Influence of Home Health Operations and Clinical Variables on 30-Day Hospital Readmissions During Home Health Services

by

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# DEDICATION

I dedicate this dissertation to single, working mothers striving hard to better their lives while balancing the needs of their beloved children. To my sister and parents who had my back at the right times over the past two years, and a very heartfelt dedication to my daughter, Sarah, who continually inspires me to reach ever-higher.

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ABSTRACT

Influence of Home Health Operations and Clinical Variables on 30-Day Hospital Readmissions During Home Health Services

Irene S. Cole

Reducing patient readmissions within 30 days of an initial hospitalization is fiscally responsible and important to patient-centered care. Home health (HH) agencies, have been publicly reported by Medicare on 30-day readmission to the hospital from HH since 2015, and are proposed to be measured on potentially preventable 30-day post-discharge readmissions in 2019. The body of 30-day readmissions evidence inclusive of HH is small and inconsistent, comprised in part from national claims data or federal-level reports. We cannot assume that while the hospital and HH settings share the same patients that the risks, determinants of readmission and preventative interventions are also the same, nor that Medicare-specific data reports the full story. This study was performed as a dissertation, and retrospective, secondary analysis of electronic health record data, aimed at determining HH operations predictors influencing readmission to the hospital during HH services in one northern California HH agency. Logistic regression was used to determine univariate and multiple predictors of two readmission models: 30-day readmission to the hospital during HH services and readmission to the hospital at any time during HH services. Univariate results with 30-day readmission produced 8 significant predictors which were then entered into the 30-day readmission multiple logistic regression (MLR) model simultaneously (omnibus test chi-square 32.058, p=0.000). Two variables continued to demonstrate unique contribution to the model: frontloaded contacts rate in the first week (AOR = 0.970, p = 0.005) and number of high-risk medications (AOR =

1.638, p = 0.027). Univariate results with readmission at anytime produced six significant predictors which were then entered simultaneously to the readmission at anytime MLR model (omnibus test chi-square 29.565, p=0.000). Two variables continued to demonstrate unique contribution to the model: homebound status by medical contraindication (AOR = 5.058, p = 0.011) and HH total length of stay (days) (AOR=1.034, p=0.033). Both the 30-day and anytime readmission models described a unique combination of significant predictors of readmission to the hospital during HH services. This study also defined a manner of calculating frontloaded contacts in the first week of care, which contributed to the 30-day readmission model, bearing operational interest to HH settings.

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# CHAPTER I

# INTRODUCTION

## Statement of the Problem

Thirty-day hospital readmission is a healthcare quality and financial metric that can affect clients of all ages. In the United States (US), the Centers for Medicare and Medicaid Services (CMS) have mandated Medicare-certified healthcare agencies to manage 30-day hospital readmissions (CMS, 2015; CMS, 2017; Medicare Payment Advisory Committee (MedPAC), 2014; MedPAC, 2016). All healthcare settings are increasingly being held accountable to improve quality of care for the best patient experience while reducing waste and controlling for unnecessary healthcare costs derived from preventable hospital readmissions. In today's healthcare marketplace, many insurers are interested in the 30-day hospital readmission metric, which has emerged as a consequential quality and financial outcome relevant to Medicare-certified healthcare settings, including home health (HH) agencies, which are the focus of this study (Agency for Healthcare Research and Quality [AHRQ], 2015; CMS, 2016; MedPAC, 2017; Minott, 2008; Stone & Hoffman, 2010).

Fiscally, there is a sense of urgency to rein in Medicare-spending as baby boomers age into Medicare, which is estimated to last through 2030 (MedPAC, 2017). As these new Medicare beneficiaries retire from the workforce, their wage-tax contributions to the Medicare Trust Fund will desist. Medicare spending, as a share of the gross domestic product, grew from $16 billion to $499 billion between 1975 and 2009, and began rising again in 2014 because of the baby boomer generation. In 2005, 17.6% of all Medicare hospital admissions resulted in 30-day readmissions, equating to an annual cost of $15 billion (MedPAC, 2007). Moreover, 76% of these readmissions were estimated to be potentially preventable.

Reducing readmission within 30 days of an acute hospital stay is an important part of client-centered, quality care in terms of assuring that patients understand how to self-manage at home and that the right resources have been initiated upon discharge from the hospital (AHRQ, 2015; Auerbach et al., 2016; Minott, 2008). Black (2014) found that 22% of patients experienced at least one 30-day hospital readmission, and among these patients, 72% of them experienced three or more hospitalizations. Many 30-day hospital readmissions are preventable and risk factors should be addressed while patients are still engaged in the community, for example, when they are receiving care in HH (Acharya, Laeeq, Carmody, & Lown, 2016; Retrum, Boggs, Hersh, Wright, Main, Magid, & Allen, 2013; Shih, Buurman, Tynan-McKiernan, Tinetti, & Jenq, 2015).

Hospitals originally carried the sole burden of responsibility as the setting of focus in managing 30-day readmissions (CMS, 2015). Hospitals receive financial incentives or penalties depending on their performance on the 30-day readmission metric. According to *Hospital Compare*, a nationally, publicly-reported system that monitors the quality of care provided by Medicare-certified hospitals in the US, the average 30-day readmission rate was 15.3% of hospital discharges between July 1, 2015 and June 30, 2016 (Medicare.gov, 2018a). In HH, the national average 60-day readmission rate, also known as the 'acute care hospitalization measure,' was 15.9% of HH episodes between October 1, 2016 and September 30, 2017 (Medicare.gov, 2018b). Thirty-day hospital readmission monitoring in HH was not added to publicly, mandated reported outcomes until 2015 (Acumen, 2017; CMS, 2017). The national average 30-day readmission rate in HH has yet to be publicly posted by *Home Health Compare*, a system similar to *Hospital Compare*, that monitors the quality of care in HH.

Home health has a growing body of published evidence about 30-day and other timelines to hospital readmission from the HH setting, however, the science is not nearly as mature as the body of published evidence about readmission of any timeline in inpatient settings. This paucity of evidence, regulatory, non-regulatory and scientific, limits accurate prediction of the influence of HH-specific variables on the 30-day hospital readmission metric. Furthermore, HH-specific variables have not been well-defined or consistently named in the extant HH literature. We cannot assume that while hospital and HH settings share the same patients, the risks, determinants of readmissions and preventative interventions are also the same. Further research needs to be conducted in order to test the significance of HH-specific variables on the 30-day and other timelines to hospital readmission phenomenon. Until then, HH organizations, clinicians and even policy-makers continue to drive their assumptions, attention, and care plans derived from hospital-based studies and regulatory publications often derived from claims data instead of from a larger scientific body of HH studies. There is a need for further elucidation of HH-specific variables that reflect HH operations, functions and decisions that may or may not affect 30-day hospital readmission.

Home health operations include actions that are overtly accessible to administrators and clinicians. If HH operations have impact on hospital readmissions, HH agencies should be able to make changes directly in order to improve readmission outcomes. Two examples of HH operations variables, which are not specifically driven by the CMS Outcomes Assessment Information Set (OASIS), are continuity of care and communications with primary providers. Low continuity of care in HH was found to be associated with increased rates of hospital readmission and emergency department utilization (Russell, Rosati, Rosenfeld, & Marren, 2011). Communication failures between HH nurses and physicians were found to increase the likelihood of 30-day hospital readmissions in patients with heart failure (Pesko, Gerber, Peng, & Press, 2017). These findings suggest that HH agencies operating with the best practices of care continuity and consistent communication with providers appear to have a greater possibility of reducing 30-day hospital readmission while patients are on HH services.

## Purpose of the Study

The purpose of this study is to examine the influence of HH operational variables on 30-day readmission to the hospital from HH. Home health operations variables are those within the purview of HH administrators and/or clinicians to influence change on an outcome. The study questions and related hypotheses are presented below.

Question 1: Do HH operations variables influence the outcome of 30-day hospital readmission from HH?

Hypothesis 1: HH operations variables do influence the outcome of 30-day hospital readmission from HH.

Questions 2: Is there as difference in timeliness of care between HH clients who were readmitted to the hospital and those who were not readmitted to the hospital?

Hypothesis 2: There is a difference in timeliness of care between HH clients who were readmitted to the hospital and those who were not readmitted to the hospital.

This study of HH operations is fairly unique in that several variables that reflect the daily clinical and administrative decisions in HH will be investigated for their unique and combined potential influence on 30-day readmission to the hospital from HH. Study findings may reveal a constellation of HH operational factors that work together to amplify or dampen the effect on 30-day readmission to the hospital from HH.

## Definition of Terms

The following definition of terms are relevant to this study. See Appendix A for a complete set of definitions of terms relevant to this study.

### Home Health

Home health refers to a Medicare-certified, skilled HH agency (CMS, 2011).

### Readmission

Readmission refers to a rehospitalization to a short-term, acute care hospital in a U.S. neighborhood of a single patient or cohort of patients while on service with HH (CMS, 2017; Horwitz et al., 2011)

### 30-day Hospital Readmission

Thirty-day hospital readmission is defined as the entire 30-day period from HH start of care (CMS, 2012; Horwitz et al.).

### Home Health Operations

Home health operations include actions that are overtly accessible to administrators and clinicians, specifically, start of care/resumption of care and timeliness of care. *Start of care* or *resumption of care* refers to the number of days between referral to and the start date in HH or the resumption of care date in HH after a hospitalization (CMS, 2011). *Timeliness of care* indicates a HH agency's ability to start or resume care within 48 hours or on the date ordered by the physician (CMS, 2011, 2018); it is one of the most heralded and regulated operations variables in HH practice.

## Assumptions of the Study

An assumption of the study is that evidence-based measures and regulatory measures, such as HH operations variables, can be deployed to suppress appropriately preventable 30-day hospital readmissions.

## Organization of the Dissertation Chapters

The dissertation is divided into six chapters: (I) introduction, (II) literature review, (III) conceptual lens, (IV) methodology, (V) results, and (VI) discussion. Following this introductory chapter is Chapter II, which is a description of a systematic literature review of hospital readmissions from Medicare-certified HH settings within 30 days and other timeframes. A concept analysis of 30-day hospital readmission within the context of the Medicare-certified HH setting is presented in Chapter III. Chapter IV is a description of the methodology used to examine the influence of HH operational indices on 30-day readmission to the hospital from HH. Presented in Chapter V are the results of the study. Chapter VI consists of a discussion of the findings, implications for HH and nursing practice, recommendations for further research, limitations and conclusions. Following Chapter VI are the appendices, including the University of California, San Francisco Institutional Review Board's approval letter to conduct the study.

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# CHAPTER II

# LITERATURE REVIEW

In this chapter, a 10-year lookback of evidence on hospital readmissions within 30 days and other timeframes from Medicare-certified home health (HH) settings in the United States (US) is presented. The purposes of this systematic literature review are to determine 30-day acute care hospital readmission rates while receiving HH services, and to describe risks and interventions to reduce 30-day readmissions to the hospital from HH. The chapter ends with identification of gaps in the literature and implications and recommendations for future practice, research and policy.

## Background and Significance

Reduction of 30-day hospital readmissions has been identified as having impact to Medicare-certified organizations' individual financial and quality metrics (Medicare Payment Advisory Committee [MedPAC], 2014; MedPAC, 2015; MedPAC 2016). Healthcare spending is projected to increase substantially through 2030 as the baby boomer generation ages in to Medicare (MedPAC, 2016). There, however, will be fewer working citizens per Medicare beneficiary paying into the Medicare Trust Fund through wage tax as baby boomers retire. These data motivated Centers for Medicare and Medicaid Services (CMS) to assert that 30-day hospital readmissions needed to be reduced, out of which outcome measures, regulations and financial penalties were created (CMS, 2015a; MedPAC, 2007; Stone & Hoffman, 2010).

Medicare claims data revealed four medical conditions, from highest to lowest burden, represented the highest hospital readmission cost-burden: heart failure, pneumonia, chronic obstructive pulmonary disease and acute myocardial infarction (MedPAC, 2007). In 2005, the total number of 15-day hospital readmissions for these four medical conditions equaled 237,885 readmissions for a total Medicare expenditure of $1.6 billion; 30-day readmission data were not reported. By 2013, these four medical conditions contributed $7 billion or 13% of aggregate spending due to 30-day readmissions, of which $5.2 billion was paid by Medicare after an index admission (Fingar & Washington, 2015). An index admission is an initial admission to an acute care hospital for specific diagnoses, including heart failure, pneumonia, chronic obstructive pulmonary disease and myocardial infarction, and so begins the subsequent 30-day all-cause readmission measure at discharge. In addition to the aforementioned four diagnoses, the current list of eligible index admissions also includes stroke, coronary-artery bypass graft surgery, and joint arthroscopies for knee and hip (CMS, 2015b).

The addition of post-acute care organizations being monitored for their effect on 30-day hospital readmissions reflects a responsibility of collaboration in the partnership between post-acute care providers and hospitals to assist patients in remaining safely in the community as long as possible. In promoting this collaborative responsibility, federal-level innovative models to unify and align cross-setting measures have been added and developed. Home health value-based purchasing is one such measure; it reports a total performance score including a 30-day hospital readmission rate (CMS, 2015c; MedPAC, 2017). Furthermore, the IMPACT Act of 2014 requires cross-setting data standardization among post-acute care facilities (CMS, 2015d).

In addition to regulatory mandates, Medicare continues to exert financial outcomes on hospitals, such as penalties for 30-day readmissions, for an estimated $428 million in 2013 (Rau, 2014) and $420 million in 2014 (Rau, 2015). In each of these years, the number of penalties were delivered to greater than half of U.S. hospitals. While some well-performing hospitals received adjusted upward payment on the 30-day readmission metric, most hospitals received penalties. In its report to Congress, MedPAC (2017) suggested a unified prospective payment system revision for four post-acute settings (skilled nursing facilities, home health agencies, long-term care hospitals, and inpatient rehabilitation facilities) based on patient characteristics and episodes of care. The MedPAC also suggested continue consideration for value-based purchasing that connects payments, incentives and penalties to quality outcomes. The revisions to the *Medicare Conditions of Participation* for HH agencies (CMS, 2017a) stipulate increased rigor in quality improvement and specify that the governing body for each agency ensures the complexity of all services and outcomes including “use of emergent care services, hospital admissions and re-admissions” (section 484.65, p. 4582).

## Overview of Home Health

Presentation of some purposefully-chosen state and federal regulations guiding HH is important for clarity and context regarding the exploratory nature and objectives of this systematic review. Home health is a substantially regulated setting on the state and federal levels and is dependent on several functions going well to succeed. Home health is required to coordinate care with primary providers in the community and depends on them to be responsive when contacted for reports, orders and signatures on regulated documentation (CMS, 2011). Care must also be coordinated with patients and caregivers and depends on their involvement to succeed (CMS, 2017b). The type of HH services discussed in this chapter are Medicare-certified, skilled HH agencies. The CMS (2011, 2012a, 2012b, 2014, 2017b, 2017c) mandates the following for clients being referred to HH and for HH organizations: need for intermittent, short-term care; need for goals to ultimately be achievable to work toward discharge from services; care is coordinated, ordered and signed by a physician every 60 days (60 days = one episode of care); certification document must be signed before HH start-of-care, referred to as a face-to-face encounter requirement, and must explain the skilled care to be provided by HH and the reasons that the client is functionally homebound. In addition, clients must be admitted to the HH service within 48 hours of referral or return to home, whichever is most relevant, both at start of care, and if returning, to care after an interruption in service due to hospitalization.

Medical providers of HH care are not regular employees in HH agencies due to a potential conflict of interest for referrals and not being a reimbursable HH clinician; the exception is being a director, supervisor or medical director to the HH agency paid for specific work (CMS, 2011; CMS, 2017c). Medicare reimburses care provided by the following clinicians only if ordered by a physician:  registered nurse, licensed vocational nurse, registered physical therapist, certified physical therapy assistant, registered occupational therapist, certified occupational therapy assistant, speech language pathologist, licensed clinical social worker and certified home health aide. While there are stringent rules about the coordination of care and which discipline manages the case, these professionals must adhere to strict communication and collaboration techniques to maintain best client care practices (CMS, 2011).

There are non-regulatory considerations in the daily work-life of HH clinicians, such as not having a supply closet with extra supplies in the home if something is needed. Moving between homes and neighborhoods to meet productivity expectations requires a dependable method of transportation, the right addresses and phone numbers on the incoming referrals, and willingness of patients and caregivers to accept HH services. Traditionally, HH clients are not responsible for giving their own medications, making their meals or providing their wound or intravenous care while in the hospital. Once they return home, however, they must self-manage with or without the help of caregivers. If changes to the care plan are needed, those changes cannot be performed without a physician’s order (CMS, 2011). Yet, there can be delays in getting through to the appropriate physician for many reasons.  These factors demonstrate the need for HH substantiating its own, consistent body of evidence demonstrating what works, what does not work, environmental, operational and clinical variables that contribute to 30-day hospital readmissions from HH, and state-of-the-art innovations that can reduce burdens to the setting while keeping clients safe and well at home after an acute hospitalization.

## Methodology

The PRISMA guidelines were used to conduct this systematic literature review of Medicare readmissions evidence from the HH setting (Moher, Liberati, Tetzlaff, Altman & The PRISMA Group, 2009). Operational definitions that guided this literature review are presented below.

