to enroll in Medicare (96.5% vs. 95.7%) and had dual eligibility (2.9% vs. 2.7%), had impaired decision making (25.5% vs. 8.4%), less likely to live alone on (21.9% vs. 35.3%), and less likely to be discharged from acute care hospital (40.7% vs. 47.1%) when admission to HHC services than patients who had non-severe ADL dependency. Patients with severe ADL dependency also had a higher CCI (0.91 vs. 0.86) than the counterparts.

Overall, 88.4% patients had some level of ADL dependency on admission to HHC services; 79% were dependent in grooming, 84% in dressing upper body, 88.4% in dressing lower body, 96.8% in bathing, 67% in toilet transferring, 73% in toileting hygiene, 88.2% in transferring, 94.7% in ambulation/locomotion and 55.5% in feeding or eating, and the most common ADL dependency was bathing (Table 3.2). Most patients improved in ADL dependency from admission to discharge from HHC (mean ADL change score = −1.69, SD = 1.39).

Aim 2: Identify the risk factors for severe ADL dependency

Table 3.3 shows the results of the logistic regression model predicting the risk factors associated with severe ADL dependency at admission. Increasing age (odds ratio [OR] = 1.02, 95 % confidence interval [CI]= 1.01-1.02) and female gender (OR = 1.14, 95% CI = 1.11-1.16) were associated with severe ADL dependency. Compared to White patients, racial/ethnic minorities had higher odds of severe ADL dependency (Black OR = 1.30, 95% CI = 1.25-1.34;

Hispanic OR = 1.38, 95% CI = 1.32-1.45 and other minority race: OR = 1.36, 95% CI = 1.26-1.47). The odds of severe ADL dependence decreased by almost 50% for patients who lived alone (OR = 0.51; 95% CI = 0.50-0.53).

Compared to patients with Medicare, patients with Medicaid were almost half as likely to develop severe ADL dependency (OR = 0.40 95%, CI = 0.37-0.46). Compared with patients without prior impatient stay, patients with a prior inpatient stay (SNF OR = 1.20; 95% CI = 1.16-1.24 and other facilities such as LTACH or IRF and inpatient psych OR = 1.29; 95% CI = 1.23-1.34) were also more likely to have severe ADL dependency

The odds of severe ADL dependency were 3.5 times higher for patients with impaired decision-making (OR = 3.51; 95% CI = 3.39-3.63) at admission to HHC services. We found no statistically significant association between severe ADL dependency and dual eligibility and (OR = 1.06; 95% CI = 0.99-1.14), and prior stay in a hospital and severe ADL dependency (OR = 0.93, 95% CI = 0.91-1.00).

Aim 3: To identify the predictors of ADL improvement.

Of the 105,654 patients with admission and discharge assessments, 58.1% (n = 89,997) experienced ADL improvement, 35.6% (n = 55,057) had ADL decline and 6.3% (n=9,747) experienced no change from admission to discharge. Patients with ADL improvement were, on average, 77.1 years of age (SD = 11.2), predominantly female (65.7%) and White (82.0%). Most of these patients received payment under Medicare (97.0%). Patients with ADL improvement had less comorbid conditions compared with patients with no change or decline ADL (mean CCI = 0.77, SD = 1.11 vs mean CCI = 0.93, SD = 1.30). Patients with ADL improvement were also less likely to have impaired decision compared with patients with ADL decline or no change

(16.3% vs 22.8%), and had longer HHC episode of care (mean HHC LOS = 31.29, SD =18.07 vs mean HHC LOS = 28.70, SD = 20.75). Compared with patients ADL decline or no change, patients with ADL improvement were more likely to have a prior in patient stay (SNF = 17.5% vs 12.7%), acute care hospital (46.3% vs 39.1%) and other inpatient settings (9.5% vs 7.2%) (Table 3.4).

Table 3.5 summarizes the results of the logistic regression assessing the likelihood of experiencing ADL improvement for each independent variable. Several factors were associated with the odds of ADL improvement. Increasing HHC LOS was associated with a greater likelihood of ADL improvement (OR =1.01, 95% CI = 1.01-1.01, $p<0.005$). Being female (OR = 1.07, 95% CI = 1.03-1.11, $p<0.005$) increased the likelihood of ADL improvement. Compared to Whites, Blacks had a lower likelihood of ADL improvement, (OR = 0.76, 95% CI = 0.72-0.81, $p<0.005$). History of prior inpatient stay within 14 days of admission to HHC was also highly associated with ADL improvement. Compared to HHC episodes in which patients did not have a prior inpatient stay, the odds of ADL improvement was about two times higher for patients with a prior inpatient stay: (Hospital: OR = 1.97, 95% CI = 1.89-2.05), (SNF: OR = 2.20, 95% CI = 2.08-2.32) and (Other inpatient settings such as LTACH, IRF and inpatient psych: OR = 2.06, 95% CI = 1.93-2.21).

Compared to Medicare patients, having Medicaid as their primary payer (OR =0.36, 95%CI = 0.30-0.42), and dual eligibility (OR = 0.79, 95% CI = 0.71-0.87) was associated with lower likelihood of ADL improvement. Increasing CCI (OR= 0.86, 95% CI = 0.84-0.87) and impaired decision-making (OR =0.74, 95%CI = 0.67-0.73) was also associated with a lower likelihood of ADL improvement.

Discussion

Type and Level of ADL Dependency

This description of the ADLs of HHC patients using national representative OASIS data showed that most (88.4%) HHC patients had some level of ADL dependence at admission. This is common in a HHC population where most of the HHC services are targeted for rehabilitative needs (MedPAC, 2017). We also found that over 60% of the patients have severe ADL dependency at admission, which we defined as dependence in seven or more ADLs. Although such high prevalence of severe ADLs dependency among HHC patients is unexpected, as from a practice perspective most patients with higher ADL level of dependency receive PAC services in alternative settings such as SNFs or IRFs (Stein, Bettger, Sicklick, Hedeman, Magdon-Ismail, & Schwamm, 2015; Mallison et al.,2014).

Very few studies have characterized the ADLs of HHC patients. Using data collected from the 2000 to 2007 National Home and Hospice Care Survey, consistent with our findings, one study reported that 84% of HHC patients had at least 1 ADL limitation and 14.8% had no ADL limitations (Caffrey, Sengupta, Moss, Harris-Kojetin, & Valverde, 2011). In an effort to provide a comprehensive description of the ADLs of HHC patients, the present study used summary scores and dichotomized individual ADLs to identify the types and levels of ADL dependency among HHC patients.

Using summary scores of ADL, we found that overall, patients improved in ADL dependence from admission to discharge from HHC. In terms of individual ADLs, bathing which perhaps requires a larger complexity of ADL ability was the most common ADL dependency.

These findings are consistent with previous HHC studies that have reported bathing as the most common ADL dependency (Scharpf & Madigan, 2010) and improvement in ADLs from admission to discharge (Han, Kim, Storfjell & Kim,2013; Madigan,2008; Asiri et al.,2014). This is not surprising because from a clinical perspective a patient whose ADLs decline after admission to HHC is usually transferred to a different level of care to receive appropriate clinical services.

Although the ADLs of HHC patients have been examined in previous studies (Asiri et al.,2014; Han et al,2013), patients scores were often condensed to a single summary value (Asiri et al.,2014; Scharpf & Madigan, 2010; Madigan,2008; Han et al,2013), simple counts of ADLs (Caffrey, Sengupta, Moss, Harris-Kojetin, & Valverde, 2011), or the sample was limited to specific disease processes (Asiri et al.,2014, Madigan,2008; Chen et al.,2016). A strength of this analysis is that we examined the types and levels of ADL dependency among HHC patients on admission. A notable limitation is that we were unable to describe the ADLs of HHCs during critical time points such as hospitalization because OASIS data do not provide a measure ADLs during transfer from HHC services.

Risk Factors for Severe ADL Dependency

In our regression analysis, impaired decision making was strongly associated with severe ADL dependency. Other associated predictors included increasing age, race/ethnicity and prior inpatient stay in a SNF or LTACH or IRF. As expected, older age increased the risk for severe ADL dependency. This finding is consistent with research in other settings (Fauth, Schaefer, Zarit, Ernsth-Bravell, & Johansson, 2017; Puente, Terry, Faraco, Brown, & Miller, 2014; Millán-Calenti et al., 2012). Compared to White patients, we found that racial/ethnic minorities had higher odds

of severe ADL dependency. Researchers have previously documented racial /ethnic disparities in ADL ability among the general population of older Americans, with minorities experiencing more severe ADL dependency than Whites (Brenner &Clarke,2015; Dunlop, Song, Manheim, Daviglus & Chang,2007), and emerging research has documented similar findings among HHC patients (Chase et al.,2017). Mitigating racial/ethnic disparities in ADLs in the community has the potential to reduce excess economic costs allocated to caring for minority patients with severe ADL dependencies (Carrasquillo, Lantigua & Shea, 2000). As expected, patients with a prior inpatient stay were also more likely to have severe ADL dependencies.

Patients with severe ADL dependency are vulnerable to poor clinical outcomes and account for substantial financial expenditure to the health care system. A recent study by Greysen and colleagues of Medicare HHC patients revealed that patients with severe ADL impairment cost three times more than HHC patients without ADL impairment (Greysen et al., 2016). This highlights the need for targeted interventions to manage severe ADL dependency among HHC patients to reduce the cost of care in this population and ensure that upon admission to HHC, patients with severe ADL dependency receive the appropriate rehabilitative services or palliative care approach to optimize their clinical outcomes.

Predictors of ADL change

Our results show that prior inpatient stay, race/ethnicity, living alone, increasing HHC LOS and being female were associated with ADL improvement, adding to previous HHC studies which reported that factors such as cognitive status, age and baseline ADL status at start of care were also associated with ADL change (Asiri et al., 2016; Riggs et al., 2011). In the present

study, patients with a history of a prior inpatient stay within 14 days of admission to HHC services had a higher likelihood of ADL improvement. This is unsurprising, because patients discharged from an inpatient setting are likely to have poorer ADLs than their counterparts from the community, and would more likely to improve during the HHC episode because they started with worse ADLs. Similar findings have been reported by previous HHC research (Riggs, Madigan & Fortinsky (2011).

Research examining the association between race/ethnicity and ADL ability in HHC patients is scarce. We found racial and ethnic disparities in ADL improvement during a HHC episode of care, with Blacks less likely to achieve ADL improvement compared to Whites. This result aligns with recent research that has documented similar racial differences in ADL outcomes of HHC patients with findings that non-Hispanic Whites experienced greater overall ADL improvement compared with Asian, Hispanic and African American patients (Chase et al., 2017). Our finding provides new information that underscores the HHC as an important setting in health service delivery to explore the mechanism of health disparities in ADL ability.

Increasing HHC LOS which is likely a proxy for the complexity of HHC services a patient receives, or severity of the patient's condition was also associated with ADL improvement. Although very few HHC studies have examined the impact of HHC LOS on patient outcomes. One study found that longer HHC LOS was associated with positive patient outcomes such as decreased acute care hospitalizations (O'Connor, Hanlon, Naylor& Bowles, 2015). A possible explanation is that patients with longer HHC LOS may have received more nursing and therapy services (MedPAC, 2015a) , and therefore have better ADL outcomes.

Compared to patients who had only Medicare, dual eligibility and having Medicaid was associated with lower likelihood of ADL improvement. A possible explanation is that patients receiving Medicare represent a post-acute care population in HHC services, and may have had a prior inpatient stay or have been identified with potential to improve in the HHC setting compared to patients from the community. Another possible explanation is that from a clinical perspective Medicare post-acute care patient generally receive therapy during a HHC episode, and may have had more focused rehabilitation goals since Medicare is intended to cover post-acute services such as nursing and therapy in a HHC setting. The Medicare HHC benefit generally does not cover HHC services for those who need sustained assistance over time, but people with rehabilitative potential to improve (O'Shaughnessy, 2014). Unsurprisingly, patients who were sicker denoted by higher Charlson Index scores and patients with impaired decision making also were less likely to have ADL improvement.

Strengths & Limitations

Our large, nationally-representative sample is a major strength of this analysis. A second major strength is its prospective longitudinal design which captures ADLs at important time points such as admission and discharge. The availability of detailed information on ADL status at these time points allowed us to carefully characterize ADL trajectories. Another strength is that we included clinically meaningful and policy relevant covariates in the logistic regression model such as HHC LOS, which very few HHC studies have examined.

Despite these strengths, there are study limitations. First, data regarding service utilization during the HHC episode of care were not available for analysis, although previous

studies have found associations between patient LOS and provider (PT or RN), and functional status outcomes (Riggs et al., 2011). The present study only used data for one year, which did not allow us to make comparisons between ADL changes of the HHC population over a longer period of time. In addition, we were not able to assess the ADLs of patients who were hospitalized, since the OASIS does not measure ADLs during at the time of transfer to hospital.

Furthermore, to identify ADL dependency levels, each ADL was dichotomized and then summed to indicate the total number of dependencies experienced by a HHC patient. This method can obscure information regarding the varying difficulty levels between ADL items. Of note, the lack of consistency in the number of response and categories across OASIS ADL item present a challenge in the use of ADLs for research purposes. Although the likert method, which was used in this study to assess ADL improvement is widely used in HHC research, the psychometric properties of this approach have not been established. Importantly, to date, studies of the reliability and validity of the OASIS are based on the OASIS-B and not the revised OASIS-C measures.

Conclusions

For years, changes in ADLs have been a key measure monitored by CMS and also publicly reported on the World Wide Web. This measure provides agency-level information on the percentage of patients who improve in specific ADL items. Findings from this study illustrate that there are key patient characteristics associated with ADL improvement, and the HHC clinicians, policy makers and agencies could focus on such characteristics to achieve the goal of ADL improvement.

Table 3.1 Bivariate Associations between Patient Characteristic and ADL Dependency level

		ADL Dependency level		
	Total (n=154,801)	**Non- Severe** (n=54801)	**Severe** (n=99991)	**p-value**
Characteristic	n (%)	n (%)	n (%)	
Age years, mean (SD)	77.06 (11.8)	75.53 (11.9)	77.90 (11.5)	<0.001
Male	54,675 (35.3)	20,166 (36.8)	34,509 (34.5)	
Female	100,126 (64.7)	34,635 (63.2)	65,482 (65.5)	<0.001
Race				
White	123,590 (79.8)	44,922 (82.0)	78,668 (78.7)	<0.001
Black	17,612 (11.4)	5,812 (10.6)	11,800 (11.8)	<0.001
Hispanic/Latino	10,174 (6.6)	3,099 (5.7)	7,075 (7.1)	<0.001
Other	3,425 (2.2)	977 (1.8)	2,448 (2.4)	<0.001
Living situation (Lives alone)				
No	113,559 (73.4)	35,478 (64.7)	78,081(78.1)	<0.001
Yes	41,242 (26.6)	19,332 (35.3)	21,910(21.9)	<0.001
Insurance				
Medicaid	1,457 (0.9)	880 (1.6)	577 (0.6)	<0.001
Medicare	148,950 (96.2)	52,427 (95.7)	96,523 (96.5)	<0.001
Dual eligible	4,394 (2.8)	1,503 (2.7)	2,891 (2.9)	<0.001
Charlson Index, mean (SD)	0.89 (1.2)	0.86 (1.2)	0.91 (1.22)	<0.001
Impaired Decision Making				
No	124,701 (80.6)	50,225 (91.6)	74,476 (74.5)	<0.001
Yes	30,100 (19.4)	4,585 (8.4)	25,515 (25.5)	<0.001
Prior inpatient hospitalization				
None	48,552 (31.4)	16,490 (30.1)	32,061 (32.1)	<0.001
Skilled Nursing Facility	25,198 (16.3)	8,061 (14.7)	17,137 (17.1)	<0.001
Acute Care Hospital	66,503 (43.0)	25,792 (47.1)	40,711 (40.7)	<0.001
Other	14,548 (9.4)	4,467 (8.1)	10,081 (10.1)	<0.001