- *Readmission* refers to a rehospitalization to a short-term, acute care hospital in a U.S. neighborhood of a single patient or a cohort of patients while on service with HH, usually within 30 days (CMS, 2012a; Horwitz, Partovian, Zhenqiu, Herrin, Grady, Conover, et al., 2011).
- *Home health* refers to a Medicare-certified, skilled HH agency (CMS, 2011).
- *Episode of care* refers to the start of care (admission) per physician's order in 60-day episodes. A recertification order for continued care beyond 60 days can be ordered by a physician (CMS, 2017d).
- *Frontloading* refers to a technique of placing more home visits at the front of the episode of care proximal to the hospitalization. Currently, there is no set standard frequency or duration of visits qualifying as frontloading, however, there is implicit meaning that the number of visits would exceed usual care and be individualized for the needs of the patient (HHQI, 2016; O'Connor, Bowles, Feldman, St. Pierre, Jarrin, Shah, & Murtaugh, 2014). Visits can be frontloaded by way of multiple disciplines, not only nursing, tending

to the patient more frequently in the beginning of care; in short, frontloading is a short-term blast of care in hopes of capturing any risks, signs or symptoms that might exacerbate shortly after hospitalization.

**Selection of Studies: Search Strategy and Eligibility Screening**

The literature search was performed in a systematic, iterative fashion with a focus on 30-day hospital readmission from HH. EndNote was utilized to manage and sort the library of search results. A comprehensive list of search terms was developed after reading regulatory documents and healthcare newsfeeds on readmissions and reviewing 30-day readmissions studies, which mainly reflected hospital settings. Originally, the targeted readmission timeline was 30-day readmission from HH; however, the search results were not robust. Subsequently, the search was widened to any readmission time period. As previously discussed, HH data on 30-day readmission have been available for only about two years, and thus, the majority of HH publications have yet to reflect this specific outcome measure. Moreover, the most publicly-reported quality measure was 60-day acute care hospitalization. There are a large number of readmissions studies available, but the majority of studies stem from the hospital setting.

Several online indexed databases were used to identify studies on 30-day readmission from HH: PubMED, CINAHL, EMBASE and Research Gate. In addition, several websites that post regulatory documents about hospital readmission from HH were searched: CMS.gov and caretransitions.org. A manual search of publication references lists was also conducted. The following search terms, in combination and by hierarchy, were used to search the aforementioned electronic databases and websites: home health, home care, 30-day readmission, 30-day rehospitalization, readmission, rehospitalization, transitions of care, care transition, and discharge home. Each search term was run as a singular term and then again as a plural term. The initial search resulted in 11,820 records related to a setting other than HH, partially due to inaccuracy of the search term *home health*, which the database engine filtered as two separate words. Once duplications and non-conforming studies were removed, 6,092 records remained out of the 11,820 records.

A line-by-line review of the 6,092 records' title and, if needed, of the abstract occurred using the following inclusion criteria: study measured readmissions after initial hospitalizations with preference given to 30-day readmission timeline; study investigated readmissions for a chronic or acute disease process/surgical procedure/condition; study occurred in an HH setting; study was quantitative; study published within the last 10 years. Screening of the 6,092 records resulted in the exclusion 445 records, yielding 472 records for the next round of screening.

A second-level line-by-line review by title and abstract was performed on the 472 records. Inclusion criteria were the same as above with the additions of: study included reimbursable HH clinicians as the providers of care; study included adult Medicare patients; study conducted in the US; and, study reflected HH setting and operations rather than policy or evidence-based practice studies. In addition, studies were excluded if: study was not focused on clinical criteria; study involved genetics; study involved patients at home without HH; study involved payment, cost or insurance analysis; study focused on a discipline not reimbursable by Medicare in HH; and, study did not adequately consider readmissions in the design and analysis. Application of these inclusion and exclusion criteria resulted in 35 records for which the full-text articles were assessed for inclusion in the systematic literature review.

Of the 35 full-text articles reviewed, 16 studies were excluded based on the aforementioned eligibility criteria as well as the following additional criteria: study was a pilot study; study focused on informatics, electronic health records or analytics; study focused solely on psychometrics of a measurement tool; study involved multiple settings where untested interactions may have occurred; and, study focused quality improvement. Nineteen studies were included in the systematic literature review (see Table 1 and Figure 1).

*Table 1. Results of the Literature Search Process*

| Search Terms | Results | Source | Filters |
|---|---|---|---|
| Home health readmission(s)[a] | 2,291 | • PubMED<br>• Embase<br>• CINAHL<br>• Research Gate<br>• Care Transition Intervention (caretransitions.org)<br>• Google search<br>• CMS.gov<br>• Manual search of publication references lists | • English language<br>• Humans<br>• Adults ≥ 18 years<br>• 2006 to April 2017<br>• Any country |
| Home health rehospitalization(s) | 371 | | |
| Home health 30-day readmission(s) | 585 | | |
| Home health 30-day rehospitalization(s) | 314 | | |
| Home care readmission(s) | 3,293 | | |
| Home care rehospitalization(s) | 883 | | |
| Home care 30-day readmission(s) | 840 | | |
| Home care 30-day rehospitalization(s) | 362 | | |
| Discharge home 30-day readmission(s) | 650 | | |
| Discharge home 30-day rehospitalization(s) | 55 | | |
| Discharge home rehospitalization(s) | 277 | | |
| Discharge home readmission(s) | 2,717 | | |
| Transitions of care home readmission(s) | 907 | | |
| Transitions of care home rehospitalization(s) | 257 | | |
| Care transitions readmission(s) | 963 | | |
| Care transitions rehospitalization(s) | 192 | | |
| 30-day readmission(s) from home | 771 | | |
| 30-day rehospitalization(s) from home | 66 | | |
| Other sources: transitions of care, home health quality measures and specific author names | 20 | | |
| | | | |
| Records identified | 15,814 | | |
| Records after errant removal[b] | 11,820 | | |
| Records after duplicative removal[c] | 6,092 | | |
| Records screened[d] | 472 | | |
| Articles reviewed[e] | 35 | | |
| Articles included in the review | 19 | | |

[a]Search term run as a singular term and then again as a plural term. [b]After removal of errant search results, such as pediatrics or maternity. [c]After removal of duplications. [d]Relevant to home health and readmissions. [e]Met study eligibility criteria.

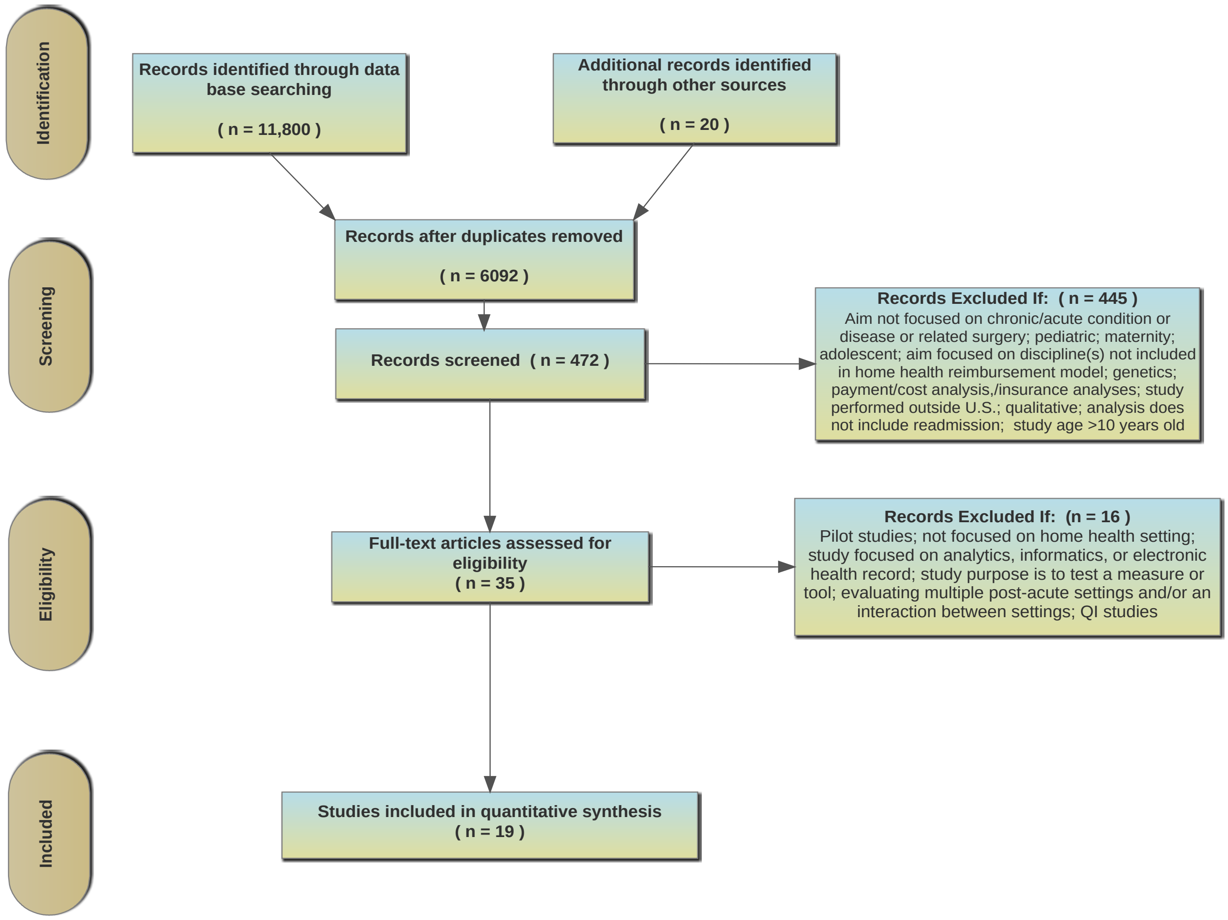


*Figure 1*. PRISMA flow diagram of selection of studies

## Results

Each of the 19 studies were read, critiqued, summarized and/or synthesized by two reviewers. Results are organized and will be presented to align with the twofold purpose of the systematic literature review: (a) determine 30-day acute hospital readmission rates while on service with HH, and (b) describe risk factors and interventions to reduce 30-day hospital readmissions from the HH setting, including what was shown to work and not to work.

### Study Characteristics

See Table 2 at the end of the chapter for a summary of the studies' major characteristics: citation, purpose, design, theoretical underpinning, sample, setting, variables, findings and conclusions. The sample of studies reviewed included five randomized-controlled trials, one prospective cohort study, two quasi-experimental studies and 11 retrospective secondary analyses. All reviewed studies contained an adult HH Medicare sample, involved the HH setting, and investigated acute hospital readmissions. Except where noted, a majority of the studies were not underpinned by an explicitly stated theoretical framework. The major types of HH interventions evaluated in the studies were usual care, telehealth, telemonitoring, phone visits, depression CAREPATH, palliative care, restorative care, frontloaded visits, continuity of care, type of caregiver, healthcare provider communication, and intensity of visit (see Table 3 at the end of the chapter). These interventions are believed to reduce hospital readmissions (Home Health Quality Improvement [HHQI], 2016; Health Services Advisory Group [HSAG], 2015; CMS, 2017a). The primary dependent/outcome variable was 30-, 60- and/or 90-day hospital readmission and one to 10 main independent/predictor variables were assessed in the studies (see Table 4 at the end of the chapter). The main independent/predictor variables included patient sociodemographic and clinical health characteristics, number of HH visits, emergency department visits, patient satisfaction, self-care, activities of daily living, quality of life, mental health (e.g., dementia, depression, etc.), and nurse/physician contact.

Considering the enormous range of factors that could influence the HH setting and patient population, the number of variables assessed in the 19 studies was surprisingly low, although not unexpected given that until January 2015, the HH industry did not track and monitor hospital readmissions in the manner that is currently mandated. In addition, several known HH variables that could affect hospital readmission were not included in the studies or were included in a limited number of studies: pre-discharge introduction to HH services ($n$ = 0), 48-hour admission to HH ($n$ = 1), care coordination among HH team members ($n$ = 1), weekend

HH visits the first two weekends after a hospital discharge ($n$ = 0), and recertification for another 60 days on HH service ($n$ = 1). Pre-discharge introduction to HH services, 48-hour HH admission and weekend HH visits are part of the Enhanced Home Health Program's Seven Touchpoints© (Health Services Advisory Group [HSAG], 2015). See Figure 2. This program is in the public domain and was piloted within the last 10 years by a few U.S. hospitals (Bodie, 2014), including Cedars-Sinai (2013) in Southern California. Published scientific studies testing the program, however, were not found in the literature.

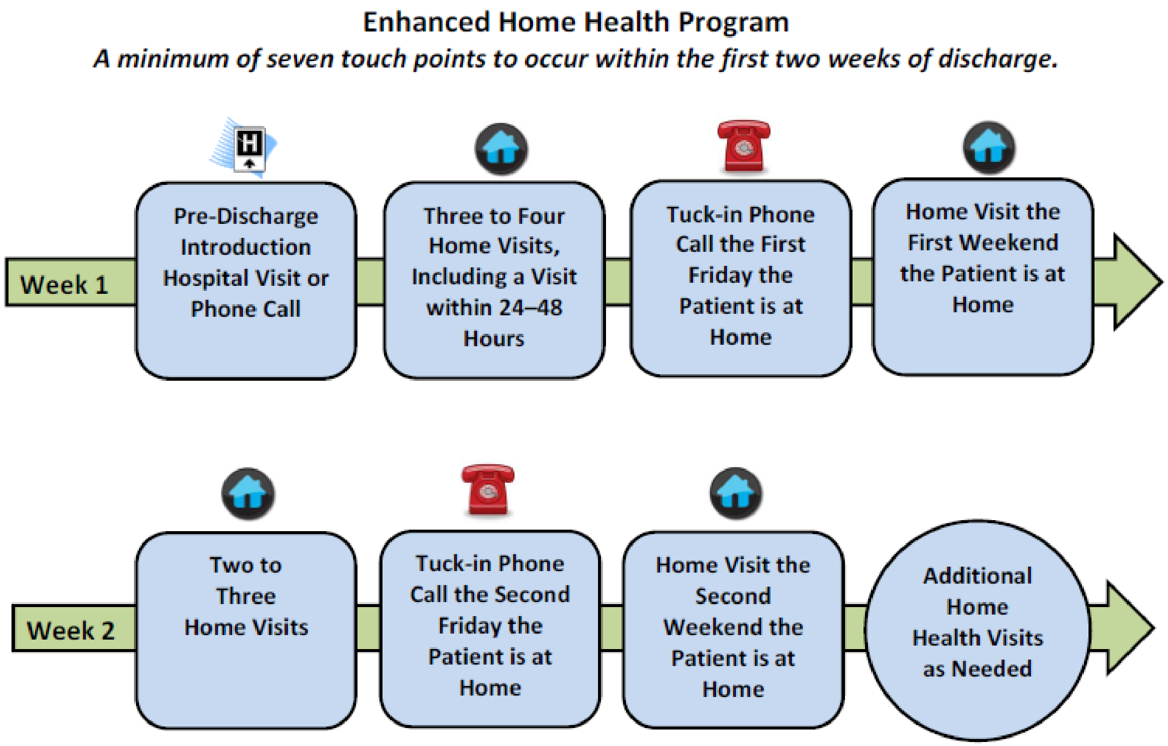


*Figure 2*. Enhanced Home Health Program's Seven Touchpoints©. This figure is in the public domain and was prepared by Health Services Advisory Group, a Medicare Quality Improvement Organization for California under contract with the CMC, from material originally prepared by Cedars-Sinai Health System. Publication No. CA-11SOW-C.3-03312015-01.

**Home Health Interventions Effect on the Prevalence of Hospital Readmissions**

Two prospective studies found a statistically significant reduction in hospital readmissions. Bruce, Lohman, Greenberg, Bao & Raue (2016) and Ranganathan, Dougherty, Waite & Casarett (2013) conducted prospective studies that tested a specialized HH intervention: depression CAREPATH and palliative care delivered by a hospice care team, respectively. Each study had a large sample ($n$ = 755 and $n$ = 1282, respectively) and utilized statistical methods that controlled for confounders. Bruce et al. (2016) found that depressed patients in the CAREPATH program had a relative hazard (HR) of being readmitted that was 35% lower within 30 days of starting HH ($HR$ = .65; $p$ = .01) and 28% lower within 60 days ($HR$ = .72; $p$ = .03). Ranganathan et al. (2013) found that with propensity score matching for severity of patient condition, palliative care HH patients had a 9.1% probability of readmission compared to 17.2% of usual care HH patients. The mean average treatment effect (ATT) was 8.3% (95% CI: 8.0, 8.6). Both studies have limited generalization. CAREPATH might be prohibitive for use in agencies with pre-existing depression protocols embedded in their electronic health record systems, as there can be significant cost and technical issues in transitioning to a new clinical pathway. The palliative care program was operated by a hospice program with an Inter-disciplinary Conference Team, which is not a usual capability for HH agencies.

Two retrospective, secondary analysis studies reported a statistically significant reduction in hospital readmissions. Russell and colleagues (2011) investigated a continuity of care protocol on hospital readmission. Results demonstrated patients receiving low continuity of nursing care had a greater risk of readmission than patients receiving high continuity of nursing care ($OR$ = 1.43, *95% CI* [1.35-1.50], $p$ <.001). The time to readmission was not reported. Neither clinical considerations, such as seriously ill or frail patients, high-frequency patients in need of IV or wound care, nor differentiation between continuity of care and type of therapy were considered in the analyses. Guided by Andersen's Behavioral Health Model, Murtaugh, Deb and colleagues (2016) investigated four levels of patient contact with HH nurses and physicians in the immediate time frame after initial hospitalization, using multiple national datasets. Results were statistically significant for reduced probability of 30-day readmission with both high intensity nursing visits and physician appointment within one week of hospitalization. The chances of readmission in the dual-contact group was 7.8 percentage points lower than in the no contact group (*95% CI*: [-11.59, -3.95], $p$ =.006). This study was limited to heart failure patients.