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Table 3.2 Types and Levels of ADL Dependency

ADL Variables	Admission n (%)	Discharge n (%)	McNemar's p-value
M1800 Grooming			
Dependent	122,360 (79.0)	34,934 (22.6)	<0.001
M1810 Ability to Dress Upper body			
Dependent	130,072 (84.0)	55,271 (35.7)	<0.001
M1820 Ability to Dress lower body			
Dependent	136,776 (88.4)	61,982 (40.0)	<0.001
M1830 Bathing			
Dependent	149,911 (96.8)	99,908 (64.5)	<0.001
M1840 Toileting Transferring			
Dependent	103,772 (67.0)	39,236 (25.3)	<0.001
M1845 Toileting Hygiene			
Dependent	113,114 (73.0)	29,489 (19.0)	<0.001
M1850 Transferring			
Dependent	136,588 (88.2)	69,260 (44.7)	<0.001
M1860 Ambulation/Locomotion			
Dependent	146,575 (94.7)	99,120 (64.0)	<0.001
M1870 Feeding or Eating			
Dependent	85,938 (55.5)	25,325 (16.4)	<0.001

Table 3.3 Risk Factors for Severe ADL Dependence at admission

Risk Factor	Adjusted Odds Ratio	95% Confidence Interval
Age	1.02	(1.01-1.02)
Female	1.14	(1.11-1.16)
Race and Ethnicity (White is the reference group)		
Black	1.30	(1.25-1.35)
Hispanic	1.38	(1.32-1.45)
Other	1.36	(1.26-1.47)
Lives alone	0.51	(0.50-.53)
Insurance (Medicare is the reference group)		
Medicaid	0.40	(0.37-0.46)
Dual eligibility	1.06	(0.99-1.14)
Inpatient stay 14 days before start of HHC episode (No inpatient stay in previous 14 days is the reference group)		
Hospital	0.93	(0.91-1.00)
Skilled Nursing Facility	1.20	(1.16-1.24)
Other (for example LTACH, IRF, Inpatient Psych)	1.29	1.23-1.34)
Charlson Comorbidity Index	1.04	(1.03-1.05)
Impaired Decision Making	3.51	(3.39-3.63)

Table 3.4 Sample characteristics of HHC patients with ADL improvement

Variable	Total N=105654(%)	Improved n=89997(%)	No change or decline n=64804(%)	p-value
Predisposing factors				
Age years, mean (SD)	77.19 (11.4)	77.12 (11.2)	77.62 (12.8)	<0.001
Gender (reference, Male)				
Male	36,504 (34.6)	30,853 (34.3)	5,651 (36.1)	<0.001
Female	69,150 (65.4)	59,144 (65.7)	10,006 (63.9)	
Race (reference, White)				
White	85,977(81.4)	73,755 (82.0)	12,222 (78.1)	<0.001
Black	10,578 (10.0)	8,681 (9.6)	1,897 (12.1)	
Hispanic/Latino	6,781 (6.4)	5,632 (6.3)	1,149 (7.3)	
Other	2,318 (2.2)	1,929 (2.1)	389 (2.5)	
Enabling factors				
Lives alone	28,418 (26.9)	24,485 (27.2)	3,933 (25.1)	<0.001
Insurance (reference, Medicare)				
Medicare	102,266 (96.8)	87,339 (97.0)	14,927 (95.3)	<0.001
Medicaid	697 (0.7)	475 (0.5)	222 (1.4)	
Dual eligible	2,691 (2.5)	2,183 (2.4)	508 (3.2)	
Need factors (health condition and functions)				
Charlson Index, mean(SD)	0.89 (1.2)	0.77 (1.11)	0.93 (1.30)	<0.001
Prior inpatient stay (reference, no prior inpatient stay)				
No prior inpatient stay	30,466 (28.8)	24,048 (26.7)	6,418 (41.0)	<0.001
Skilled Nursing Facility	17,735 (16.8)	15,746 (17.5)	1,989 (12.7)	
Acute Care Hospital	47,750 (45.2)	41,633 (46.3)	6,117 (39.1)	
Other	9,703 (9.2)	8,570 (9.5)	1,133 (7.2)	
Impaired Decision Making	18,287 (17.3)	14,712 (16.3)	3,575 (22.8)	<0.001
HHC LOS	32.7 (21.04)	31.29 (18.07)	28.70 (20.75)	<0.001

Table 3.5 Factors predictive of improved ADL from admission to discharge

Risk Factor	Adjusted Odds Ratio	95% Confidence Interval
Age	1.00	(0.99-1.00)
Female	1.07	(1.03-1.11)
Race and Ethnicity (White is the reference group)		
Black	0.76	(0.72-0.81)
Hispanic	0.91	(0.85-0.97)
Other	0.91	(0.81-1.02)
Lives alone	1.09	(1.04-1.13)
Insurance (Medicare is the reference group)		
Medicaid	0.36	(0.30-0.42)
Dual eligibility	0.79	(0.71-0.87)
Inpatient stay within 14 days prior to HHC admission (No inpatient stay is the reference group)		
Hospital	1.97	(1.89-2.05)
Skilled Nursing Facility	2.20	(2.08-2.32)
Other (for example LTACH, IRF, Inpatient Psych)	2.06	(1.93-2.21)
HHC Length of Stay	1.01	(1.01-1.01)
Charlson Comorbidity Index	0.86	(0.84-0.87)
Impaired Decision Making	0.74	(0.67-0.73)

Chapter Four: UTI-related Hospitalization Among Home Health Care Patients

Chapter Four will address aim three of this dissertation using 2015 OASIS data, which is to examine the relationship between UTI-related hospitalization and ADLs.

Abstract

Introduction: UTI's are the most common bacterial infection among older adults. UTI related hospitalizations are a poor patient outcome in the rapidly growing HHC arena which serves a predominantly elderly population. There is no national data to identify clinically and policy relevant factors that increase risk for UTI-related hospitalization during a HHC episode of care. We examined the association between ADLs and risk of UTI-related hospitalization among this population**. Methods:** Using a retrospective cohort design, this secondary data analysis analyzed a 5% random sample of a national HHC dataset, the Outcome and Assessment Information Set (OASIS) for the year 2013**.** Andersen Model of health service utilization was used as a guiding framework for statistical modeling. The dependent variable was UTI-related hospitalization. The key independent variable was ADL dependency levels. **Results:** Among the beneficiaries (n=24,887) who were hospitalized in the year 2012, 1133 had UTI-related hospitalizations. HHC patients with a UTI-related hospitalization were more likely to have severe ADL dependency, impaired decision making, lower Charlson Comorbidity Index(CCI), than those with a non UTI-related hospitalization (P<0.001). On multivariable analysis, the risk factors for UTI-related hospitalization included Female gender :1.44, 95% CI: 1.25-1.66). Medicaid (AOR: 1.99, 95% CI: 1.09-3.64), severe ADL dependency (AOR: 1.50, 95% CI: 1.16-1.94), the presence of a caregiver to assist with supervision and safety (AOR: 1.26, 95% CI: 1.06-1.49), treatment for UTI in the past 14 days (AOR: 2.85, 95% CI: 2.46-3.29), presence of a urinary catheter (AOR: 3.77, 95% CI: 2.98-4.77), and prior history of indwelling/suprapubic catheter (AOR: 1.44, 95% CI: 1.06-1.94).

Conclusions: ADL dependency levels are a potentially modifiable risk factor for UTI-related hospitalization on admission to HHC. ADL dependency levels can inform clinical interventions to ameliorate ADL dependency in HHC setting, and identify groups of patients at high risk for UTI-related hospitalization.

Key words: urinary tract infection, hospitalization, home healthcare, Outcome and Assessment Information Set (OASIS).

Introduction

The need for home health care (HHC) is common among the elderly, and has grown substantially over the past two decades in the United States. In 2013, 3.5 million Medicare beneficiaries received HHC services from approximately 12,613 HHC agencies (MedPAC, 2015a; Mor, Rahman & McHugh, 2016), and HHC accounted for 50% of all patient discharges to post-acute care settings (PAC) settings (Tian, 2016). On average, HHC patients have 4.2 diagnoses, and 84% have at least 1 limitation in their activities of daily living (ADLs) (Caffrey, Sengupta, Moss, Harris-Kojetin & Valverde, 2011). The acuity of illness among the HHC population has increased, at least partially as a result of shorter lengths of hospital stay under the current health system that emphasizes community based health services (Burke, et al., 2015). Given this background, the impetus to examine quality of care provided in the HHC setting has become critical. One outcome used to determine quality of care in this setting is the development of a urinary tract infection (UTI) requiring hospitalization while receiving HHC services (CMS, 2016b).

Urinary tract infections (UTIs) are one of the most common bacterial infections (Rao & Patel, 2008; Rowe & Juthani-Metha, 2014), the third leading cause for infection-related hospitalizations in the elderly (Goto, Yashida, Tsugwa, Camargo & Hasegawa, 2016), and may lead to more severe infections such as sepsis, particularly in the elderly **(**Peach, Gérard, Garvan & Cimiotti, 2016; Shaw et al., 2015). A 2016 study from the US Centers for Disease Control and Prevention's (CDC's) Emerging Infections Program estimated that nearly 80% of sepsis cases started at home, and among adults hospitalized for sepsis, 25% had a UTI (Centers for Disease Control and Prevention [CDC], 2016).

Using a nationally representative sample of 4,394 HHC patients, Dwyer and colleagues (2010) found that 11.6% of HHC patients had an infection, 3.6% of which were UTIs. Further, 9.2 % of HHC patients had an indwelling urinary catheter, which is a known risk factor for UTIs. Nevertheless, little research has examined UTIs and the risks for acute care hospitalization among the HHC population.

Difficulty in the ability to perform ADLs has been identified as a predictor for UTI-related hospitalization among residents of skilled nursing facilities (SNFs). In previous research focusing on SNFs, improvement of walking ability or maintenance of the ability to walk observed in 29% of SNF residents was associated with a 53% reduction in the risk of UTI-related hospitalizations (Rogers et al., 2008). This suggests that a patient's ability to perform ADLs may affect risk for UTI-related hospitalization, however findings from this study were limited to the SNF population. To our knowledge, the association between ADLs and UTI-related hospitalizations among elderly HHC patients has not been explored. Using a 5% random sample of a national HHC dataset, the Outcome and Assessment Information Set (OASIS), this study was conducted to assess the risk factors for UTI-related hospitalization among elderly HHC patients. In particular, the specific aim was to examine the relationship between UTI-related hospitalization and ADLs. We hypothesized that low ADL ability is associated with increased risk for UTI-related hospitalizations among elderly patients receiving HHC.

Methods

Study Design

This was a retrospective cohort study using an existing dataset to identify risk factors for UTI-related hospitalizations among elderly patients receiving HHC and examine whether their ADL ability was associated with their risk for UTI-related hospitalization.

Data Source

OASIS data were obtained from a 5% random sample of HHC recipients, 65 years of age or older who had a hospitalization while receiving HHC services in the year of 2013. The unit of analysis was the HHC episode of care.

OASIS was first released in 1999 by the CMS as the mandated patient assessment tool for collecting administrative and clinical data on all patients receiving HHC from Medicare certified HHC programs. The OASIS items were designed to measure HHC patient outcomes, with appropriate adjustment for patient risk factors affecting those outcomes. The OASIS contains data regarding patients' socio-demographic status, environment, support systems, health status, functional status and behavioral status data (O'Connor & Davitt, 2012). Multiple versions of the OASIS have been developed and validated since its inception in 1999; the OASIS-C that was implemented in 2010 (Deitz, Dowell, Madigan &Richard, 2010) and used in this study.

The OASIS provides longitudinal data during a patient stay in HHC collected at specific times during the receipt of HHC services: on admission, transfer to the acute care hospital, discharge from a facility back to the HHC agency, change in medical status, discharge from the agency, death, or every 60 days if HHC services continue (O'Connor & Davitt, 2012). The most

comprehensive time points for OASIS data collection are admission and discharge, while other time points have abbreviated versions.

Inter-rater reliability on most OASIS items has been reported as Cohen's kappa of .60 or higher (Hittle et al., 2003; Madigan & Fortinsky, 2000). Madigan and colleagues (2004) tested inter rater reliability of items using OASIS-B, the previous version of the OASIS-C, and found that all ADL items had kappa values above 0.70 except the feeding or eating item which had a score of 0.67. Evidence for the validity of the OASIS-B items has shown that the functional status items are sufficiently valid (Tullai-McGuiness et al. 2009). Compared to the OASIS-B, the OASIS-C expands on the ADL item of toileting ability, with the addition of an item to assess toilet transferring (CMS, 2013a). There are currently no studies to evaluate the reliability and validity of the OASIS-C items.

Sample

Included in this analysis is a 5% random sample of OASIS-C data from patients 65 years and older who were hospitalized during a HHC episode of care. Patient who has a UTI-related hospitalization were compared to patient hospitalized for all other causes. This comparison group was selected because prior HHC research has found that HHC patients who are hospitalized are different from the general HHC population (Fortinsky et al., 2014)

Conceptual Framework

The initial Andersen's Behavioral Model of Health Service Utilizations (Andersen & Newman, 1968) was used as a framework for determining the key predictor of UTI-related hospitalization and estimating the relation between ADLs and UTI-related hospitalization while adjusting for other empirically determined predictor variables identified from previous literature

(Fortinsky, Madigan, Sheehan, Tullai-McGuinness, & Fenster, 2006; Madigan et al., 2012; Madigan, 2008; Madigan & Fortinsky, 2001). According to the model depicted in Figure 1, health care utilization such as UTI-related hospitalization is affected by predisposing factors (age, race, sex), enabling conditions (whether patients live alone, level of caregiver ability), and need factors (comorbid conditions and ADLs).

Outcome variables

The primary outcome measure was a dichotomous variable indicating UTI-related hospitalization. Two OASIS-C items were used to identify UTI related hospitalizations: 1) Question M2410 askes "To which inpatient facility has the patient been admitted?" This item lists 5 answers including "hospital"; 2) Question M2430 asks "What reason(s) did the patient require hospitalization". This item includes 18 medical conditions as reasons for acute care hospitalization, one of which is UTI (CMS, 2016b). Both M2410 & M2430 are collected when a patient is transferred to an inpatient facility.

Independent Variables

The risk factors are grouped into the Andersen Model categories of predisposing, enabling and need for health care. The start of care OASIS assessment conducted during admission to HHC was the data source for these risk factors.

Predisposing factors included gender, age, and ethnicity or racial group membership. Age was classified as a continuous variable. Race was categorized as Black/African American, Hispanic, White, and Other.

Enabling factors included whether patients were a) dual eligible, denoted by whether patients had Medicaid insurance in addition to their Medicare coverage, b) whether patients lived

alone or with others indicated by a living arrangement variable on the OASIS-C, and c) presence of a caregiver. This was identified by the OASIS-C variable which asks the ability and willingness of non-agency caregivers to provide assistance in 7 tasks, with responses that characterize the presence and ability of a caregiver to provide assistance on a scale of 0 to 5. Each of the 7 tasks were dichotomized into presence or absence of caregiver(s).