Nine studies (47%) showed no statistically significant reduction in hospital readmissions from HH. Four of the nine studies investigated telemonitoring in HH and were prospective, randomized-controlled studies (Bowles, Hanlon, Glick, Naylor, O'Connor, Riegel et al., 2011; Bowles, Holland, & Horowitz, 2009; Hoban, Fedor, Reeder, & Chernick, 2013; Madigan, Schmotzer, Struk, DiCarlo, Kikano, Piña & Boxer, 2013). One study showed that receiving HH (24.3%) as compared to not receiving HH (19.8%) was a statistically significant predictor of increased 30-day readmissions to the hospital for severe reasons, but not for non-severe reasons, in the recovery period at home after pancreatectomy (Sanford, Olsen, Bommarito, Shah, Fields, Hawkins, et al., 2014). Two studies investigated the effect of frontloaded HH visits: one of which was a non-randomized, prospective design (Rogers, Perlic, & Madigan, 2007) and the other study was a secondary analysis (O'Connor, Hanlon, & Bowles, 2014). Using a prospective, non-randomized study design, Tinetti and colleagues (2012) examined the effect of a Restorative Model of Care on hospital readmission, and Cho (2007) examined the effect non-professional caregivers on hospital readmission, using secondary analysis. Sample sizes ranged widely between 80 and 770 participants in the prospective studies and between 9,832 and 44,892 participants in the retrospective studies. While the results of a majority of the studies had significance and value for HH implications, methodological issues may have contributed to the lack of statistical significance. For instance, the interaction effects between home visit frequency or medications and telemonitoring could have been examined. Weighting or matching for participant level data (acuity) or clinical level data (nurse or physician visit) might have yielded different hospital readmission results for the frontloading HH visit or restorative HH visit interventions.

Eight studies included only patients with a heart failure diagnosis. Only two of the eight studies demonstrated statistically significant reductions in hospital readmissions (Murtaugh et al., 2016; Pesko et al., 2017). Secondary analyses of multiple datasets were performed in both studies. Pesko and colleagues studied nurse-to-physician communication and purposefully selected cases where at least one communication between nurse and physician had occurred. The sample was well-sized ($n$ = 2,680). The researchers independently developed three levels of equations to analyze nurse-physician communication failures on hospital readmissions, controlling for clinician, hospital and patient characteristics. Communication failures were associated with a 7.9% likelihood of readmission for heart failure patients during the HH plan of care compared to no communication failures ($p$ = .01). Murtaugh and colleagues (2016) compared heart failure patients who received intensive HH care at the start of care and physician follow-up within a week of hospital discharge to their counterparts receiving usual HH care ($n$ = 98,730). Separately, intense HH care and physician follow-up within one week did not demonstrate statistically significant effects on readmission reduction; however, when combined, their effect reduced the probability of 30-day all cause readmission for heart failure patients by 8 percentage points ($p$ <.001). Findings of both studies suggest compelling results that intensive coordination of care with involvement of the primary provider could contribute to reduced hospital readmissions for heart failure patients in the HH setting. Findings also demonstrate the value of having advanced statistical knowledge on a research team to create tailored equations and prediction models.

Five studies tested the effect of a telemonitoring intervention on hospital readmissions from HH. Of the five studies, four studies were comprised of patients with heart failure (Bowles, et al., 2011; Hoban et al., 2013; Madigan et al., 2013; Thomason, Hawkins, Perkins, Hamilton & Nelson, 2015). The other study compared telemonitoring with a simple phone intervention and usual care in the general HH population (Bowles et al., 2009). Although there was a difference in readmission between telemonitored and non-telemonitored groups, the difference was not statistically significant in none of the five telemonitoring studies. Bowles et al. (2011) demonstrated a 3% delta in 30-day readmission between the control group (19%) and the telemonitored group (16%). Hoban and colleagues (2013) showed a 5% delta in 60-day readmission between the control group (7.5%) and the telemonitored group (2.5%), and a 10% greater rate of zero-readmission during the 90-day study period for the telemonitored group. Although not statistically significant, these potentially clinical and operational significant differences may contribute to aggregate decreases in hospital readmission rates and associated cost reductions.

Three of the five telemonitoring studies reported a statistically significant greater number of home visits (Bowles et al., 2009, 2011; Madigan et al., 2013), better self-rated health (Madigan et al., 2013), improved interactions with family members (Hoban, et al., 2013), greater number of phone calls to primary providers (Madigan et al., 2013), a greater hospital length of stay (Bowles et al., 2011), and more recertifications (Bowles et al., 2011) among patients receiving telemonitoring as compared to patients who did not receive telemonitoring. In addition, telemonitored patients had better self-management skills especially around medications and diet (Bowles et al., 2009; Hoban et al., 2013; Madigan et al., 2013) and were three times more likely than non-telemonitored patients to perceive they received the right amount of care (Bowles et al., 2011). Unexpectedly, more depressive symptomatology was greater in telemonitored patients than in non-telemonitored patients (Bowles et al., 2009). The researchers were surprised by the depression finding and made a further research recommendation to examine depressive symptomatology in HH patients who are telemonitored.

Three studies did not describe the statistical methods employed, disallowing a full critique of data analyses. Although Hoban and colleagues (2013) reported that self-care behavior improved significantly in the telemonitored group of HH patients with heart failure as compared to their non-telemonitored counterparts and there was no statistically significance difference in hospital readmission between the two groups, a description of the statistical procedures computed were not described. Only a simple count of readmissions to the hospital was displayed for each group (12 in the non-telemonitored group and 9 in the telemonitored group). In one of these three studies, the prevalence of hospital readmission was reported as 20.4% and comorbidities, prognosis and medication complexity was significantly worse in the readmitted group as compared to the non-readmitted group, but the statistical procedures were not described (Dierich, Mueller, & Westra, 2011). In the study by Thomason and colleagues (2015), the prevalence of hospital readmission was reported for both the telehealth (10%) and non-telehealth (19.7%) groups, but no significance testing was reported for the difference in hospital readmission between the two groups.

**Risks Associated with Hospital Readmission from Home Health**

Although 10 of the 19 studies specifically sought to identify risks or factors contributing to hospital readmissions from HH, all reviewed studies reported risks or factors relating to readmissions from HH. For each of the 19 studies, each statistically significant association between readmission and a particular predictor, covariate or independent/intervention variable was counted as one. Then, the total count was tallied to provide a sense of which variables consistently (defined as two or more studies) showed a statistically significant association with readmission (see Figure 3). The five most frequently described risks significantly associated with hospital readmission from HH are listed below.

- Heart failure (as a primary diagnosis or co-morbidity)
- Number of home visits (more visits)
- Co-morbidities (increased number of secondary diagnoses or co-morbidities)
- Depression (more depressive symptomatology)
- Age (most often less than 85 years)

Predictors, covariates or independent variables found to be significantly associated with readmission in only one study were not included in Figure 3. These variables were anxiety, quality of life, self-management disability, depression CAREPATH model, palliative care model, use of tubes (intravenous, parenteral nutrition and urinary catheter), severe pain, pancreatectomy after-care in HH, post-operative hospital length of stay, caregivers, consistency of care, living alone, smoking, oxygen use, falls and being at risk for falls, and functional status.

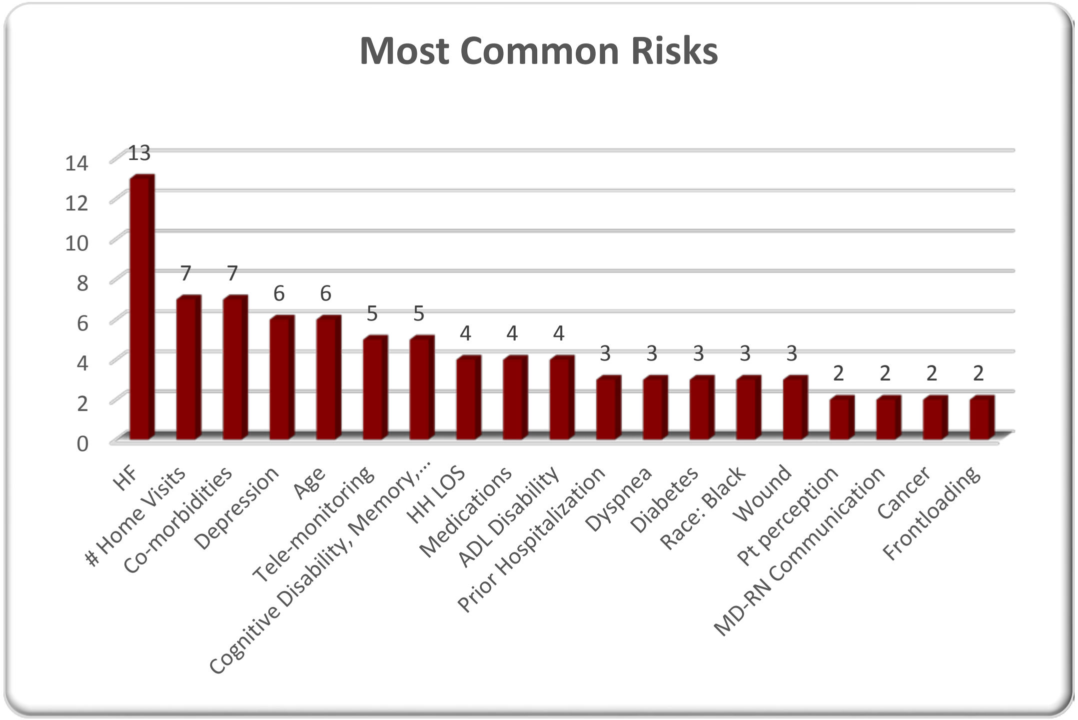


*Figure 3*. Distribution of risks significantly associated with hospital readmission from HH in two or more studies. ADL = activities of daily living. HF = heart failure. HH = home health. LOS = length of stay. MD = medical doctor. RN = registered nurse. Wound refers to either a pressure or stasis ulcer.

**Discussion**

The 19 reviewed studies provide useful information for HH regarding risks of hospital readmission from HH, successful interventions, interventions with marginal results, and even shed light on what is still missing. A discussion of the findings and recommendations are presented in this section and are organized around two overarching types of HH interventions that influenced hospital readmission from HH: telemonitoring, and coordination of care and communication.

**Telemonitoring**

The Home Health Quality Improvement Campaign (HHQI) (2016) suggests telemonitoring as one possible best practice toward reducing hospital readmissions from HH. Although there were reductions in readmissions across the reviewed telemonitoring studies, none of the reductions in readmissions were statistically significant between telemonitoring HH and usual care HH. These statistically insignificant reductions in readmissions, however, may have had potentially clinical and operational significance that may have contributed to aggregate decreases in hospital readmission rates and associated cost reductions with value-added in real-world operations. Furthermore, as compared to non-telemonitored HH patients, telemonitored HH patients experienced significantly more frequent phone calls with physicians (Madigan et al., 2013), improved interactions with family members (Hoban et al., 2013), more frequent home visits (Bowles et al., 2011), greater hospital length of stay (Bowles et al., 2011), more recertifications (Bowles et al., 2011), and greater perceptions that they felt they received the right amount of care (Bowles et al., 2011). Between patients and nurses, telemonitoring was shown to be a more intensive modality of monitoring leading to improved medication knowledge (Bowles et al., 2009).

Some of the aforementioned findings resulted in positive outcomes, which could cost the HH agency. It is unknown what the operational costs to HH agencies were regarding the telemonitoring protocols for any of the reviewed telemonitoring studies. Moreover, there were requirements of daily calls and managing the data stream into the website for patients monitored at home, as well as equipment costs.  The CMS (2017d, section 110) cautions HH agencies that telemonitoring is neither reimbursed by Medicare nor allowed to replace in-person skilled visits. Still, as demonstrated in this systematic review, telemonitoring remains a valid technique for remote monitoring with greater empirical abilities than a regular phone call, and in cases of escalating symptoms, can be a faster way to measure biomarkers to triage a patient. Future studies in honing more generalizable and reliable methods of deploying a successful telemonitoring program should consider the strengths and limitations of the reviewed telemonitoring studies, including the perspective of HH operations including costs.

**Coordination of Care and Communication**

The CMS (2011, 2017a) mandates that care be coordinated constantly among all team members, which includes the physicians external to the agency, the team within the agency, the patient and caregivers. Several researchers examined components of coordination of care and communication models on reducing hospital readmissions from HH. One model was restorative care, which focused on a shift in attitude and purpose from the clinicians to a patient- and family-centered approach in co-development of treatment goals (Tinetti, Charpentier, Gottschalk, & Baker, 2012). In the Restorative Model, care is multidisciplinary and communication amongst the team is paramount, including a contiguous report left in the home to communicate progress and changes in the care plan amongst all involved. This coordinated level of care increased the number of visits, but reduced readmissions; and while the readmission difference between those receiving and not receiving restorative care was not statistically significant, the operational significance is important: the 15 fewer readmissions reported equated to $108,000 in savings in 2005 Medicare dollars. The number of visits might have some short-term costs for agencies, however it demonstrates outward compliance with the Medicare Conditions of Participation for agency coordination of care among patients and physicians, with some tertiary results relating to positive perception of care. Other models found that physician-nurse communication failures (Pesko et al., 2017) and patients with a low continuity of nursing care (Russell, Rosati, Rosenfeld

& Marren, 2011) were predictors of increased hospital readmissions from HH, demonstrating the negative effects of healthcare provider communication failures and the protective effects of improved nursing care coordination.

The findings of this review related to increased coordination of care and communication having positive effects on reducing hospital readmissions in the HH setting are consistent with similar studies in the hospital setting that have shown reduced 30-day rehospitalization to be associated with care coordination and communication interventions such as home visits, phone calls, and timely clinic follow-up with a physician (Hansen, Young, Hinami, Leung, & Williams, 2011). Reasons for rehospitalization included patient frustration at HH care, at providers not explaining things well at discharge or at the addition of more medications (Acharya, Laeeq, Carmody, & Lown, 2016). One study found that primary providers and HH nurses believed the overarching causes of readmission were provider-level lack of involvement and lack of communication with the primary care provider (Shih, Tynan-McKiernan, Buurman, Tinetti, & Jeng, 2015). Consistent with other similar literature, previously discussed, the findings of this review indicate the importance of coordinating with patients as members of the team, as well as communications among healthcare professionals, in influencing readmissions reductions.

**Limitations**

The limitations of this systematic review include having a limited number of studies available from which to summarize and synthesize results of 30-day readmission from HH. There were fewer than expected significant results in suppressing readmission rates from HH demonstrated, and in some cases statistical analyses were limited in rigor or not reported. Heart failure being a strong indicator of readmission and being targeted by the CMS as a 30-day readmissions index hospitalization is frequently studied, leaving other disease processes and comorbidities not well investigated. Also, published HH research has not yet caught up to the newer 30-day readmission measure in fully examining real-time data.

**Recommendations and Implications**

Home health agencies need to improve their outcomes for readmissions, as well as prepare for possible penalty structures for excessive 30-day readmissions by CMS. However, there are several HH studies demonstrating positive effects on readmissions rates, as demonstrated in this systematic review. There may be inherent bias with studies conducted by researchers outside of the HH daily milieu in not understanding operational, clinical and patient variables. If patients streaming to HH have complex, unique or state of the art needs, there becomes an opportunity for best-practice care coordination and hand-overs of information during the referral process. One example would be defining severe and non-severe reasons for readmission by the referral source to enable HH clinicians to assess for those signs and symptoms and increase the chances of avoiding preventable readmissions. This is the level of detail that relates to care coordination, and even portions transitions of care models, that speak to hand-over communication and coordination as patients move between settings (Coleman, Parry, Chalmers, & Min, 2006; Naylor, 2012; Naylor, Brooten, Campbell, Jacobsen, Mezey, Pauly & Schwartz, 1999). We especially need to approach with caution the interpretations of studies conducted by researchers outside of the HH setting and assure that HH findings stem directly from the setting, preferably from HH researchers who are practiced with the regulatory underpinnings.

Medications are a known patient safety factor with high risk potential and there is a need to reconcile medications thoroughly (Institute for Safe Medicine Practices [ISMP], 2017; The Joint Commission, 2018; Institute for Healthcare Improvement [IHI], 2017). Medications were examined as a predictor of hospital readmission from HH in only four of the 19 studies included in the review (Bowles et al., 2009; Hoban et al., 2013; Chen, Popoola, Radhakrishnan, Suzuki, & Homan, 2015; Dierich et al., 2011). The lack of acknowledgement around medications and reconciliation practice in HH is concerning and warrants recommendation for future study. Several implications for further research stem from this review (see Table 5 at the end of the chapter). Without doubt, adding to the small body of independent research in HH is needed. Contributing and testing new operational variables in relation to clinical factors, and increasing the design and analytical rigor, is also needed to better understand HH readmissions reductions, particularly 30-day readmissions

## Conclusion

The HH setting is a highly-regulated setting by each state and CMS, with a revision to the Conditions of Participation set to deploy on July 13, 2017 (CMS, 2011; CMS, 2017b). Medicare-certified HH is experiencing increased responsibility to manage care quality and costs, which if done well would be beneficial for patients, HH organizations and for the Medicare Trust Fund. Readmissions from HH, especially the newer 30-day readmissions timeline, contain relevance to both quality and cost. This measure has been vastly studied and published for hospitals, however, HH has a small number of recent studies available from which to design evidence-based care planning and prediction modeling. The CMS tends to rely on claims analyses to develop policy targets (Acumen LLC, 2014; MedPAC, 2017). In fact, policy and regulation, based on claims and quality data, have changed so rapidly in the last few years that research looking back 10 years may already be losing relevance simply due to evolution of our healthcare system.