Need factors were measured by clinical and functional characteristics of the HHC patients and included the following: a) ADL, b) having a prior inpatient stay, c) comorbidities, d) impaired decision making, e) presence of indwelling catheter and history of UTI treatment, f) history of an indwelling/suprapubic catheter in the past 14 days, g) urinary catheter presence, and h) urinary incontinence.

ADL dependency levels were measured from 9 items in the OASIS-C. Items varied in their range of scores: grooming, dressing upper body, dressing lower body, and toileting hygiene were each scored 0-3, toilet transferring has a score ranging from 0-4, transferring, feeding or eating, and ambulation/locomotion scored 0-5 each, and bathing was scored 0-6. For all ADLs, a value of 0 indicates independence and a higher score is indicative of greater difficulty in managing the task independently. Following the approach of Chen, Carlson and colleagues (2016), each respective ADL was dichotomized into 0 or 1, with 0 indicating total independence, and 1 indicating some level of dependence in managing the task (Chen, Carlson, Popoola, & Suzuki, 2016). Second, the total number of functions in which an individual required assistance was summed to create a categorical variable with 4 levels: (1) independent in all functions, (2) required assistance in 1 to 3 ADL functions (mild); (3) required assistance in 4 to 6 ADL

functions (moderate); and (4) required assistance in all 7 ADL functions (severe), indicating complete dependence on someone to perform ADL functions.

Prior inpatient stay was included as a covariate using the OASIS item that identifies whether the patient had been discharged from an inpatient facility within 14 days prior to HHC admission, including in a SNF, acute care hospital or other inpatient unit such as long term acute care hospital (LTACH), intensive rehabilitation facility (IRF), long term nursing facility or psychiatric hospital unit prior to admission for HHC services.

The weighted Charlson Comorbidity Index (CCI) was used to identify co-morbidities at HHC admission (Monsen, Swanson, Oancea & Westra, 2012). This score was based on ICD-9-CM codes within the OASIS assessments. The ICD-9 codes used to compute the Charlson Comorbidity Index from the OASIS were generated from the following 18 OASIS fields: primary diagnosis (n = 1), secondary diagnoses (n = 5), reasons for inpatient treatment (n = 2), reasons for treatment change (n = 4), and payment diagnoses for Medicare patients (n = 2). Impaired decision making was defined based on the OASIS question M1740 which asks if a patient displays cognitive, behavioral and psychiatric symptoms at least once a week. Dichotomous variables were created to identify whether a patient had a urinary catheter present (M1610), history of indwelling/suprapubic catheter in the past 14 days (M1018), history of UTI treatment (M1600), and prior urinary incontinence (M1018**).**

Statistical Analysis

Baseline patient demographics were summarized using descriptive statistics (means and standard deviation for continuous variables and counts/percentages). To identify independent risk factors for UTI-related hospitalization during a HHC episode, baseline characteristics

between patients with UTI- related hospitalization and without a UTI-related hospitalization were compared using bivariate analyses (Chi square tests for categorical variables and *t*-test for continuous variables). In addition, continuous variables (age and CCI) of the ADL categories were analyzed with ANOVA.

Variables that were significantly different between the groups were entered the multivariable regression model as covariates. Prior to this, multicollinearity was assessed among independent variables that appeared related (M1018 - indwelling/suprapubic catheter in the past 14 days and M1610 - urinary catheter presence; impaired decision making and the respective ADL variables) by calculating the variance inflation factor. A variance inflation factor value of 5 or greater was considered to indicate the presence of multicollinearity. Since the associated variance inflation factor we obtained was 1, we retained both variables in the model. Adjusted odds ratios (OR) and 95% confidence intervals (CI) are reported. Statistical significance was set at $P < 0.05$. All analyses were conducted using IBM SPSS Statistics Version 24.0.

Results

Sample Characteristics

Table 4.1 summarizes characteristics of the sample of 24,887 HHC patients and bivariate associations between sample characteristics and UTI-related hospitalizations. Among this sample, 1,133 (4.6%) had UTI-related hospitalizations and 23,754 (95.4%) had non-UTI-related hospitalizations. The average age for the entire sample was 77 (SD= 11.6) years. Overall, patients were predominantly female (60.4%) and white (79.5%). Most were insured by the Medicare (96.1%) and almost a quarter lived alone (24.4%). About three quarters (74.5%) had an

inpatient facility stay, primarily in an acute care hospital (48.0%), within 14 days prior to the HHC admission. The CCI for this sample was 0.89 (SD 1.2).

Compared to patients who were hospitalized for all causes, HHC patients with a UTI-related hospitalization were older (mean age = 79.7 years vs 76.6 years), more likely to be female (68.4% vs 60%), white (85.3% vs 79.3%), and have had a SNF stay 14 days prior to HHC admission (23.0% vs 16.2%). Patients with a UTI-related hospitalization were less likely to live alone (19.1% vs 24.6%) and more likely to have caregiver present for assistance with ADLs (95.2% vs 92.5%), medication administration (86.8% vs 80%), supervision and safety (78.1% vs 66.9%) and advocacy or facilitation (95.9% vs 94.4%).

Overall, about 70% of the patients had severe dependence on ADL requiring assistance in all 7 ADL functions. Patients with a UTI-related hospitalization were more likely to have severe ADL dependency (81.8% vs 70.1%) than those with a non UTI-related hospitalization. Compared to HHC patients hospitalized for other reasons, HHC patients with a UTI-related hospitalization had fewer comorbidities indicated by a lower CCI score (mean 1.07, SD=1.34) vs (mean 1.27, SD=1.44) and were less likely to have a history of urinary incontinence (50.1% vs 62.1), however, they were more likely to have impaired decision making (30.9% vs 21.7%), have a urinary catheter present (17.7% vs 4.3%), a history of indwelling/suprapubic catheter (9.4% vs 2.1%), and a history of being treated for a UTI in the previous 14 days (29.3 vs 9.8%).

Table 4.2 compares sample characteristics among patients with four ADL dependency levels. Compared with patients with other ADL dependency levels, patients with mild ADL dependency, namely those required assistance in 1 to 3 ADLs, were more likely to live alone (46.9%), be discharged from an acute care hospital (56.3%) prior to HHC admission, and have

urinary incontinence (71.9%). Compared with other ADL dependency levels, patient with mild ADL dependency were also less likely to have a caregiver to assist in most tasks, and less likely to have impaired decision making ($p<0.001$).

Table 4.3 shows the results of regression analyses to determine the risk factors for UTI-related hospitalizations. All variables that were significantly associated with UTI-related hospitalization in the bivariate analyses ($p<0.05$) were included in the regression model (age, gender, race, living condition, insurance, ADL levels, CCI, impaired decision making, prior inpatient stay, treatment for UTI in the past 14 days, indwelling/suprapubic catheter in the past 14 days, presence urinary catheter and the presence of a primary caregiver to provide assistance with: a) ADL, b) medication administration, c) supervision and safety and, d) advocacy or facilitation. Female gender was an independent risk factor for UTI-related (adjusted odds ratio [AOR]:1.44, 95% Confidence Intervals [CI]: 1.25-1.66). Compared to patients with Medicare, having Medicaid as the primary payer increased the risk for UTI-related hospitalization (AOR: 1.99, 95% CI: 1.09-3.64), and compared to patients who were independent in ADLs, patients with severe ADL dependency level had significantly increased the risk for UTI-related hospitalization (AOR: 1.50, 95% CI: 1.16-1.94). Other significant predictors included: the presence of a caregiver to assist with supervision and safety (AOR: 1.26, 95% CI: 1.06-1.49), treatment for UTI in the past 14 days (AOR: 2.85, 95% CI: 2.46-3.29), presence of a urinary catheter (AOR: 3.77, 95% CI: 2.98-4.77), and prior history of indwelling/suprapubic catheter (AOR: 1.44, 95% CI: 1.06-1.94).

The risk of UTI-related hospitalization decreased by 21% for patients who lived alone (AOR: 0.79, 95% CI: 0.67-0.92), and by 36% for patients who had a prior stay in an acute care

hospital (AOR: 0.64, 95% CI: 0.54-0.74). Compared to White patients, racial/ethnic minorities had decreased risk of UTI-related hospitalization (Black AOR: 0.72, 95% CI: 0.58-0.89; Hispanic AOR: 0.68, 95% CI: 0.50-0.92). Compared to patients who were independent in ADLs, the odds of UTI-related hospitalization also decreased by 38% for patients with mild ADL dependency (AOR: 0.62, 95% CI: 0.40-0.97). The risk of UTI-related hospitalization decreased by 29% for patients who had a caregiver to assist with ADLs (AOR: 0.71, 95% CI: 0.51-0.99) and 24% for patients with a history of urinary incontinence (AOR: 0.76, 95% CI: 0.67-0.87).

There was no statistically significant association between UTI-related hospitalizations and the following variables: older patient age (AOR: 1.01; 95%CI: 1.00-1.02), CCI (AOR: 0.95, 95% CI: 0.91-1.00) and dual eligibility (AOR: 1.30, 95% CI: 0.90-1.86).

Discussion

To our knowledge, this is the first study to examine factors associated with UTI-related hospitalizations using nationwide OASIS-C dataset. Significant associations of predisposing factors (gender, race), enabling factors (presence of caregiver for supervision and safety, Medicaid insurance), need-related factors (impaired decision making, history of UTI in 14 days, history of suprapubic catheter, and the presence of urinary catheter) and UTI-related hospitalizations were identified. Women in this study had higher risk for UTI-related hospitalization than males, which is consistent with well-established evidence of higher risk for UTIs among female gender (Castle, Engberg, Wagner, & Handler, 2017; Foxman, 2014). On the other hand, and inconsistent with previous reports (Fortinsky, Madigan, Sheehan, Tullai-McGuinness, & Kleppinger, 2014; Yan et al., 2014; Nyweide et al., 2013), Blacks and Hispanics

in this study had reduced risk of UTI-related hospitalizations. Since Blacks in our sample had higher all-cause hospitalization rates than Whites (15.1% and 17.2%, respectively), it suggests that Blacks were more likely to be hospitalized for reasons other than UTI (Appendix A).

Our finding that having Medicaid as a payer source increased the risk of UTI-related hospitalizations is similar to other studies that have found increased health care utilization and higher risk of being hospitalized among the Medicaid population (Jiang et al., 2016; Raven, Billings, Goldfrank, Manheimer, & Gourevitch, 2009; Regenstein & Andres, 2014; Chen, Benjamin et al., 2016). Other risk factors identified (history of indwelling urinary catheter, history of treatment for a UTI and presence of a urinary catheter) have been previously reported (Castle, Engberg, Wagner, & Handler, 2017; Geerlings, Fonseca, Castro-Diaz, List, & Parikh, 2014). As expected, having impaired decision-making was also an independent risk factor for UTI-related hospitalization among this sample of elderly HHC patients.

HHC patients who had a caregiver present for supervision and safety were at increased risk for UTI-related hospitalization. In general, patients with caregivers assisting with supervision and safety were more complex and had higher ADL dependent levels which may increase their risk for UTI-related hospitalizations. Patients living alone were less likely to have a UTI-related hospitalization possibly because they have had less ADL dependence compared to patients living with others (Weissman & Russell, 2016).

The results of our study suggest that severe ADL dependence is an independent risk factor for UTI-related hospitalizations. Notably, for patients at the highest level of ADL dependence, the risk of UTI-related hospitalization increased by nearly 50% compared to patients who were ADL independent. However, we found that patients with mild ADL

dependence (in 1-3 ADLs) had a 38% reduction in the risk for UTI-related hospitalization compared to patients independent in ADLs. Using the same ADL levels in national OASIS data, another study reported similar findings (Chen, Carlson, Popoola & Suzuki, 2016). Our analysis found that compared with patients with mild ADL dependence, patients who were ADL independent were more likely to have impaired decision making and/or have a history of suprapubic/indwelling, which were both risk factors of UTI-related hospitalization.

Implications

This study provides evidence of risk factors on admission to HHC that could put HHC patients at greatest risk for UTI related hospitalizations. Registered nurses and physical therapists working in HHC settings can identify high-risk patients on admission to HHC who may benefit from monitoring and interventions to mitigate these risk factors earlier in the HHC episode. Two of these risk factors identified are potentially modifiable: severe ADL dependency (Tinetti, Charpentier, Gottschals & Baker, 2012) and the presence of urinary catheter. Knowledge of the level of ADL dependence can be used to identify patients who are similar in the severity of ADL dependence (Hennessy et al., 2015). Patients with severe ADL dependence are a high cost-utilization population (Greysen, Stijacic Cenzer, Boscardin, & Covinsky, 2017). An important contribution of our study to HHC literature is use of well-defined ADL levels to identify the stage of ADL dependence associated with UTI-related hospitalization. This may provide valuable information that can be combined with cost information to help with policy development, planning, and designing interventions targeted at ADL ability to mitigate the risk for UTI-related hospitalizations. Such interventions could be the focus of home physical therapy and other coordinated rehabilitative services in the outpatient setting.

The development of a UTI during a HHC episode and acute care hospitalization during a HHC episode are both home health quality measures monitored by CMS described as potentially avoidable events (CMS, 2016b). With growing evidence that infections in the community, including UTI's are risk factors for sepsis on admission to the hospital setting (Novosad et al., 2016), future efforts towards UTI-related hospitalization risk prediction modeling and the development of targeted interventions for high-risk patients on admission to HHC would be important endeavors. Reducing inappropriate use of urinary catheters could also be an important strategy for HHC clinicians to adapt to reduce the risk of UTI among HHC.Managing these at-risk patients more aggressively in the HHC setting may prevent unnecessary hospitalizations, and reduce associated healthcare costs.

Strengths and Limitations

Our study had several strengths and some limitations. By using data from the nationwide OASIS database, we were able to study a large population of patients in HHC. We investigated ADL dependence as an independent risk factor for UTI-related hospitalization using carefully defined categories that identify the level of ADL dependence predicts a UTI-related hospitalization. We also examined individual care management variables in the OASIS-C and their contribution to the risk for UTI -related hospitalization which very few HHC studies have examined.

Some of the limitations of this study are inherent to the OASIS data set. The study only captured a snap shot of ADL dependence level on admission to HHC and did not include changes in ADL that may occur upon transfer to the hospital. This is because the OASIS does not assess ADLs upon transfer to inpatient setting during a HHC episode. Next, although the

rigor and accuracy of OASIS, it is dependent on the clinician who completes the form, we had no information on those completing the form or information on other important variables such as patient medications, nursing or therapy visits per episode, and physician coordination or visits.

The identification of the sample with UTI-related hospitalization was also restricted to the assessment by the registered nurse during the transfer OASIS and not necessarily a confirmed medical diagnosis for hospitalization. Future studies should consider linking OASIS data to claims data to get a clear picture of hospitalization diagnosis and services received prior to hospitalization.

Conclusion

In conclusion, using a nationwide sample of HHC OASIS we found that gender, Medicaid insurance, the presence of a caregiver for supervision and safety, severe ADL dependence level, history of UTI treatment within 14 days, history of a suprapubic/indwelling catheter, presence of a urinary catheter, and impaired decision making on admission to HHC services are risk factors for UTI-related hospitalizations. Importantly, we also show that ADL dependency levels may serve as an additional predictor of adverse health outcomes such as UTI-related hospitalization on admission to HHC. These findings highlight the importance of managing patients with the identified risk factors more closely in the HHC to prevent hospitalizations, and reduce associated healthcare cost.