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Table 2

*Summary of the Studies' Major Characteristics*

| Citation | Purpose, Design, & Theory | Sample & Setting | Variables | Findings | Conclusions |
|---|---|---|---|---|---|
| Bowles, Holland, & Horowitz (2009) | Compare effect of evidence based disease management guidelines using telephone, telemonitoring and usual care.<br><br>Prospective, randomized control trial (unknown period) | 303 adult HH patients (112 usual care, 98 telemonitoring, and 93 telephone)<br><br>Four HH agencies in Pennsylvania (mostly rural) | IV: group (usual care, telemonitoring, or telephone)<br><br>DV: 60 day hospital readmission | • Adjusting for medical diagnosis and number of HH visits, there were no statistically significant differences in hospital readmission among the three groups. | Type of HH visit did not make a difference in 60 day hospital readmission for HH patients |
| Bowles, Hanlon, Glick, Naylor, O'Connor, Riegel, . . . Weiner (2011) | Assess the effect of substituting telehealth contacts for HH visits<br><br>Randomized controlled clinical trial (March 2006 November 2009) | 217 adult HF patients in HH (116 control and 101 intervention)<br><br>Large HH agency in Pennsylvania | IV: group (HH or telehealth)<br><br>Main DV: 30 day hospital readmission<br><br>Other DVs: time to readmission; time to death; # readmissions; # ED visits; # hospital days; # HH visits; and patient satisfaction | • No statistically significant difference in hospital readmission, time to readmission, time to death, # hospital days, and # ED visits between HH and telehealth groups<br>• Telehealth group had 3% fewer hospital readmissions than HH group (not statistically significant)<br>• As compared to the HH group, the telehealth group had significantly more visits, more recertifications for an additional 60 day episode of HH and spent more days on HH service<br>• Patients in both the HH and telehealth groups equally satisfied with adequacy of visits; however, a significantly greater proportion of the usual HH group (75%) reported they were discharged too soon as compared to telehealth group (25%) | There was no difference in 30 day readmission rates between HF patients who received telehealth and those who received HH visits |
| Hoban, Fedor, Reeder, & Chernick (2013) | Determine if there was a difference in hospital readmission, QOL and self care behaviors in HF patients receiving telemonitoring<br><br>Randomized controlled clinical trial (2009 2012) | 80 adult HF patients (40 control and 40 intervention)<br><br>Large, non profit HH agency in Pennsylvania (rural, suburban and urban) | IV: HH group (telemonitoring or no telemonitoring)<br><br>Main DV: 30 , 60 & 90 day hospital readmission<br><br>Other DVs: QOL; self care; and demographic and clinical characteristics | • Hospital readmission was not statistically significant between the telemonitored group and the not telemonitored group<br>• QOL was significantly improved in the telemonitored group compared to the not telemonitored group<br>• Self care behaviors (eating less, weighing self and family interactions) improved significantly in the telemonitored group compared to the not telemonitored group | Telemonitored patients had better QOL and self care behaviors than not telemonitored patients, but hospital readmission rates were similar between the two groups |

| Citation | Purpose, Design, & Theory | Sample & Setting | Variables | Findings | Conclusions |
|---|---|---|---|---|---|
| Madigan, Schmotzer, Struk, DiCarlo, Kikano, Piña, Boxer (2013) | Investigate older patients with HF in HH, and their time to combined endpoint (readmission, emergency dept., death) with telemonitoring<br><br>Prospective, randomized controlled trial | 99 adult HF patients (54 telemonitor and 45 usual care)<br><br>7 HH agencies in Ohio | IV: type of HH (telemonitor or usual care)<br><br>Main DV: hospital readmission<br><br>Other DVs: ED visit; death; self rated health; QOL; physician nurse contact; hospital length of stay; and HH visit | • Median time to combined readmission= 62 days (usual care), Median time to readmission = 60 days (telemonitoring); not statistically significant<br>• Telemonitoring group patients had significantly improved self rated health, more frequent physician nurse contacts and more HH visits than usual care group patients at follow up<br>• No statistical difference in QOL or hospital length of stay between the telemonitor and usual care groups at follow-up | Telemonitoring improved self rated health and coordination of care, but did not significantly lengthen time to endpoint (readmission, emergency department and death) |
| Bruce, Lohman, Greenberg, Bao, & (2016) | Investigate the effect of the Depression CARE for Patients at HOME (CAREPATH) intervention on hospital readmission in HH patients<br><br>Randomized control study, clustered geographically (period unknown) | 755 adult depressed HH patients<br><br>Six HH agencies from purposefully chosen areas across the U.S. | IV: group (CAREPATH intervention or usual HH)<br><br>Main DV: 30 & 60 day hospital readmission<br><br>Other DV: depression | · 18% of patients had 30 day hospital readmissions, which was statistically significant between the CAREPATH intervention group (15.5%) and the usual HH group (22%)<br>· There was no statistically significant difference in 60 day hospital readmission between the CAREPATH intervention group (23.5%) and the usual HH group (29.4%)<br>· Depression CAREPATH enhanced general HH nurses in fuller assessment & monitoring of depressed patients but did not show a difference between groups in improving mild depression | A HH intervention targeted for depressed patients led to reduced 30 day readmissions; however, there was no difference in 60 day hospital readmission between the control and intervention groups nor an improvement in mild depression symptoms |
| Ranganathan, Dougherty, Waite, & Casarett (2013) | Examine the impact of palliative HH on 30 day hospital readmission<br><br>Prospective cohort (unknown period) | 391 adult palliative HH patients and 890 adult routine HH patients<br><br>Three HH agencies in Pennsylvania | IV: type of service (palliative HH or routine HH)<br><br>DV: 30 day hospital readmission | • Chance of hospital readmission was 9.2% for palliative HH patients vs. 17.2% for routine HH patients | Palliative HH significantly reduced 30 day readmission as compared to routine HH |
| Tinetti, Charpentier, Gottschalk, & Baker (2012) | Compare frequency of hospital readmissions between usual HH vs restorative model of HH<br><br>Prospective, quasi experimental (November 1998 April 2000)<br><br>Chronic care model; behavioral change theory; Institute for Healthcare Improvement (IHI) | 682 adult patients (341 usual HH and 341 restorative HH)<br><br>Large HH agency in Connecticut | IV: group (usual HH or restorative HH)<br><br>DV: 30 day hospital re admission | • Difference in hospital readmission was not statistically significant between the restorative HH group (13.2%) and the usual HH group (17.6%) | Restorative HH may be a better model than usual HH in reducing 30 day hospital readmissions. While not statistically significant for 30 day readmission reduction, there was a 4.4% delta between groups with a $108K savings in 2005 Medicare dollars |

| Citation | Purpose, Design, & Theory | Sample & Setting | Variables | Findings | Conclusions |
|---|---|---|---|---|---|
| Rogers, Perlic, & Madigan (2007) | Test the effect of frontloading home visits on patient satisfaction, clinical and utilization outcomes<br><br>Prospective, quasi experimental (unknown period) | 330 adult patients (246 with HF and 84 with type 2 DM) | IV: frontloaded home visits (60% of planned visits in the first 2 weeks of the HH episode)<br><br>DV: hospital readmission | • HF patients with frontloaded home visits had significantly fewer hospital readmissions (15.8%) compared to those who did not receive frontloaded home visits (39.4%)<br>• There was no significant difference in hospital readmission between DM patients with frontloaded home visits and those without frontloaded home visits | Frontloading home visits yielded a reduction in hospital readmission for HF patients but not for DM patients |
| Sanford, Olsen, Bommarito, Shah, Fields, Hawkins, . . . & Linehan (2014) | Determine if discharge home with HH predicts increased hospital readmission after pancreatectomy.<br><br>Retrospective, secondary analysis of the Healthcare Cost & Utilization Project State Inpatient Database for California (2009 2011) | 3,573 adult patients who underwent pancreatectomy (readmission=752; no readmission=2821)<br><br>California | IV: discharge home with or without HH<br><br>DV: first 30 day hospital readmission (severe or non severe as measured by the propensity score)<br><br>Covariates: comorbidities; benign or malignant original diagnosis; and complications | • Significant relationship between hospital readmission (unadjusted for severity) and DM (OR=1.22; 95% CI, 1.02 1.47), hypertension (OR=1.28; 95% CI, 1.07 1.54), benign original diagnosis (OR=1.35; 95% CI, 1.11 1.64), and severe complications (OR=1.43; 95% CI, 1.10 1.86) and HH as an independent predictor (OR=1.37; 95% CI, 1.11 1.69)<br>• Patients discharged home with HH had a significantly increased rate of non severe readmission compared with those discharged home without HH (19.2% vs 13.9%), but not severe readmission (6.4% vs 4.7%) | HH services following pancreatomy was associated with increased 30 day non severe hospital readmissions, but not with non-severe hospital readmissions |
| Russell, Rosati, Rosenfeld, & Marren (2011) | Describe the level of continuity received in HH and assess the relationship between continuity of care (COC) and patient outcomes<br><br>Retrospective secondary analysis of OASIS (2008) | 59,354 HH visits (adults)<br><br>One large, urban skilled HH agency in New York | IV: COC: no continuity (0) to 100% continuity (1)<br><br>Main DV: hospital readmission<br><br>Other DVs: ED visit and ADLs | • Total HH visits per case: 2 to 461 (M=9; Md=6)<br>• COC: M=.54 (SD=.34); Md=.50<br>• High COC: 26% of patients<br>• Low COC: 10% of patients<br>• Patients with low COC significantly more likely to be hospitalized (OR=1.4), visit the ED (OR=1.3), and 20% less likely to have improved ADL function compared to those with high COC<br>• Patients with moderate COC 1.1 times more likely to be hospitalized or visit the ED than those with high COC; there were no differences in ADL function between the moderate & high COC patients | Low continuity of care in HH was associated with increased hospital readmission and ED utilization and decreased ADL functioning |

| Citation | Purpose, Design, & Theory | Sample & Setting | Variables | Findings | Conclusions |
|---|---|---|---|---|---|
| Cho (2007) | Examine differences in hospital readmission among HH patients with and without non professional caregivers<br><br>Secondary analysis of OASIS (6 months in 2002)<br><br>Social network theory | 9,832 adult HH patients<br><br>One large urban HH agency in New York | IV: type of caregiver (no caregiver, spouse/ significant other, daughter/son, other family member, or non relative caregiver/ paid helper)<br><br>DV: 60 day hospital readmission | • No statistically significant difference in hospital readmission among types of caregiver | Type of caregiver did not make a difference in 60 day hospital readmission for HH patients |
| Pesko, Gerber, Peng, & Press (2017) | Examine the relationship between communication failures in HH and hospital readmission<br><br>Retrospective secondary analysis of matched datasets: Visiting Nurse Services of New York OASIS and Medicare Beneficiary Annual Summary File (2008 2009) | 2,680 adult HH patients<br><br>Large, urban HH agency in New York | IV: communication failure (failures in communication between HH nurses and physicians)<br><br>DV: 30 day hospital readmission<br><br>Covariates: clinician, hospital and patient characteristics | • Among HF patients, communication failure was significantly associated with a 7.9% increased likelihood of hospital readmission<br>• Controlling for clinician, hospital and patient characteristics, there was a statistically significant 6% increased likelihood of hospital readmission for patients where there was a communication failure and the hospital readmission probability increased significantly for high risk patients (9.1%) where there was a communication failure | Communication failures between HH nurses and physicians increased the likelihood of 30-day hospital readmission in HH patients with HF, who were at high risk |
| Thomason, Hawkins, Perkins, Hamilton, & Nelson (2015) | Describe program and health outcomes of HH telehealth HF population<br><br>Retrospective chart review of OASIS (2010 2012) | 1,407 adult HF patients (1,337 non telehealth and 70 telehealth)<br><br>One, moderate sized HH agency in San Diego, California | IV: type of HH (telehealth or non telehealth)<br><br>DV: hospital readmission<br><br>Covariates: clinical and demographic characteristics; QOL; and self-care | • 264 non telehealth patients (19.7%) and 7 telehealth patients (10%) had hospital readmissions | Telemonitored patients had better QOL and self care behaviors than non telemonitored patients, but readmission rates were similar between the two groups |
| Chen, Popoola, Radhakrishnan, Suzuki, & Homan (2015) | Identify ambulatory care sensitive condition (ACSC) risks associated with 30 day hospital readmission in ambulatory care Medicare patients with DM in HH<br><br>Retrospective, secondary analysis of several national databases (2009)<br><br>Andersen's Behavioral Model of Health | 120,208 episodes of care with adult DM patients National sample | IV: intensity of HH visit<br><br>DV: 30 day hospital readmission<br><br>Covariates: clinical & demographics; quality of hospital care; hospital based HH; and, ADL | • 20% of sample had 30 day readmissions; 6% related to ACSCs<br>• Risks not significantly associated with ACSC hospital readmission: age 85+ years, Hispanic or other race, female, dual eligible, living alone, ADL function, comorbidities, and hospital based HH<br>• Risks significantly associated with ACSC hospital readmission: increased home visit intensity | Increased intensity of HH visits was associated with ACSC hospital readmissions |

| Citation | Purpose, Design, & Theory | Sample & Setting | Variables | Findings | Conclusions |
| --- | --- | --- | --- | --- | --- |
| Dierich, Mueller, & Westra (2011) | Describe the elder HH population admitted for acute hospitalization<br><br>Retrospective, secondary analysis of OASIS B1 dataset (2004) | 911 elderly HH patients<br><br>15 HH agencies in the Midwest and on the East Coast | IVs/predictors: comorbidity; prognosis; depression; memory; decision making; ED visit<br><br>DV: hospital readmission | • Hospital readmission 20.4% of sample<br>• Compared to non hospitalized patients, readmitted patients had significantly more comorbidity, prognosis of <6 months, greater incidence HF, DM, pressure ulcer, surgical wound and UTI treatment, greater depression, memory deficit and impaired decision making; more ED visits; and more prone to polypharmacy, PIM and medication complexity | Hospitalized elder HH patients were frailer, had more comorbidities, greater memory deficits and were on more complex and numerous medications compared to elders not hospitalized |
| O'Connor, Hanlon, & Bowles (2014) | Determine if frontloaded home visits (HV) was associated with lower 30 day hospital readmission<br><br>Retrospective secondary analysis using five different Medicare datasets (2009)<br><br>Quality Health Outcomes Model | 44,892 adult HH patients<br><br>National sample | IV: frontloaded HV (60% of the planned skilled nursing visits within the first 2 weeks of the HH episode); 60% ≥ 5 skilled nursing visits within 14 days of HH admission<br><br>Main DV: 30 day hospital readmission<br><br>Other DVs: ADL; depression; and high risk diagnoses | • Hospital readmission not statistically significant between frontloaded HH patients (1.8%) and non frontloaded HH patients (2.8%)<br>• Depressed patients significantly had a 94% greater chance of hospital readmission than those not depressed<br>• Patients with more high risk diagnoses significantly had a 17% greater chance of hospital readmission compared to those with less high risk diagnoses<br>• Patients with more bathing disability significantly had a 17% probability for hospital readmission vs those with less bathing disability | Frontloading HV did not lead to a reduction in hospital readmissions for HH patients |
| Murtaugh, Deb, Zhu, Peng, Barron, Shah,. . . Siu (2016) | Compare effectiveness of two treatments in reducing hospital readmissions<br><br>Retrospective cohort, secondary analysis of several national databases (July 2009 June 2010)<br><br>Andersen's Behavioral Model of Health | 98,730 adult HF related hospitalizations Large, urban HH agency in New York | IV: type of care: (a) early intensive HH nursing, (b) early physician visit, (c) both nurse & physician visits, or (d) no care<br><br>DV: 30 day hospital readmission | • Distribution of types of care: HH nursing (23%), physician visit (24.3%), nurse and physician visit (12.6%), and no visit (40.1%)<br>• The hospital readmission rate was 20.8% for the total sample<br>• Neither nurse nor physician visit had an effect on hospital readmission<br>• Having both nurse and physician visits significantly reduced probability of hospital readmission | Both nurse and physician visits may be important in reducing 30 day hospital readmission for HF patients receiving HH |

| Citation | Purpose, Design, & Theory | Sample & Setting | Variables | Findings | Conclusions |
|---|---|---|---|---|---|
| Madigan, Gordon, Fortinsky, Koroukian, Piña, & Riggs (2012) | Determine patient, HH agency and geographic factors related to 30 day readmission in a national sample of HF patients<br><br>Retrospective cohort, secondary analysis of several national databases (2005)<br><br>Andersen's Behavioral Model of Health | 74,580 adult HF related hospitalizations of HH patients<br><br>National sample | IVs/predictors: visit intensity and agency and geographical factors (organizational characteristics, clinical/patient characteristics, reasons for readmission)<br><br>DV: 30 day hospital readmission | • Hospital readmission rate 26%<br>• Mean time to readmission 13.6 days<br>• HF was the most frequent primary diagnosis of preventable readmission (34%)<br>• Most frequent secondary diagnoses of preventable readmission: HF (55%), HTN (34%) COPD (32%)<br>• Significant hospital readmission predictors: readmission history within last 6 months, age ≤ 85 years, poor prognosis, urinary continence (not incontinence), better cognitive functioning, physical therapy visits, female, HH aide visits and service from non hospital based HH agency | Readmission rate for the sample was 26% with mean time to readmission occurring before 30 days.<br><br>Factors related to preventable readmission were HF, HTN, COPD.<br><br>Several significant predictors of readmission were found. |
| Fortinsky, Madigan, Sheehan, Tullai McGuinness, & Kleppinger (2014) | Study factors observed at HH admission associated with hospital readmission<br><br>Retrospective cohort, secondary analysis of several national databases (2002)<br><br>Andersen's Behavioral Model of Health | 374,123 adult Medicare patients with a complete HH episode<br><br>National sample | IVs/predictors: demographics (predisposing); insurance (enabling); and healthcare utilization (need)<br><br>DV: hospital admission | • Hospital readmission rate 17.1%<br>• Top three predictors significantly associated with 10% or greater likelihood of hospital readmission: skin ulcer/wound (AOR=1.5), rehabilitation prognosis at start of HH (AOR=1.5), HF (AOR=1.2)<br>• Top three predictors significantly associated with a 10% or lower likelihood of hospital readmission: osteoarthritis (AOR=0.42), Asian (AOR=0.72), and HH agency located in U.S. West region (AOR=0.82) | Readmission rate for the sample was 17.1%. Several significant predictors of readmission were found, as well as predictors of lower readmission. |

*KEY - in alphabetical order:* ACSC = ambulatory care sensitive conditions; ADL = activities of daily living; AOR = adjusted odds ratio; CI = confidence interval; COC = continuity of care; COPD = chronic obstructive pulmonary disease; DM = diabetes mellitus; DV = dependent variable; HF = heart failure; HH = home health; HTN = hypertension; IV = independent variable; OASIS = outcome and assessment information set; OR = odds ratio; QOL = quality of life

Table 3

*Types of Home Health Interventions in the Reviewed Studies*

| | Usual Care | Telehealth | Depression CAREPATH | Palliative | Restorative | Frontloaded | Continuity of Care | Type of Caregiver[a] | Commun-ication | Intensity of Visit |
|---|---|---|---|---|---|---|---|---|---|---|
| Citation | | | | | | | | | | |
| Bowles et al. (2011) | x | x | | | | | | | | |
| Bowles et al. (2009) | x | x | | | | | | | | |
| Hoban et al. (2013) | x | x | | | | | | | | |
| Madigan et al. (2013) | x | x | | | | | | | | |
| Bruce et al. (2016) | x | | x | | | | | | | |
| Ranganathan et al. (2013) | x | | | x | | | | | | |
| Tinetti et al. (2012) | x | | | | x | | | | | |
| Rogers et al. (2007) | x | | | | | x | | | | |
| Sanford et al. (2014) | x | | | | | | | | | |
| Russell et al. (2011) | x | | | | | | x | | | |
| Cho (2007) | x | | | | | | | x | | |
| Pesko et al. (2017) | x | | | | | | | | x | |
| Thomason et al. (2015) | x | x | | | | | | | | |
| Chen et al. (2015) | x | | | | | | | | | x |
| Dierich et al. (2011) | x | | | | | | | | | |
| O'Connor et al. (2014) | x | | | | | x | | | | |
| Murtaugh et al. (2016) | x | | | | | | | x | | |
| Madigan et al. (2012) | x | | | | | | | x | | x |
| Fortinsky et al. (2014) | x | | | | | | | | | x |

[a]Caregiver was a professional (nurse or physician) or non-professional (family, friend or paid caregiver).

Table 4

*Outcome and Predictor Variables Assessed in the Reviewed Studies*

| | Outcome Variable | | Predictor Variable | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 days | 60/90 days | Personal/ Health Conditions | # of HH Visits | ED Visits | Patient Satisfaction | Self-care | ADL | Self-rated Health | QOL | Mental Health | RN/MD Contact |
| Citation | | | | | | | | | | | | |
| Bowles et al. (2011) | | x | x | x | | | | | | | | |
| Bowles et al. (2009) | x | | | | x | x | | | | | | |
| Hoban et al. (2013) | x | x | x | | | | x | | | | | |
| Madigan et al. (2013) | x | x | | | | | | | x | x | | x |
| Bruce et al. (2016) | x | x | | | | | | | | | x | |
| Ranganathan et al. (2013) | x | | | | | | | | | | | |
| Tinetti et al. (2012) | x | | | | | | | | | | | |
| Rogers et al. (2007) | x | x | x | | | | | | | | | |
| Sanford et al. (2014) | x | | x | | | | | | | | | |
| Russell et al. (2011) | x | x | | | x | | | x | | | | |
| Cho (2007) | | x | | | | | | | | | | |
| Pesko et al. (2017) | x | | x | | | | | x | | x | | x |
| Thomason et al. (2015) | x | x | x | | | | x | | | x | | |
| Chen et al. (2015) | x | | x | | | | | x | | | | |
| Dierich et al. (2011) | x | x | x | | x | | | | | | x | |
| O'Connor et al. (2014) | x | | x | | | | | x | | | x | |
| Murtaugh et al. (2016) | x | | | | | | | | | | | x |
| Madigan et al. (2012) | x | | x | x | | | | | | | | |
| Fortinsky et al. (2014) | x | x | x | x | | | | | | | | |

*Key - in alphabetical order:* ADL = activities of daily living; ED = emergency department; HH = home health; MD = medical doctor; QOL = quality of life; RN = registered nurse

Table 5
*Recommendations and Implications for Hospital Readmission from Home Health*

| Topic | Implication/Recommendation |
|---|---|
| Home health agency | There is insufficient research aimed at understanding a home health agency's operations and its effects on hospital readmissions. Managing cost should be highlighted moving forward, possibly even between bundled Accountable Care Organizations and private home health organizations. There is also a need to measure the cost effectiveness of home health operations versus cost savings in readmissions prevention. |
| Depression | Early signs and symptoms of depression should be assessed routinely in home health for escalation toward hospital readmission. Interventions or protocols, such as creating a risk profile, to prevent depression-related readmissions should be investigated. |
| Frailty or complexity | Home health does not assess patients for a distinct level of frailty or complexity. OASIS offers many assessment points that could possibly be combined to equate to a frailty index that might be better than the current M-item measuring hospital risks. |
| Telemonitoring | Examine the feasibility of telemonitoring in home health patients with other conditions besides heart failure. There may be a need to develop a possible visit-per-episode and triage rubric if telemonitoring continues to increase the number of home health visits needed and emergency department use. |
| Standing orders | Have individualized as-needed standing orders in place to act quickly for patients exhibiting early, exacerbating signs and symptoms. Further research is needed to examine the effectiveness of standing orders on prevention of hospital readmission from home health. |
| Transitions of care | There is a need to test the Transitions-of-Care Model from the receiving end in home health, follow out 30-60 days and discharge from home health. Most of the available data are on transitions of care from the hospital's perspective. How are hand-overs at the back end of care, and can home health adapt to some of the transitions-of-care guidelines such as advanced care nurses or transitions coaches? |
| Preventative models | Build and test practical models of readmissions prevention for home health. |
| Readmission prevention monitoring | Create an easy operational mechanism to measure prevented 30-day readmissions from home health. We focus on lowering the more easily verifiable endpoint of readmission; however, we do not have sight of home health competency in prevention. |
| Falls and associated injuries | The literature is insufficient on falls and related trajectories and predictors of falls, such as medications, in home health. Determine what constitutes an effective fall program in home health. |

| Topic | Implication/Recommendation |
| --- | --- |
| Sepsis | Determine sepsis-related predictors associated with readmissions from home health. Design, implement and evaluate interventions or protocols, such as a risk profile or frailty index, at start of care to identify their priority level and to prevent sepsis-related readmissions. Since 2017, CMS has begun to monitor hospital performance on sepsis and has added infection control to the Conditions of Participation for home health |
| Medications | Medications (high risk, polypharmacy, knowledge, self-management, caregiver competency, and reconciliation) are a well-known patient safety factor with implications for readmissions and as a moderator of coordination of care. |
| Enhanced Home Health Program, Seven Touchpoints (HSAG, 2015) | Use a randomized-controlled design to test the model’s real-world effectiveness on preventing readmissions from home health, including costs associated with its operation in home health. |

# CHAPTER III

# CONCEPTUAL ANALYSIS

Thirty-day readmission to the hospital has emerged as a consequential quality of care and financial outcome for which healthcare organizations, including home health (HH) agencies, in the United States (US) are mandated to monitor and manage in order to reduce costs due to preventable readmissions (Agency for Healthcare Research and Quality [AHRQ], 2015; Centers for Medicare and Medicaid Services [CMS], 2016a; Medicare Payment Advisory Committee [MedPAC], 2017; Minott, 2008; Stone, & Hoffman, 2010). Yet, the 30-day hospital readmission concept, within the context of the Medicare-certified HH setting, lacks clarity. As the HH industry seeks to revolutionize the way in which clients seek and receive care in HH, it should strive for a consensus meaning of the 30-day hospital readmission metric. Thus, a concept analysis of the 30-day hospital readmission phenomenon, within the context of the Medicare-certified HH setting, is presented in this chapter. In addition, implications toward the goal of a unified, standard definition of the 30-day hospital readmission from HH concept are provided.

## Methodology

The aims of this concept analysis and the uses, attributes, antecedents, consequences and exemplar cases of the 30-day hospital readmission from HH concept are discussed in accordance to the guidelines by Walker and Avant (2011). The concept analysis focuses on 30-day readmissions that occur for Medicare patients who are discharged from an acute care setting for any diagnosis or condition, are transitioned to a HH agency for post-acute care, and who are readmitted to an acute care hospital within 30 days of HH admission. The HH setting is defined as Medicare-certified HH agencies and their clinicians, delivering care on an intermittent basis to homebound clients having met regulatory eligibility for HH care (CMS, 2017a, 2017b). Hospital readmission, in particular 30-day readmission, is well-studied in the inpatient setting. There, however, are comparatively few studies on readmission to the hospital from the HH setting, making differentiating the nuances of 30-day readmission by setting, that is, hospital versus HH, practically impossible.

A literature search of studies that examined 30-day hospital readmission from HH was conducted using PubMed, CINAHL and EMBASE electronic databases and internet searches. In addition, policy documents from CMS, healthcare newsfeeds and contractor or government reports specific to 30-day readmission in the HH setting were reviewed. A literature review, limited to the last 10 years (January 2006 to March 2017), yielded 10 relevant studies for this concept analysis. The studies fall into four major categories: (a) descriptive studies seeking to discover information about the characteristics of hospital readmissions, (b) studies investigating the effects of strategies and interventions to reduce hospital readmissions, (c) systematic literature reviews about hospital readmissions, and (d) models published by regulatory or non-regulatory bodies describing methodologies to measure or control hospital readmissions. Operational definitions of 30-day readmission, which often were not provided in a majority of studies, typically were empirically-, financially- or population-based, using big data from CMS.

## Results

Results of the concept analysis are organized into four major sections: (a) aims of the concept analysis, (b) uses of the 30-day hospital readmission from HH concept, (c) attributes, antecedents and consequences of the 30-day hospital readmission from HH concept, and (d) exemplar cases of the 30-day hospital readmission from HH concept. Empirical referents of the 30-day hospital readmission from HH concept are based on the hospital literature, which is abundant compared to the sparse HH literature. This literature was used to inform and formulate a definition of the 30-day hospital readmission from HH concept. Three exemplar cases of the 30-day hospital readmission concept in the Medicare-certified HH setting are presented: a model case, a borderline case, and a contrary case.

**Aims of the Concept Analysis**

The aim of this concept analysis was to understand and provide clarity to the meaning of the 30-day hospital readmission from HH concept. Unlike the hospital setting, HH currently does not have a consensus meaning of, or rich literature related to, 30-day readmission. Yet, it is a measure that is now mandated by CMS to be monitored and publicly reported. The preponderance of data currently informing 30-day hospital readmission from HH is derived from HH Medicare claims data, or large datasets from the Outcome and Assessment Information Set (OASIS), and not from HH field studies; which unlike the hospital setting, does not have a very large, international current and ongoing body of literature about 30-day hospital readmission risks and interventions.

A concept analysis of 30-day hospital readmission from HH could provide greater clarity and form a taxonomy as a beginning foundation upon which to build for both research and evidence-based practice in the HH setting. The need for a clear understanding of 30-day hospital readmission from HH is essential and timely, given MedPAC's (2017) recent recommendation that HH and other post-acute care settings unify their payment structures, which may include penalties for poor quality outcomes. This recommendation compels HH agencies and their healthcare teams, to understand the meaning of the contributing patient, caregiver and healthcare drivers of the 30-day hospital readmission from HH concept, as well as to implement efforts to reduce preventable 30-day hospital readmissions from HH.

**Uses of the 30-day Hospital Readmission from Home Health Concept**

According to Walker and Avant (2011), exploration of the uses of a concept must be as inclusive as possible to demonstrate what it is and is not. *Admission* is the root of *readmission*. *Merriam-Webster Dictionary* (2015a) does not list *readmission* as a single term. The prefix *re* has several meanings depending on the form of speech:

- Re (noun) is the second note of a musical scale; the second tone of the diatonic scale in solmization which contains the notes do, re, mi, fa, so, la, ti; from the syllable sung in a hymn to Saint John the Baptist in Medieval Latin (first known use in the 14th century)
- Re (proposition) means on the subject of; regarding or concerning; with regard to
- RE (symbol) is the chemical element rhenium
- Re (prefix) means again and back. *Merriam-Webster* online provides a very long list of examples of words with the prefix *re-* including the words readmit and readmission.

*Admission* as a noun has several meanings:

- the act of admitting or allowing something
- a statement or action by which someone admits a weakness, fault
- the right or permission to enter a place
- the price of entrance
- the granting of an argument or position not fully proved
- acknowledgement that a fact or statement is true
- medical definition is the act or process (verb) of accepting someone into a hospital clinic, or other treatment facility as an inpatient; someone who is so admitted

- legal definition is the act or process (verb) of admitting (admitting into evidence); a party's acknowledgment that a fact or statement is true; a party's prior out-of-court statement or action that is inconsistent with his or her position at trial and that tends to establish guilt

Applicable synonyms of *admission* listed in the *Merriam-Webster Thesaurus* (2015b) included access, accession, entrance, admittance, entry, ingress, and entrée. Related words included approval, authorization, certification, permission and qualification. Antonyms included discharge, dismissal, ejection, expulsion, ouster, rejection and removal. In the healthcare vernacular, *admission* is often used as a verb, for instance "Dr. Brady is admitting Mrs. Tracy" or as an adjective to describe a patient (an *admitted* patient).

Combining the prefix *re* and the word *admission* creates the word, *readmission*, which has a different meaning and usage. One meaning of *readmission* could be right or permission to enter again or the right or permission to come back. Another meaning of *readmission* could be admitting again that a statement is true or readmitting something into evidence in court. In HH, *readmission* typically means a subsequent admission to HH or to the hospital. Thus, the setting should be specified for clarity in written and oral communications about *readmission*. For example, a HH supervisor might leave a voicemail for a clinician-employee to inform her or him that the patient was *readmitted to the hospital*. Not specifying the setting could lead to misinterpretation about where the patient was readmitted.

Other terms synonymous with *readmission* and used in healthcare are *rehospitalization* and *recidivism*. The noun *recidivism* means to relapse into a previous condition or behavior (Merriam-Webster, 2015a). Within healthcare, the meaning of *recidivism* is related to the exacerbation of a pre-existing disease or condition than the action of returning to the hospital for another inpatient stay. *Rehospitalization* as a single word was not listed in the *Merriam-Webster Dictionary*; it is a word created from the combination of the prefix *re* and the noun, *hospitalization*, which is derived from the verb *hospitalize*, meaning to place in the hospital as a patient (Merriam-Webster, 2015a).

In healthcare, *rehospitalization* or *readmission* means to place a patient in the hospital again. From the perspective of CMS (2015a), *readmission* is defined operationally as a two-midnight rule. This rule means that a hospital can consider a patient in its onsite emergency department or urgent clinic as being under observation instead of being readmitted to the hospital officially under Medicare if two midnights have not passed since the patient arrived. Under this rule, a physician has the right to determine a patient's need for hospital admission or readmission under Medicare Part A, even if the patient does not stay for two midnights. Moreover, an admission lasting less than two midnights should be rare and the reasons should be well-documented in order to be reimbursed by Medicare Part A. The two-midnight rule, including proper documentation, also applies to HH agencies transferring Medicare patients to the hospital for any reason after any length of time while on HH service.

*Admission* can be referred to as *index admission* by Medicare, defined as "any eligible admission to an acute care hospital assessed in the measure for the outcome (readmitted or not within 30-days)" (Horwitz et al., 2011, p. 6). An index admission is the starting point or initial admission that CMS has identified for health outcome and financial improvements. For certain high-risk diagnoses, 30-day readmission may be eligible simultaneously as both an index admission and a readmission when patients are hospitalized for multiple diagnostic reasons. Currently, hospital index admissions are defined operationally and based on the following diagnoses: acute myocardial infarction, heart failure, pneumonia, hip and knee joint replacements (together in one category), coronary bypass graft surgery, stroke and chronic obstructive pulmonary disease.

**Attributes, Antecedents and Consequences of the Concept: 30-day Readmission to the Hospital from Home Health**

**Attributes.** According to Walker and Avant (2011), "the best analyses refine the defining attributes to the fewest number that will still differentiate the concept of interest from surrounding concepts" (p. 162). A hospital readmission can occur at any time, for any reason, for a patient of any age and from any setting, location or living space. Readmissions are not predicated on payment by Medicare or any other insurance, despite regulations. The main attribute of the 30-day readmission from HH concept appears to be temporality. Dharmarajan and colleagues (2015) found that the readmission trajectory was a temporal process, meaning that it is conditional and may or may not occur if a condition is met or not met within a certain time period, such as 30 days. There are likely many events or antecedents that can occur and actions that can be taken between discharge from initial admission and 30-day readmission from HH. Thus, the 30-day window provides an opportunity to prevent or reduce readmission from HH if a HH agency can intervene during this time period to keep a patient at home if certain conditions are met.

Interventions that have been shown to reduce likelihood of readmission included telephone interactions (D'Amore, Murray, Powers, & Johnson, 2011), facilitated transitions of care (Naylor et al., 1999; Coleman, Parry, Chalmers & Min, 2006), social worker referral (Bronstein, Gould, Berkowitz, James, & Marks, 2015), nurse-physician contact (Pesko, Gerber, Peng, & Press, 2017), care continuity (Russell, Rosati, Rosenfeld, & Marren, 2011), telemonitoring (Bowles, Holland, & Horowitz, 2009), palliative care (Ranganathan, Dougherty, Waite, & Casarett, 2013), depression care (Bruce, Lohman, Greenberg, Bao, & Raue, 2016), frontloading home visits (Rogers, Perlic, & Madigan, 2007), and risk assessment (Home Health Quality Improvement National Campaign, 2016). Alternative care provision services also can reduce or prevent 30-day readmissions with reduced disruption to patients and their families. For example, Kaiser Permanente in Riverside, California piloted a program where eligible patients in the emergency department were offered the opportunity to receive hospital care at home instead of a 30-day hospital readmission ("Kaiser program brings," 2015). The program included home visiting physician care, intermittent nursing care, home intravenous medication if needed and other resources. Home health is set up to provide this type of alternative care coordination and in the absence of a physician on staff, coordinated care is performed with a patient's primary provider.