Table 4.1 Sample characteristics and risk factors for UTI-hospitalization

Variable	Total N=24,887(%)	UTI-Hospitalization n=1133(%)	Non UTI Hospitalization n=23754(%)	p-value
Predisposing factors				
Age years, mean (SD)	77.12(11.6)	79.66(10.9)	76.60(12.2)	<0.001
Gender(reference, Male)				
Male	9851(39.6)	358(31.6)	9493(40.0)	<0.001
Female	15036(60.4)	775(68.4)	14261(60.0)	
Race(reference, White)				
White	19793(79.5)	967(85.3)	18826(79.3)	<0.001
Black	3096(12.4)	101(8.9)	2995(12.6)	
Hispanic/Latino	1479(5.9)	1430(4.3)	49(6.0)	
Other	3425(2.1)	503(1.4)	16(2.1)	
Enabling factors				
Lives alone	6071(24.4)	216(19.1)	5855(24.6)	<0.001
Insurance(reference, Medicare)				
Medicare	23923(96.1)	1086(95.9)	22837(96.1)	0.685
Medicaid	207(0.8)	12(1.1)	195(0.8)	
Dual eligible	757(3.0)	35(3.1)	722(3.0)	
Presence of a caregiver				
ADL assistance	23042(92.6)	1079(95.2)	21963(92.5)	<0.001
IADL assistance	24287(97.6)	1111(98.1)	23176(97.6)	0.292
Medication administration	19989(80.3)	984(86.8)	19005(80.0)	<0.001
Medical procedures/treatments	10453(42.0)	497(43.9)	9956(41.9)	0.193
Management of equipment	8946(35.9)	393(34.7)	8553(36.0)	0.366
Supervision and safety	16784(67.4)	885(78.1)	15899(66.9)	<0.001
Advocacy or facilitation	23498(94.4)	1086(95.9)	22412(94.4)	0.032
Need factors (health condition and functions)				
ADL(reference, independent)				
Independent	2529(10.2)	71(6.3)	2458(10.3)	<0.001

Mild dependence	1738(7.0)	32(2.8)	1706(7.2)	
Moderate dependence	3048(12.2)	103(9.1)	2945(12.4)	
Severe dependence	17572(70.6)	927(81.8)	16645(70.1)	
Charlson Index, mean(SD)	0.89(1.22)	1.07(1.34)	1.27(1.44)	<0.001
Prior inpatient stay(reference, no prior inpatient stay)				
No prior inpatient stay	6353(25.5)	325(28.7)	6028(25.4)	
Skilled Nursing Facility	4119(16.6)	261(23.0)	3858(16.2)	<0.001
Acute Care Hospital	11948(48.0)	410(36.2)	11538(48.6)	
Other	2467(9.9)	137(12.1)	2330(9.8)	
Impaired Decision Making	5495(22.1)	350(30.9)	5145(21.7)	<0.001
UTI 14 days	2668(10.7)	332(29.3)	2336(9.8)	<0.001
Foley catheter present	1230(4.9)	200(17.7)	1030(4.3)	<0.001
Urinary incontinence	15308(61.5)	568(50.1)	14740(62.1)	<0.001
Prior catheterization	606(2.4)	107(9.4)	499(2.1)	<0.001

Table 4.2: Sample characteristics by ADL dependency level

Variable	Total	Independent	Mild dependence	Moderate dependence	Severe dependence	p-value
	100 (1133)	n(%) 71(6.3)	n(%) 32(2.8)	n(%) 103(9.1)	n(%) 927(81.8)	
Predisposing factors						
Age years, mean (SD)	79.66(10.8)	77.63(9.9)	75.84(14.8)	79.63(10.3)	79.95(10.8)	0.069
Gender(reference, Male)						
Male	31.6	32.4	31.3	32.0	31.5	0.998
Female	68.4	67.6	68.8	68.0	68.5	
Race(reference, White)						
White	85.3	94.4	84.4	86.4	84.6	0.272
Black	8.9	4.2	6.3	6.8	9.6	
Hispanic/Latino	4.3	0.0	9.4	3.9	4.5	
Other	1.4	1.4	0.0	2.9	1.3	
Enabling factors						
Lives alone	19.1	31.0	46.9	37.9	15.1	<0.001
Insurance(reference, Medicare)						
Medicare	95.9	98.6	93.8	91.3	96.2	0.004
Medicaid	1.1	1.4	6.3	2.9	0.6	
Dual eligible	3.1	0.0	0.0	5.8	3.1	
Presence of a caregiver						
ADL assistance	95.2	81.7	43.8	85.4	99.1	<0.001
IADL assistance	98.1	90.1	84.4	95.1	99.5	<0.001
Medication administration	86.8	71.8	43.8	68.0	91.6	<0.001
Medical procedures/treatments	43.9	36.6	40.6	29.1	46.2	0.005
Management of equipment	34.7	22.5	25.0	24.3	37.1	0.004

Supervision and safety	78.1	66.2	21.9	50.5	84.0	<0.001
Advocacy or facilitation	95.9	90.1	78.1	93.2	97.2	<0.001
Need factors (health condition and functions)						
Charlson Index, mean(SD)	1.07(1.34)	1.10(1.50)	1.09(1.30)	1.31(1.51)	1.04(1.30)	0.021
Prior inpatient stay(reference, no prior inpatient stay)						
No prior inpatient stay	28.7	21.1	21.9	25.2	29.9	
Skilled Nursing Facility	23.0	19.7	18.8	21.4	23.6	<0.001
Acute Care Hospital	36.2	52.1	56.3	42.7	33.5	
Other	12.1	7.0	3.1	10.7	12.9	
Impaired Decision Making	30.9	14.1	3.1	17.5	34.6	
History of UTI treatment						
No	67.3	70.4	59.4	70.9	67.0	0.804
Yes	29.3	25.4	34.4	27.2	29.7	
History of suprapubic/indwelling catheter	9.4	8.5	6.3	8.7	9.7	0.897
Presence of foley catheter	17.7	18.3	18.8	17.5	17.6	0.997
Urinary incontinence	50.1	64.8	71.9	60.2	47.1	<0.001

Table 4.3 Multivariate regression analysis for predictors of UTI-related hospitalization

Variable	Odds ratio	CI Lower	CI Upper
Predisposing factors			
Age years, mean (SD)	1.01	1.00	1.02
Gender(reference, Male)			
Male			
Female	1.44	1.25	1.66
Race(reference, White)			
White			
Black	0.72	0.58	0.89
Hispanic/Latino	0.68	0.50	0.92
Other	0.65	0.39	1.08
Enabling factors			
Lives alone	0.79	0.67	0.92
Insurance(reference, Medicare)			
Medicare			
Medicaid	1.99	1.09	3.64
Dual eligible	1.30	0.90	1.86
Presence of a caregiver			
ADL assistance	0.71	0.51	0.99
IADL assistance			
Medication administration	0.99	0.80	1.21
Medical procedures/treatments			
Management of equipment			
Supervision and safety	1.26	1.06	1.49
Advocacy or facilitation	0.87	0.64	1.20
Need factors (health condition and functions)			
ADL(reference, independent)			
Independent			
Mildly dependent	0.62	0.40	0.97
Moderately dependent	1.31	0.96	1.79
Severe dependent	1.50	1.16	1.94
Charlson Index, mean(SD)	0.95	0.91	1.00

Prior inpatient stay(reference, no prior inpatient stay)			
No prior inpatient stay			
Skilled Nursing Facility	1.10	0.93	1.31
Acute Care Hospital	0.64	0.54	0.74
Other	0.97	0.78	1.20
Impaired Decision Making	1.20	1.04	1.38
UTI 14 days	2.85	2.46	3.29
Foley catheter present	3.77	2.98	4.77
Urinary incontinence	0.76	0.67	0.87
Prior catheterization	1.44	1.06	1.94

Chapter Five: Conclusion

Summary of findings

Older adults in HHC represent an increasing part of the U.S. population who disproportionately experience ADL decline, infections, and increased hospitalizations. A key priority of HHC during the post-acute care period is to equip both the patient and caregiver with skills to safely and optimally manage their conditions at home, and minimize the likelihood of hospitalization during a HHC episode of care. Hospitalization for common conditions such as UTI while receiving HHC services is an undesirable patient outcome. Knowledge of risk factors for UTI-related hospitalizations may increase early recognition and understanding of HHC patients and help prevent more severe consequences such as sepsis. Accordingly, the overarching goal of this dissertation was to identify risk factors of UTI-related hospitalization among this population, and to examine if ADL status is associated with such risk.