**Antecedents.** Antecedents to 30-day readmission from HH are events and factors, for example those listed below, that precede readmission, could not be managed from the home or outpatient setting, and are limited, but serious, and thus requires a hospital stay.

1. exacerbation of a pre-existing acute or chronic disease or condition or occurrence of a new event, referred to as a red flag (a stimulating factor)
2. after trying to self-manage a health problem, a patient or caregiver seeks care, in-person or by phone, of a primary provider (patient-level decision point to seek care)
3. a patient travels to a hospital emergency department or a primary provider's office because of a health problem (transport to medical care)
4. a patient's health history, physical and/or diagnostics indicate a health problem (assessment and determination of extent of the health problem)

5. a primary provider in the emergency department, clinic or private office makes an informed decision that a patient requires treatment beyond what can be provided at home (clinical decision for hospital readmission)

Patient-, provider- and systems-level antecedents of readmission have been described in the literature and could be used to conceptualize and map a trajectory such that prevention of readmission rather than rehospitalization for a disease or health condition would be the focus of intervention, where appropriate. Hebert and colleagues (2014) found that certain patient-mediated factors were associated with higher risk of readmission: polypharmacy, single marital status, recent history of hospitalization and emergency department use, and longer length-of-stay in the hospital. Certain patient diagnoses have also been found to contribute to increased 30-day readmissions (CMS, 2015b; Hebert et al., 2014; Hines, Barrett, Jiang, & Steiner, 2014).

Caregiver-mediated factors associated with readmission included no caregiver availability at home or insufficient caregiver involvement at the point of discharge (Coleman & Min, 2015). Provider- and systems-mediated factors associated with readmission included inadequate patient preparation for discharge from the hospital (Phytel, 2011); unsupported transitions of care due to lack of education provided to patients and caregivers after discharge from the hospital (Coleman & Min, 2015); and, inadequate transitions of care and hand-overs of information (Naylor, Aiken, Kurtzman, Olds, & Hirschman, 2011; Naylor, 2012).

Home health in and of itself has been found to be an antecedent of readmission. Topaz and colleagues (2015) found that hospitalized patients who refused post-acute services, such as HH, were twice as likely to be readmitted in 30 days compared to those who received post-acute services. Other factors that have been associated with readmissions were pain level, level of care, social support, depression, insurance coverage, end-of-life care, among others (Bruce et al., 2016; Ranganathan et al., 2013).

**Consequences.** Consequences of 30-day readmission from home occur after the patient is discharged from HH and are the sequelae to all of the care and attention received. Consequences to hospital readmission could be positive or negative. These include, but are not limited to wellness or improved condition, improved knowledge and self-management competency for the patient, and death. Another consequence of a readmission is the patient is now at risk for future hospital readmissions. Consequences also can occur on the organizational level, reflecting on a HH agency's quality and financial performance, whether or not publicly reported.

Taking into consideration the attributes, antecedents and consequences (see Table 6), the concept of 30-day hospital readmission from HH is not an end-point, but rather is an event that might happen, maybe repeatedly, can be prevented, is predicated on time passing and hinges on many patient, caregiver and system factors. The concept analysis indicates that the 30-day hospital readmission from HH concept is complex and multifactorial. It will require better knowledge of modifiable factors to harness effective and sustainable outcomes that reduce and prevent readmissions with specificity to the 30-day timeline, HH setting, and meaningful difference between patients who will and will not be readmitted.

The temporal trajectory for 30-day readmission within the hospital and HH settings is relatively undescribed in the literature, rather it is discussed as a point in time or single outcome. Although the research, practice and policy literature continue to emerge, much of the readmission studies were retrospective, hospital-based and from Medicare databases that often did not include patient-level and HH setting-operational variables.

**Exemplar Cases of the 30-day Readmission from Home Health Concept**

**Model case.** Model cases have all of the attributes of the concept (Walker & Avant, 2011). There are several possible model cases depending on the situation. In examining the 30-day readmission from HH concept as a temporal process that may or may not occur, readmissions can be avoidable or non-preventable. Non-preventable cases will always result in a readmission because the patient required that level of care and observation for his or her well-being. Avoidable cases can be influenced by any number of patient risks. A model case of readmission will have as many of the attributes in the example as possible; therefore, a non-preventable 30-day readmission from HH is posited in the case below.

> Mr. Green was 85 years of age, with multiple diagnoses including heart failure, history of myocardial infarction, complicated type 2 diabetes on insulin, atrial fibrillation on Coumadin, history of infection from his chronic diabetes neuropathic ulcer of the left foot, arthritis and gout. His level of pain at home is never self-reported to be lower than a level of 5 on a scale of 1 to 10. He is prescribed 18 daily medications with include high risk medications. He has trouble sleeping, is obese, has sleep apnea for which he uses a bi-pap machine attached to oxygen and describes many symptoms of depression but refuses to receive help or diagnostic evaluation. He does however admit to bouts of severe anxiety especially when alone or at night, for which he uses anti-anxiety medication. He has a girlfriend who lives in the home with him. Their relationship is strained by his medical needs and she is out of the home for 4-6 hours at a time, sometimes unpredictably, several days per week visiting her friends and family.

Mr. Green has been in and out of the hospital many times in the past year and a half. His last hospitalization lasted 7 days due to his wound infection needing debridement and heart failure exacerbation, after which home health started care. The HH nurse explained the care plan to Mr. Green, but he refused the next two nursing visits and physical therapy evaluation. This resulted in a trip to the emergency department without hospitalization because he was in severe pain and anxious that his condition was worsening. Mr. Green is a Medicare and Medicaid patient, and has been on HH service for 15 days. In attempting to get out of bed this morning, Mr. Green, in a lot of pain, feeling very angry and anxious, did not cooperate well with his girlfriend during transfer to wheelchair and they both fell to the ground. She was able to recover, stand and get to the phone to call 911. They did not contact the HH agency at all. She was treated as an outpatient and sent home within 8 hours with a belt to support her back. Mr. Green however was assessed to be in heart failure, sub-therapeutic for his Coumadin therapy, and sustained multiple injuries from the fall that required observation and surgical intervention. The decision to readmit him was approved by the emergency room attending physician, and a surgical consult was ordered.

**Borderline case.** Borderline cases have some but not all of the attributes of the concept and differ in at least one way from a model case (Walker & Avant, 2011). Below is an example of a borderline case of 30-day readmission to hospital from HH.

Mrs. Ketchum is a 76 year old, widowed patient with bipolar disorder, history of pneumonia and asthma, and has a smoking history of more than 20 years (up to 10 cigarettes per day). She lives with her sister in a private, suburban home. She has a long history of hospitalizations for various reasons, some psychiatric and some medical. Her last hospitalization was two years ago. She is a Medicare patient and has an inheritance from her Uncle that she and her sister share. They have a hired Senior Advocate who helps them with their bills and decisions. Mrs. Ketchum has 10 medications prescribed and is currently managing well with support from her sister and the Senior Advocate. Mrs. Ketchum has developed a fever, shortness of breath, productive cough and her anxiety is escalating. Her sister calls the Senior Advocate who makes a visit to their home daily for 3 days, then coordinates a clinic visit to see her Nurse Practitioner (NP). After a 45-minute appointment and meeting with the patient, sister and advocate, the NP and patient are in agreement that she should be admitted to HH for skilled nursing, medication management training. Mrs. Ketchum agrees that she could try to stay at home as long as HH assesses her a few times a week. One week later, during a nursing visit, the patient appears to be dyspneic and somewhat ashen color. The HH nurse coordinates with the NP and the patient; it is decided that an emergency department visit is required for chest x-ray. Mrs. Ketchum awaits further assessment, diagnosis and treatment in the emergency department, having not been waiting more than two midnights.

**Contrary case.** Contrary cases are clear examples where the attributes do not exist and the concept is not defined or exemplified by the case (Walker & Avant, 2011). Below is a contrary case of 30-day readmission to the hospital from HH.

Mr. Shue is 72 years of age and is very active. He still does consulting at his business part time, runs three days per week for two miles and is surrounded by an extended, loving family. Mr. Shue was hospitalized over 10 years ago for an elective surgery. He is an elder at his church and is very active with some local charities. He and his wife still are able to travel twice yearly to their second home at the beach. During one of these travels, Mr. Shue cuts his hand while chopping vegetables at dinner. He puts triple antibiotic ointment on the laceration and wraps his hand with gauze. He has no pain and decides that he does not need medical treatment.

**Empirical Referents of the 30-day Readmission from Home Health Concept**

Currently, many of the 30-day readmission empirical referents discussed are in relationship to the acute care setting. Patients who are readmitted to inpatient settings from the community within the stipulated 30-day period are counted against a hospital's outcome and penalty measures if they are readmitted after an index (or initial) admission for specific, high-cost diagnoses (CMS, 2015c). National hospital claims and assessment data primarily shape hospital-based, Medicare, 30-day readmission quality and penalty models (Horwitz et al., 2014; Hines et al., 2014; Kansagara, Englander, Salanitro, Kagen, Theobald, & Kripalani, 2011; MedPAC, 2007). Home health agencies are measured and reported publicly on *Home Health Compare* with 30-day readmissions and 60-day acute care hospitalizations both measured in a prior rolling year (Medicare.gov, 2017). On January 1, 2016, the CMS (2016b) began a value-based purchasing initiative for HH settings with 100% of HH agencies situated in nine states: Massachusetts, Maryland, North Carolina, Florida, Washington, Arizona, Iowa, Nebraska, and Tennessee. In the HH model, use of the current Outcomes and Assessment Information Set data and the Home Health Consumer Assessment of Healthcare Providers and Systems patient experience data, along with newly developed measures, will be combined to create an annual Total Performance Score; which will determine distribution of value-based payment adjustments so that the highest achieving HH agencies will receive the largest upward payment adjustment. The model is different in HH than it is in hospitals, however, the mission is the same: to create a competitive advantage among agencies to provide excellent and efficient care to better align payment strategies.  In 2019, Home health agencies will begin being measured and reported for readmissions to the hospital within 30-days post home health discharge (CMS, 2017).

## Conclusions and Implications

The 30-day hospital readmission concept is currently seen as an outcome of quality care, cost and efficiency for healthcare settings, primarily in hospitals, and reflects a return to the hospital after an initial inpatient stay. Healthcare personnel in hospitals, and HH especially, are compelled daily to consider how clinical decisions might affect organizational performance. Thirty-day hospital readmissions from HH can be avoidable if certain interventions are planned, recognizing that some 30-day readmissions are unavoidable. Expanding the concept attributes of the 30-day hospital readmission from HH as a trajectory, to include the temporal process within 30-days of start of care allows more patient, setting and operational attributes or variables to be factored into the plan of treatment for assessment and early intervention. This may be a more realistic and effective manner of defining the concept.

At the federal level, per CMS regulation through monitoring, public reporting and penalties for hospitals and HH, the 30-day readmission concept is simultaneously both a quality and financial measure and a 30-day period during which time HH is involved with a patient's care. If this concept is both an outcome and a process, it should not be defined and measured separately, but redefined and measured as a process and outcome simultaneously. To reduce avoidable 30-day readmissions from HH, a plan must not only be in place, but must also be implemented accordingly during the 30-day HH trajectory; hopefully, resulting in 30-day readmission reductions and preventable readmissions that benefit patients and HH agencies. The long-term outcome should be a return to wellness, independence or higher level of care for patients; and for agencies, the outcome is performance data that reflect their understanding and rigor regarding HH care.

As clinicians, researchers and policymakers, we need to consider development of a standard taxonomy representing 30-day readmission to the hospital from HH. In the literature, the timeframe from which readmission was measured often was not reported. For this concept analysis, an extensive literature search netted only 10 studies relating to HH with explicitly reported 30-day readmission timelines. Moreover, operational definitions for the readmission concept were often not reported. The setting from which a readmission occurred is important to note. As a community of scholars and clinicians, we must acknowledge the unique differences in attributes of readmissions between various healthcare settings, not only readmissions to an acute, short-term hospital setting. There is a need for a standard, common definition of 30-day readmission across healthcare settings in order to truly measure the effectiveness of interventions.

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Table 6

*Antecedents, Attributes and Consequences of the Concept: 30-day Readmission to the Hospital from Home Health (HH)*

| Variable | Antecedent | Attribute | Consequence |
|---|---|---|---|
| Prior ED Visit and/or Hospitalization | x | | |
| Transitional Period Between Hospital and HH | x | | |
| Patient Demographics | x | | |
| Co-Morbidities, Severity of Illness | x | | |
| Cardiac Conditions and Symptoms | x | | |
| Respiratory Conditions and Symptoms | x | | |
| Surgeries and Post-Operative Hospital Length of Stay | x | | |
| Cancer | x | | |
| Diabetes | x | | |
| Psycho-emotional Conditions and Symptoms | x | | |
| Cognitive Disability, Memory, Dementia | x | | |
| Wounds | x | | |
| Functional Disability and Fall History | x | | |
| Caregiver and Community Support | x | | |
| Pre-existing Tubes: Intravenous, Feeding, Catheter | x | | |
| Receipt of Vaccines | x | | |
| Home/Environmental Safety | | x | |
| Pain/Severe Pain | | x | |
| Nutrition/Diet | | x | |
| 48-Hour Admission by HH | | x | |
| Care Coordination and Communication | | x | |
| Self-Care, Self-Management | | x | |
| Medications/Medication Reconciliation | | x | |
| Phone Call Check-Ins | | x | |
| Telemonitoring | | x | |
| Number of Home Visits Made | | x | |
| Weekend HH Visits First 2 Weeks | | x | |
| Recertification | | x | |
| HH Length of Stay | | x | |
| Specialty Model of Care (e.g., palliative, depression) | | x | |
| Usual Home Health Care | | x | |
| Frontloading Visits | | x | |
| Discharge Disposition (from HH) | | | x |
| Patient Self-Rated Health, Quality of Life | | | x |
| Patient Perception of Care (CAHPS - HH & Hospital) | | | x |
| HH Agency 30-day Readmission Metrics (Public Reporting) | | | x |
| Hospital 30-day Readmission Metrics (Public Reporting) | | | x |
| Hospital 30-day Performance Penalty or Reward | | | x |
| Home Health Agency 30-day Performance Penalty or Reward (Future) | | | x |

# CHAPTER IV

# METHODOLOGY

This chapter describes the study design, methodology, variables of study and ethical considerations, used to examine the influence of home health (HH) operational, sociodemographic and clinical variables on 30-day readmission to the hospital, and readmission at any time, during HH services. Secondary analysis of data methodology was employed. A limited and de-identified secondary dataset from the electronic health record (EHR) of one northern California home health agency was the data source for this study. Primary research, in particular randomized-controlled studies, in HH settings can be expensive, not feasible and ethically challenging. Secondary analysis of data is the use of an original, primary dataset from which to draw a second sample for research to explore and test new hypotheses (Boslaugh, 2007; Cole & Trinh, 2017; Herron, 1989; Polit & Hungler, 1995). Secondary data can be obtained from any number of sources, including but not limited to primary or parent studies, EHR, administrative data stored from organizational use of software, such as a human resources platform or a web-based recruiting site, or large state and national datasets (Cordray, 2001; Coyer & Gallo, 2005). The type of secondary research methodology used in this study is distinctly different from the method of meta-analysis, which is a secondary analysis of results from published studies (Church, 2002).

## Study Design

The design of this non-experimental, retrospective study was descriptive and correlational. Secondary analysis served as an affordable and timely design with accessibility to both clinical and operational HH data. Studying the operational and clinical predictors of 30-day readmission, and readmission at any time, required access to at least two sources of data within home health, (a) Outcome and Assessment Information Set (OASIS) assessment scores to inform clinical, social and home health (HH) operational variables (CMS, 2017a) and (b) non-OASIS data to validate diagnoses, expand the number and type of operational variables including (but not limited to) doctors' orders, prognosis scores and code status. Secondary analysis methodology is inherently retrospective, and it was important to analyze the most recent data available, maintaining proximity to real-time. Home health settings, particularly Medicare-certified HH settings, are experiencing very dynamic, regulatory changes year-over-year with requirements to be survey-ready with performance improvement projects, and public-reporting on several outcomes relating to hospitalizations and readmissions (Acumen, 2017; CMS, 2017b; CMS, 2017c). There is need for additional evidence on predictors and solutions for readmissions reduction, as well as validation of previously named factors, that streams independently from HH organizations, as policy decisions and claims data do not sufficiently describe the model (CMS, 2017d).

The design was also a cohort design with one cohort not having experienced readmission to the hospital during HH services and the second cohort experiencing a readmission to the hospital during HH services. The time to readmission to the hospital during HH services was collected and analyzed for those participants having experienced a readmission. The study dates ranged from August 2016 to January 2018. All data was retrospective and the majority of participants were discharged from HH services (n=79, 99%), with one participant remaining on HH services due to medical condition and nursing needs. All episodes of care chosen for the study were fully completed as part of the eligibility criteria. Full eligibility criteria are discussed below. The research was performed as a dissertation requirement of the doctor of philosophy (Ph.D.) program at the University of California, San Francisco (UCSF) School of Nursing. The

UCSF Institutional Review Board (IRB) certified approval of exempt status for the dissertation research, on February 13, 2018 (see Appendix B).

**Setting, Sample Selection and Eligibility Screening**

A small, privately owned, northern California HH agency with an average daily census of 130 patients, agreed to provide a de-identified and limited dataset for the purposes of this study. The agency has been operating since 2010 and has been Medicare-certified since July 2013. The agency utilizes a web-based, Health Insurance Portability and Accountability Act (HIPAA) (Department of Health and Human Services (DHHS), 2013) protected EHR to document client information. The owner of the agency is a Ph.D. prepared registered nurse. Recruitment of participants was not necessary due to the convenience sample. Each cohort was sampled randomly from the dataset until n=80 was achieved. Participants were eligible in the study for age 64 years and older, having Outcome and Assessment Information Set (OASIS) assessments performed, had at least one completed HH episode on record in the study period, was on HH services for any length of stay (LOS) after a start of care, resumption of care or recertification OASIS, and had an acute hospital inpatient stay, for any reason, prior to their studied episode (this served as the initial hospitalization from which a potential re-admission to the hospital would be measured). Participants were excluded from the study for age under 64 years, not having OASIS assessments performed, elective or non-medical procedures or other atypical reasons for HH services were not eligible due to potential confounding, participants referred but not fully started on HH services, patients who did not have an initial, acute inpatient stay prior to their study period, subsequent admissions to the HH agency (to maintain independent sampling), and patients admitted to HH from an alternative setting (such as a skilled nursing facility or from a community doctor without a prior hospital stay) to prevent confounding of results. The researcher acknowledges that readmissions to the hospital occur from HH after a patient has been referred from all types of prior settings and these are important for study. However, this study was specifically investigating readmission to the acute, inpatient setting from HH after an initial hospitalization, hence the final exclusion criteria.

**Eligibility Determination**

Of the 1,229 EHRs available for review, 174 EHRs were screened based on the previously described eligibility criteria. Of the 174 EHRs screened, 80 met the study's eligibility criteria and 94 did not meet the study's eligibility criteria (see Figure 4). Non-eligible EHRs were due to non-hospital referral source or no initial hospitalization from which to assess for readmission, younger age, no OASIS performed during HH stay and HH start of care was not completed. There were no EHRs that met the eligibility criteria but had insufficient data on the study variables. Two readmission models emerged, therefore the final sample ($n$ = 80) had two different cohort groupings, context dependent, as a non-probability convenience cohort. Thirty-day readmission to the hospital during HH services: (a) clients who had experienced a 30-day readmission ($n$ = 31), and (b) clients who had not experienced a 30-day readmission ($n$ = 49). Readmission at any time during HH services: (a) clients who had experienced a readmission at any time ($n$ = 40), and (b) clients who had not experienced a readmission at any time start ($n$ = 40). Figure 4 below displays the decision flow that nets the final sample of n=80 and the sample size of the cohorts both readmission models.

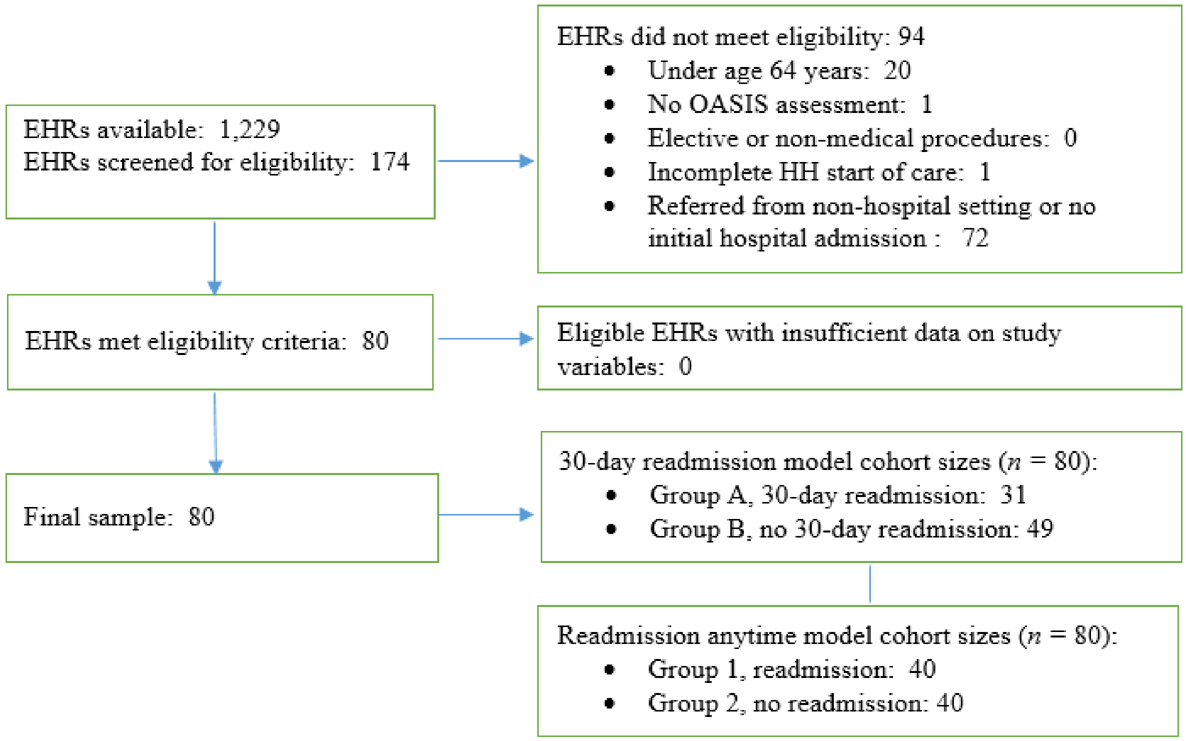


*Figure 4*. Eligibility Screening of Electronic Health Records (EHR)

## Data Collection Procedure

Data were retrieved from the HH agency's web-based EHR, and constrained to (a) the information relating to the start of care and referral, (b) the clinical and operational information within the HH episode being studied, and (c) four data points from the discharge OASIS assessment, if one was completed. Data included OASIS scores, intake and referral data points, important dates from which timelines were calculated (for example, the length of the prior hospitalization in days), and non-OASIS data such as information from the plan of treatment orders (the 485 form) such as the total number of medications. The OASIS data collection-point for this study varied depending on the chosen episode and may have included OASIS time-point data from the start of care, resumption of care, recertification, transfer and/or discharge.

OASIS assessment measures are standardized in accordance to the Centers for Medicare and Medicaid Services (CMS, 2018a). The OASIS was designed to enable systematic measurement of client risks and outcomes at start of HH care, at 60-day follow-up, around the time of an inpatient stay and at discharge. In OASIS, outcomes are defined by the assessment of changes in a client's health status between two or more time points, and agency-based outcomes are also calculated by comparing aggregate OASIS data between time points (CMS, 2012; CMS, 2016). The OASIS assesses a client's sociodemographic, environmental, support system, health status, functional status and health service utilization characteristics, as well as some of the operational functions expected of HH agencies.

The psychometric properties of OASIS through its many iterations since 1995, have been determined by the CMS, with teams of biostatisticians and technical experts (Shaughnessy, Crisler & Schlenker, 1998) as well as open comments from professionals invited at the time of a proposed ruling by CMS, who offer input on the development of each measure before final revisions occur (CMS, 2017c). CMS publishes many of their scientific papers and outcomes risk adjustment models, such as the Home Health ReHospitalization Measures Technical Documentation and Risk Adjustments (CMS, 2018b) and other technical documents (CMS, 2018c). However, CMS-based OASIS reliability and validity data is not easily located, especially given that revisions can occur annually. Independent studies of the reliability and validity of older versions of the OASIS demonstrate varying results. O'Connor and Davitt (2012) performed a systematic literature review of 12 extant studies and reported low to moderate construct and criterion validity depending on the measure and the study, with concerns around affect and behavioral domains being low for both validity and reliability. Inter-rater reliability ranged widely, with Kinatukara, Rosati and Huang (2005) reporting studied measures ranging from 0.11 to 1.0 using Cohen's kappa. The lower inter-rater reliability of 0.11 scored on the measure, rehabilitation prognosis, and similar measures were also very low, such as overall prognosis (0.21) and life expectancy (-0.01). Measures with stronger inter-rater reliability were urinary incontinence (0.81), prior toileting ability (0.70) and therapy need (0.60). Madigan and Fortinsky (2004) reported stronger inter-rater reliability findings with all of their kappa scores above 0.60, their determined threshold of acceptable reliability. The OASIS has been updated several times since inception in the 1995, and will again be revised in 2019 with some measures being retired, new measures added as well as edits to existing measures released, which will again alter reliability and validity (CMS, 2017d)

Data were entered in the HH agency's EHR by agency clinicians, intake personnel managing the referrals and administrators. Data was extracted through electronic reports to identify participants who were readmitted to the hospital versus those who were not. From those two convenience samples, participants were chosen at random and assessed for eligibility. Eligible participant data was extracted to Statistical Package for Social Sciences (SPSS) version 25 for Windows SPSS (IBM, 2018). The data extracted to SPSS were coded and did not contain participant identifiers. Non-OASIS data were also extracted to SPSS, coded, and de-identified. All data were cleaned for thoroughness and accuracy before analysis.

## Ethical Considerations

Measures were taken to protect the data and maintain de-identification. The researcher maintained control of the data at all times. Back up data is retained in UCSF Box, an encrypted, invitation-only cloud service, with accesses limited to co-principal investigators and statistician. The collateral legends to numerically coded participant information are retained in separate, password protected files from the SPSS files, despite being de-identified. No raw research data have been or will be emailed or texted, rather UCSF Box is utilized. No printing of raw data is allowed, to reduce possibility of erroneous data release, above and beyond de-identification. It should be noted that one HH agency is graciously providing de-identified data, and as such the HH agency will not be on record in files, aside from a separately filed and signed Memorandum of Understanding, to protect from any possibility of proprietary or business disclosures. The computers being used by the PIs are not shared/public, are password protected, and maintained in a locked environment when not in personal presence or in use. Destruction of data will be performed within 2 years, or after all analyses and resulting publications have been exhausted, whichever comes first. Destruction will be complete, through deletion of the SPSS dataset. The collaborating HH agency and the PI will be informed prior to dataset destruction to assure that we are in agreement with the purge. In the instance that data should not be completely destroyed within 2 years, per decision of the PI, co-PI or owner of the collaborating agency (i.e., another research or academic use has been identified), IRB approval or modification request will be submitted prior to any further use.

## Variables and Measures

### Dependent Variables

Two dependent variables emerged once analysis began. There was sufficient variance in HH lengths of stay and days to readmission among the 80 cases. It was of interest to consider two, distinct models, (a) 30-day readmission from HH and (b) readmission at any time. It was not planned to consider a second model, readmission at anytime, however there is intrinsic value as HH is now accountable to several, hospital outcome measures across multiple timelines: rehospitalization during the first 30-days, acute care hospitalization during the first 60-days

(ACH), and potentially preventable 30-day post-discharge readmission, which is due to begin in 2019 (CMS, 2017d; 2018b). Each dependent variable was dichotomous (yes or no).

**Contrast Variables and Development of Frontloading Variable**

The dataset contains 225 variables, of which 71 contrast variables were meaningful in analysis due to fit inside the contrast domains and sufficient distribution and number of data. Table 7 below displays the contrast variables in their labeled domains which were analyzed as univariate predictors of 30-day readmission and readmission at anytime. Five of the variables were developed within-study in attempt to define frontloading which lacks standard definition within the HH community yet are a sentinel intervention in readmission prevention (O'Connor, Hanlon and Bowles, 2014; Health Services Advisory Group (HSAG), 2015; Boyce and Feldman, 2007).

For this study, frontloading was measured as a rate of consultative and/or care contacts by any/all HH disciplines within the first week of home health care after a hospitalization, titled *frontloaded contacts rate in the first week*. Contacts were defined inclusively as visits, telemonitoring or consultative phone calls between home health clinicians and patients or caregivers. This dataset contained evidence of visits only for the sample n = 80, hence the frontloaded contacts rate being contextualized and tested for visits only. The number of visits that defined a frontloaded case was also developed within-study through analysis of median visit values. In an attempt to create at least one variable that could identify an accurately verified frontloaded episode of HH care, the visits made by all disciplines were assessed in several ways, all of which are displayed at the end of Table 7. It was the variable, frontloaded contacts rate, measured in the first week that emerged as the most meaningful and consistent at identifying reasonably frontloaded visits. Caution was taken to accept the calculation that defined frontloading as the most accurate and reasonable, while adhering to some of the current guidance:  visit intensity was evaluated at the beginning of HH care (Rogers, Perlic and Madigan, 2007) and all discipline visits including social work and home health aide were counted as the variable included all contacts (O'Connor, Bowles, Feldman, St. Pierre, Jarrin, Shah and Murtaugh, 2014; HSAG, 2105).  The details of measure development is as follows:

1. Contacts, versus visits only, was chosen as the lexicon to include consultation and care support to HH patients and caregivers.  Ideally, this would include home visits, telemonitoring points and consultative phone calls where health matters were discussed between patient and/or caregiver and at least one home health discipline.  However, this dataset demonstrated visits as the only contacts of record hence alternative types of contacts were not tested.
2. The calculation for the frontloaded contacts rate was simply:

$$\frac{\text{\# contacts planned or made in the first week of HH care (all disciplines)}}{\text{7 (days)}}$$

   The result can net a rate greater than 100% (1.00) which is greater than seven contacts made by all disciplines in seven days.  The use of the first week, as opposed to the general description of frontloading being deployed in the first “few weeks” of care (HHQI, 2016; Rogers, Perlic & Madigan, 2007), is acknowledgment of the shorter average length of stay for this sample being less than a full 60-day episode and reflective of many of today’s Medicare Advantage paid HH care plans, as well.

**3.** The measure being developed needed to capture 100% of frontloaded cases without fit problems.  By using the median number of combined HH visits made in the first week (Md = 4), validation of the median frontloaded contacts rate in the first week (Md:  4/7 = 57%) was possible to create the threshold from which frontloading was determined.

Frontloading as a percent of visits has been used in prior studies (Rogers, Perlic & Madigan, 2007; O'Connor, Hanlon & Bowles, 2014), defined as 60% of visits made in the first two weeks of care, which approximates this study's 57% rate definition despite differences in time frame.

The denominator was present to create the frontloaded contacts rate variable, to assure that the "first full week of HH care following an inpatient stay" was consistently defined as 7 days. The study distribution of the variable ranged above a 100% rate, falling between a 14-157% rate (representing the numerator, number of total visits made in the first week of care, ranging between 1-11 visits). The median was used as the threshold to meet or exceed, to define an affirmative frontloaded case, with the median frontloaded contacts rate being 57% and the median number of total visits in the first week being 4.

It should be noted that the title of this frontloading variable as a frontloaded "contacts" rate was highly purposed. As HH grows its own readmission evidence-base, surely operational variables will continue to gain traction in readmission prevention models. Visits are currently and precisely an in-person contact inside the patient's home. Telehealth offers remote patient monitoring, sometimes including live video connection. Phone calls are often consultative around the patient's health or to answer patient/caregiver questions. However, it is possible that as time, technology and policy advances, we find other alternative types of effective contacts (which may even be reimbursed) in preventing readmissions from HH. Therefore, the variable is being so-named with acknowledgment of our current contacts and with foresight for said advancements.

### Risk Scores Dropped

Many risk assessments occur during OASIS and non-OASIS visits: Braden Scale (Bergstrom, Braden, Laguzza & Holman, 1987) (pressure ulcer), TUG (Barry, Galvin, Keogh, Horgan & Fahey, 2014) (Time Up and Go for mobility and falls risk), PHQ-2 (Sheeran, Reilly, Raue, Weinberger, Pomerantz & Bruce, 2010) (two question depression measure), hospitalization risk (OASIS item M1036), health risks (OASIS M1033), sanitation or environmental risks (non-OASIS) and safety risks (non-OASIS). All of the risk variables presented issues for analysis either via insufficient data or insufficient range of data, and therefore were not considered in analysis (for example, there were only seven cases with a TUG score). The Braden Scale score (Bergstrom et al., 1987) which is a standardized measure of pressure ulcer risk, was eventually removed from consideration as a contrast variable despite a result on univariate analysis demonstrating statistical significance for prediction with readmission. The variable was thrown out of analysis because four participants did not have a Braden Score assessed in the EHR, and the researcher was not willing to reduce the participant sample by four (netting a final sample size of 76) on multiple logistic regression. Moving forward, this variable should be included with steps taken to assure no missing data, as the Braden Score may explain part of the variance in readmission from HH.

### Variable Domains

Three levels or domains of the variables were planned for analysis: operational variables, sociodemographic variables and clinical variables. Operational variables were those that are controlled by and might affect the HH agency or clinicians, such as the number of visits or days to HH start of care. Sociodemographic variables pertain to the participant as a descriptor and may not be controllable, such as race or gender. Clinical variables are those which reflect the participant's health status such as diagnoses or prognosis. This study was interested in HH operational variables as these are the most malleable for change and improvement by HH agencies and clinicians. However, sociodemographics and clinical features bear influence and may even interact with other types of variables in readmission, requiring investigatory inclusion.

## Data Analysis

All analyses were performed using SPSS version 25 for Windows (IBM, 2018), and were discussed in consultation with a UCSF biostatistician. Data analysis began with frequencies and measures of central tendency for demographics and characteristics of the sample. Distributions were assessed visually for quantitative variables using histograms and distribution of values tables. For some categorical variables, such as caregiver situation and code status, one or two of the categories contained too few data points, so recoding occurred to create a new dichotomous variable to analyze the category with the highest frequency. In the case of caregiver situation, a multi-level, OASIS variable (M1100) became a dichotomous variable highlighting living permanently with a caregiver at all times versus all other caregiver situations. For code status, the original three levels of code status (not stated, full code and do not resuscitate) became dichotomous, highlighting full code status versus not having full code status. Diabetes also moved from a multi-level categorical variable accounting for all types of diabetes and prescribed treatments, to a dichotomous variable acknowledging participants who had diabetes of any type versus those who did not have diabetes.