In Chapter 2 of this dissertation, I conducted an integrative review to describe the methods of assessing ADLs in SNFs and HHC. Eight studies described the methods of assessing ADLs using 4 standardized tools, and none of the studies included a recent version of the OASIS, the OASIS-C. The limited number of studies that described the methods of assessing the ADLs of HHC patients emphasized the need to describe the ADL of the HHC population. In Chapter 3, I sought to describe the ADLs of HHC patients. First, I examined the risk factors of ADL dependency on admission to HHC; next, I used admission and discharge OASIS data to analyze the predictors of ADL improvement. These analyses illustrated that over 60 % of patients admitted to HHC had severe ADL dependence (dependent in 7 or more ADL tasks), and

patients with longer HHC length of stay were most likely to experience ADL improvement during a HHC episode of care.

In Chapter 4, I presented an investigation of risk factors associated with UTI-related hospitalization. In these analyses, ADL dependency levels were the primary predictor. To characterize HHC patients with homogeneous ADL dependency, and examine which ADL predicts UTI-related hospitalizations I created 4 categories of ADLs to capture dependence in 1 to 3 ADL functions, 4 to 6 ADL functions and at least 7 ADL functions. Overall, findings were consistent with previous studies that examined the risk for UTI and identified use of catheter, history of UTI treatment and female gender as risk factors. More importantly, the analyses demonstrated that patients who had severe ADL dependence were at increased risk for UTI-related hospitalization.

Limitations

There are several limitations to this dissertation. Of note, because the nature of secondary data analysis and the quality of the data is dependent upon the accuracy of reporting by each agency, there may be unobserved or unreported factors that influence the results in examining predictors of UTI-related hospitalizations. For example, the total number of nursing or therapy visits each patient received during a home health stay was not available. As a result, I was not able to evaluate whether nursing or therapy visits were provided and whether there were differences in the outcomes of patients who received nursing only or therapy only visits or a combination. Another potentially important variable that might be important for predicting UTI-related hospitalization but was not available in this data set was patient medications. The study

is also limited by the unavailability of additional measures of enabling characteristics that are indicative of socioeconomic status such as level of education, which prior studies found to have an effect of hospitalizations (Calvillo-King L et al., 2013; Arbaje et al., 2008). HHC patients with lower levels of educational attainment may be at higher risks for hospitalization for a number of reasons such as poor understanding of treatment instructions, fewer support systems, etc. Furthermore, because ADL data are not collected on patients who are transferred to the hospital, I was not able to examine ADL change for these patients during this time period. Over 90% of the sample had Medicare coverage, limiting the generalizability of the findings. However, in the United States, Medicare is the single largest payer for HHC services and the primary insurance of over 90% of the population over 65. Finally, the psychometric properties of measures used in the study were tested with the previous version of the OASIS, OASIS Version-B (Tullai-McGuiness et al., 2009).

Strengths and Implications

This is the first study to examine the association between ADLs and UTI related hospitalizations using national data for patients receiving HHC in the year 2012. The strengths of this study include a large, nationwide HHC sample that includes diverse HHC patient characteristics. Further, guided by one of the most widely acknowledged frameworks identifying predictors for hospitalization, this dissertation identified variables that could inform post-acute care settings on potentially modifiable risk factors (ADLs) relevant to designing interventions targeted at decreasing hospitalizations in HHC. Overall, findings from this dissertation will

provide an understanding of infections in HHC, drive current national initiatives to control infections in the HHC setting, and enhance assessment for ADL ability.

This study has important policy, practice and research implications. The present HHC payment system has been held accountable for promoting the utilization of more services as providers are paid for the quantity of care as opposed to their quality. Current initiatives proposed by CMS aim to align HHC payment and incentivize HHC providers who deliver the highest quality outcomes. One example is the Home Health Value-Based Purchasing model (HH VBP). The HH VBP will adjust all HHCs' payments based on their performance on a set of 20 quality measures. Most of these measures are reported via the OASIS, including improvement in the ADLs of ambulation, bed transferring and bathing and acute care hospitalization. In efforts to meet the standards set by CMS, HHC providers face increased pressure to develop best practices and targeted interventions that improve clinical outcomes and quality or care.

Although ADL measures have been widely recognized as important indicators of quality care and reimbursement, recent initiatives by CMS, emphasize the utility of ADL levels and other patient characteristics to define HHC payment categories (CMS, 2017a). Over 60 percent of the analytical sample had severe ADL dependency on admission to HHC (defined as dependence in 7 or more ADLs). This finding may have important implications for acute care and PAC in general. To date, extensive research has documented the absence of evidence based criteria guiding decisions on what type of PAC to prescribe for a group of patients, and the similarity of patients treated by different PAC providers (Bowles, Naylor & Foust,2002; Bowles et al.,2008; MedPAC, 2016a).

This study identified potentially modifiable risk factors for UTI-related hospitalization such age urinary catheter use and ADL dependency level. The findings of this dissertation may have implications as HHCs prepare for a move to value-based purchasing models. Importantly, understanding factors associated with increased risk for UTI-related hospitalizations and ADL improvement are important next steps in designing interventions to reduce them. These factors may be critical to HHC providers and payers as payment models in HHC sector continue to evolve. This dissertation adds to the growing body of literature documenting risk factors for hospitalization during HHC (Chen et al., 2015; Fortinsky et al., 2006; Fortinsky et al., 2014; Madigan, Schott & Matthews, 2001; Murtaugh et al., 2017).

This dissertation demonstrates the need for innovative approaches to manage patients with UTI in the HHC setting and points to one potentially modifiable factor-ADL ability. Findings from this dissertation will provide an understanding of UTI- related hospitalizations among elderly HHC patients, and potentially inform the development of screening tools and rehabilitative programs to facilitate the identification of and management of HHC patients who are at high risk for UTI-related hospitalization. Finally, this dissertation also adds to the growing body of literature documenting disparities in clinical outcomes for racial minorities and extends it to the HHC setting.

Future studies

Future research should link the current OASIS –C1 with claims data (home health and hospital) to explore the impact of infections in HHC patients on healthcare costs and utilization during the HHC period preceding hospitalization. Future studies should also examine the

characteristics of patients with severe ADL admitted to HHC from an acute care hospital and their outcomes during HHC. This would provide more insight on the characteristics of patients with severe ADL discharged from the hospital setting, and inform studies that examine PAC discharge decision making.

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Appendix

Table A1.1. Hospitalizations by race

Variable	Total	No Hospitalization	Hospitalization	p-value
	n =154801	n =131170(%)	n =23631(%)	
Race				
White	123590	104919(84.9)	18671(15.1)	<0.001
Black	17612	14583(82.8)	3029(17.2)	
Hispanic/Latino	10164	8742(85.9)	1432(14.1)	
Other	3425	2926(85.4)	499(14.6)	