Paired t-tests were conducted for four sets of paired independent variables to compare sample means for data representing two time-points: (a) mean number of nursing visits ordered and made, (b) mean number of combined therapy visits ordered and made, (c) mean number of predicted therapy visits on OASIS M2200 and subsequently ordered on plan of treatment, and

(d) pain score at SOC/ROC and again at discharge (n=54 for this analysis due to 26 participants not being available for discharge OASIS assessment, which is within normal operations in the HH setting). It was of interest to evaluate HH operations' consistency and performance on (a), (b) and (c) above, desiring non-significant differences between the time points. It was of interest to evaluate pain scores from the beginning to the end of HH care as a reflection of statistically significant pain reduction over time, as a reflection of client complexity.

Univariate, logistic regression (bivariate) analysis was conducted between each contrast variable and, separately, two dependent variables, 30-day readmission and readmission anytime, to determine which variables were statistically significant at alpha 0.05 and also alpha 0.10. Each model was analyzed wholly separate from the other to avoid any confusion in analysis or interpretation.

Significant variables resulting from univariate analyses at alpha 0.05 were then entered into a multiple logistic regression model, testing both the 30-day readmission and readmission at anytime models as separate entities. Interactions among variables was a time-intensive analysis that netted one significant interaction term among all variables tested with each dependent variable: frontloaded contacts rate first week*history of diabetes mellitus any type (dichotomous yes/no) in 30-day readmission from HH. Multiple logistic regression was then again conducted with the interaction term and both contrast variables added to the model with simultaneously entry. No post-hoc tests were required such as Bonferroni, due to the nature of the variables and analyses. However, due to multiple logistic regression results (discussed in the next chapter), correlations between variables were again analyzed to assure suppression of multicollinearity, and forward logistic regression was run to assess consistency of results.

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Table 7

*Contrast Variables of Interest by Category*

| | Variable | Label | Type |
|---|---|---|---|
| | *Sociodemographic Variables* | | |
| 1 | Age | Years | Numeric |
| 2 | Marital status | Numeric, 5 strata | Categorical |
| 3 | Gender (OASIS item M0069) | Numeric, 2 strata | Categorical |
| 4 | Race (OASIS item M0140) | Numeric, 6 strata | Categorical |
| 5 | Payment source (OASIS item M0150) | Numeric, 12 strata | Categorical |
| | *Clinical Variables* | | |
| 6 | Primary diagnosis by system category | Numeric, 10 strata | Categorical |
| 7 | Secondary diagnosis by system category | Numeric, 10 strata | Categorical |
| 8 | Cardiac diagnosis as primary or secondary (recoded) | Numeric, 2 strata | Dichotomous |
| 9 | Cardiac and/or circulatory diagnosis as primary or secondary (recoded) | Numeric, 2 strata | Dichotomous |
| 10 | Infection diagnosis as primary or secondary (recoded) | Numeric, 2 strata | Dichotomous |
| 11 | Neuromusculoskeletal diagnosis as primary or secondary (recoded) | Numeric, 2 strata | Dichotomous |
| 12 | History of diabetes mellitus (any type) | Numeric, 2 strata | Dichotomous |
| 13 | Number of medications total | Count | Numeric |
| 14 | Number of high risk medications | Count | Numeric |
| 15 | Rehabilitation potential | Numeric, 4 strata | Categorical |

| | Variable | Label | Type |
|---|---|---|---|
| 16 | Prognosis | Numeric, 5 strata | Categorical |
| 17 | Overall status (OASIS item M1034) | Numeric, 5 strata | Categorical |
| 18 | Episode timing (OASIS item M0110) | Numeric, 4 strata | Categorical |
| 19 | Code status | Numeric, 3 strata | Categorical |
| 20 | Full code status (recoded code status) | Numeric, 2 strata | Dichotomous |
| 21 | OASIS M1033 health risks (9) (each coded separately) | Numeric | 9 dichotomous variables |
| 22 | Number of risks identified in M1033 | Count | Numeric |
| 23 | OASIS M1036 hospitalization risks, each coded separately | Numeric, 6 strata | 6 dichotomous variables |
| 24 | Number of risks identified in M1036 | Count | Numeric |
| 25 | Safety/environmental risks (non-OASIS, each coded separately) | Numeric, 13 strata | 13 dichotomous variables |
| 26 | Number of safety/environmental risks identified | Count | Numeric |
| 27 | Caregiver assistance (OASIS item M1100, called Living Arrangements) | Numeric, 15 strata | Categorical |
| 28 | Caregiver available continuously (OASIS M1100 score of 6, recoded) | Numeric, 2 strata | Dichotomous |
| 29 | Functional limitations (non-OASIS, each coded separately) | Numeric, 12 strata | 12 dichotomous variables |
| 30 | Number of functional limitations | Count | Numeric |
| 31 | Pain with activity (OASIS M1242) | Numeric, 5 strata | Numeric |
| 32 | Pain score at start of care (SOC) | Numeric scale | Numeric |

| | Variable | Label | Type |
|---|---|---|---|
| 33 | Pain score at discharge (DC) | Numeric scale | Numeric |
| 34 | Grooming (OASIS M1800) | Numeric, 4 strata | Numeric |
| 35 | Upper body dressing (OASIS M1810) | Numeric, 4 strata | Numeric |
| 36 | Lower body dressing (OASIS M1820) | Numeric, 4 strata | Numeric |
| 37 | Bathing (OASIS M1830) | Numeric, 7 strata | Numeric |
| 38 | Toilet transferring (OASIS M1840) | Numeric, 5 strata | Numeric |
| 39 | Toilet Hygiene (OASIS M1845) | Numeric, 4 strata | Numeric |
| 40 | Transferring (OASIS item M1850) | Numeric, 5 strata | Numeric |
| 41 | Ambulation (OASIS item M1860) | Numeric, 7 strata | Numeric |
| 42 | Ability to feed self and eat (OASIS item M1870) | Numeric, 6 strata | Numeric |
| 43 | Ability to plan and prep meals (OASIS item M1880) | Numeric, 3 strata | Numeric |
| 44 | Ability to use phone (OASIS item M1890) | Numeric, 7 strata | Numeric |
| 45 | Homebound: needs assistive device (recoded crutches, cane, wheelchair, walker, other) | Numeric, 2 strata | Dichotomous |
| 46 | Homebound: needs transportation assistance | Numeric, 2 strata | Dichotomous |
| 47 | Homebound: medical contraindication (also known as medical necessity) | Numeric, 2 strata | Dichotomous |

| | Variable | Label | Type |
|---|---|---|---|
| 48 | Homebound: functional/mental reasons | Numeric, 2 strata | Dichotomous |
| 49 | Management of oral medications (OASIS item M2020) | Numeric, 5 strata | Numeric |
| 50 | Predicted therapy visits needed (OASIS item M2200) | Count | Numeric |
| 51 | Readmission diagnoses by category | Numeric, 10 strata | Categorical |
| | *Operational Variables* | | |
| 52 | Time to HH start or resumption of care (timeliness of care verified) | Days | Numeric |
| 53 | Episode length of stay (LOS) (maximum of 60-days) | Days | Numeric |
| 54 | Home health (HH) total LOS | Days | Numeric |
| 55 | Prior hospital LOS | Days | Numeric |
| 56 | Number of nursing visits ordered | Count | Numeric |
| 57 | Number of prn nursing visits ordered | Count | Numeric |
| 58 | Number of nursing visits made | Count | Numeric |
| 59 | Number of total therapy visits ordered (combined therapies together) | Count | Numeric |
| 60 | Number of total therapy visits made | Count | Numeric |
| 61 | Number of total visits made in episode (all disciplines) | Count | Numeric |
| 62 | Social work ordered | Numeric, 2 strata | Dichotomous |
| 63 | Certified home health aide ordered | Numeric, 2 strata | Dichotomous |

| | Variable | Label | Type |
|---|---|---|---|
| 64 | Care coordination among home health disciplines | Numeric, 2 strata | Dichotomous |
| 65 | Care coordination between home health and primary provider(s) | Numeric, 2 strata | Dichotomous |
| *Operational Variables Involved with Investigation of Frontloading* | | | |
| 66 | Number of total visits made in first week (all disciplines) | Count | Numeric |
| 67 | Percent visits made in the first week | Percent, formula | Numeric |
| 68 | Percent visits ordered in the first week | Percent, formula | Numeric |
| 69 | Frontloaded Contacts Rate first week | Percent as a rate, formula | Numeric |
| 70 | Difference between nursing visits made and ordered | Count, formula | Numeric |
| 71 | Difference between therapy visits made and ordered | Count, formula | Numeric |

*Several other OASIS and non-OASIS variables were collected and analyzed for significance among the 71 listed above, however due to insufficient responses, homogeneity of responses or missing cases, they were not significant in analysis (or unable to be analyzed) hence not included in the table.

# CHAPTER V

# RESULTS

Chapter V contains a presentation of the results of two readmission timeline models, (a) 30-day readmission to the hospital from HH and (b) readmission to the hospital at any time from HH. The sample is the same (*n = 80)* for both models, hence the demographics, and other characteristics representing the sample, are displayed first. Results of univariate logistic regression analysis and multiple logistic regression analysis were rendered for each timeline readmission model and are presented separately. Results describe the influence of three domains of variables on readmission to the hospital during HH services. Operational variables were the domain of highest interest in the study and included timeliness to care after an initial hospitalization, visits made, visits ordered, disciplines ordered, and coordination of care. Sociodemographics and clinical variables included age, gender, race, payment source, caregiver situation, medications, primary and secondary diagnoses, prognosis and rehabilitation potential. These variables represented the level of influence from medical complexity and sociodemographic risks.

## Description of Study Variables

### Participants

The sample was comprised of 80, anonymous HH clients sele3cted by retrospective, convenience sampling from the electronic health record from one northern California HH agency. All participant data met eligibility criteria for study inclusion, which involved 100% of the sample having a prior admission to an acute care hospital, a necessity from which to gauge a re-admission within a measured period of time. The ages ranged between 64 and 100 years (mean = 80.69 ± 9.49), 60% were female (n = 48), 41.3% were married (n = 33) and 80% lived with their caregiver permanently in their home (n = 64). The racial distribution included 40% clients identifying as Asian (n = 32) and 32.5% clients identifying as White (n = 26). The majority of payment sources were attributed to Medicare, with Medicare Advantage being the most common payor (72.5%, n = 58) and Medicare-proper being the second most common payor (25%, n = 20). Table 8 displays the study sociodemographics, including clinical risk characteristics. Clinical risk characteristics of interest were that 31 participants (38.8%) experienced a 30-day readmission to the hospital from HH after an initial hospitalization and 40 participants (50%) experienced a readmission at any time from HH after an initial hospitalization. Home health total LOS ranged between 2 and 560 days on service (mean = 46.03 days ± 72.01), the total number of medications ranged between 0 and 26 (mean = 11.84 ± 5.26) and fall risk scores at start of care (SOC) or resumption of care (ROC) ranged between 2 and 10, with 4 or higher being a risk for falling at home (mean = 5.72 ± 1.72).

Pain scores appeared to improve on average by the end of HH services, with the mean pain score at SOC or ROC for the full sample (n = 80) being 3.82 (SD = 2.95) and the mean pain score at discharge for a partial sample (n = 54) being 1.07 (SD = 1.74). Paired t-test analysis was performed to compare the mean pain score at the HH start of care and the mean pain score at HH discharge, questioning whether there was reduction in pain score by the end of HH services. This sample within-analysis was only n = 54 because 26 participants did not have a discharge OASIS assessment, and therefore did not have an in-person assessment of their discharge pain score. Therefore, the mean pain score for SOC or ROC was evaluated for the partial sample in paired t-test analysis (n = 54, mean = 3.50 ± 2.78). The reasons for not having 26 participant discharges varied, but all were within normal operations for reasons beyond control such as patients who were readmitted to the hospital during HH services but never returned to HH care (hence no formal, discharge OASIS assessment). There was a statistically significant difference between mean pain score at the HH start of care and the mean pain score at HH discharge on this sub-sample of participants (mean difference = 2.43 ± 2.34, t = 7.605, p = 0.000, 95% C.I., 1.786 – 3.066). This suggests that participants significantly reduced their pain score between the start of HH care and discharge of HH care, on average.

Primary and secondary HH diagnoses were categorized by major system. Both primary and secondary diagnoses were accounted for due to OASIS coding rules requiring a secondary diagnostic code to support the primary problem, or to support additional HH disciplines to the plan of treatment (CMS, 2018a). Therefore, the primary and secondary diagnoses were more representative of the reasons for HH initiation. Figure 5 below depicts the diagnostic categories for all 80 participants (80 distinct primary diagnoses, 80 distinct secondary diagnoses and 160 total diagnoses) from the start of the studied episode. No diagnosis is duplicated in another field, for example, a urinary tract infection would be counted solely as Infection and not also as gastrointestinal (GI)/genitourinary (GU). Neuromusculoskeletal diagnoses were the most common, followed by cardiac diagnoses, infections then GI/GU diagnoses sequentially. These do not include reasons for any readmissions to the hospital, which are discussed subsequently.

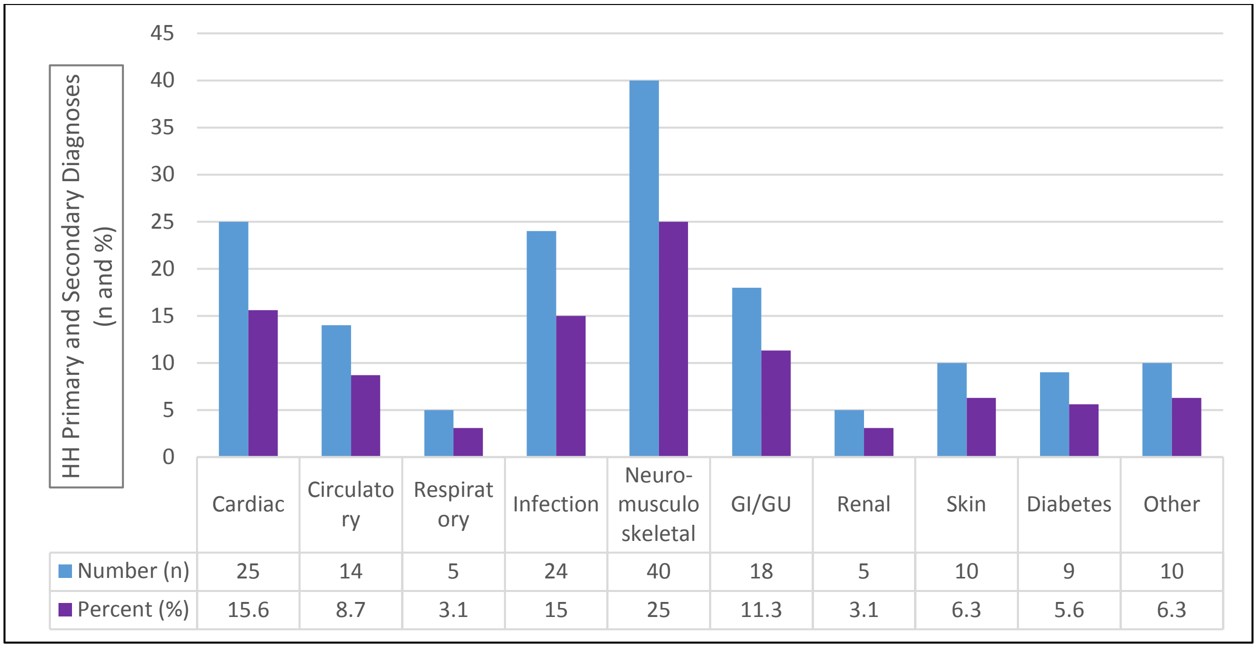



*Figure 5: Primary and Secondary HH Diagnoses by System at Start of Episode Studied*

**Home Health Operations**

An overview of the operational results are in Table 9. Operational results demonstrated timely initiation of HH care for the sample on average (mean = 1.53 days to SOC or ROC ± 1.65). Timeliness of care was not significant in either the 30-day readmission or readmission anytime models, as shown below.

| Model | Mean | | t | p |
|---|---|---|---|---|
| | No readmit | Yes readmit | | |
| Readmission to hospital from HH at anytime (n=40) | 1.75 days | 1.30 days | 1.221 | 0.226 |
| 30-day readmission to hospital from HH (n=31) | 1.71 days | 1.23 days | 1.293 | 0.200 |

*Figure 6: Timeliness of Care Comparison Between Models, Non-Significant Results (alpha 0.05)*

Frontloading of visits within the first week of HH services was performed by the agency with a mean of 4.44 combined discipline visits made within the first week of care (Md = 4.00, SD = 2.20), and the frontloaded contacts rate within the first 7 days of HH services ranged between 14

– 157% (Md = 57%). Care coordination among HH personnel and with the primary provider was documented less than 50% of the time, and was dropped from the study.

Several variables were appropriate for comparison of means at two time-points with paired t-tests. Three variable-pairs reflected the performance and decisions of HH operations. The first paired t-test evaluated the mean number of nursing visits ordered at the beginning of the HH episode (mean = 6.50± 4.62) and the mean number of nursing visits made by the end of the HH episode studied (mean = 6.45±4.97). There was not a significant difference between the mean number of nursing visits ordered at the beginning of the HH episode and the mean number of nursing visits made by the end of the HH episode (mean difference = 0.050 ± 3.58, t = 0.125, p = 0.901, 95% C.I., -0.746 - 0.846).

The second paired t-test evaluated the mean number of combined therapy visits ordered at the beginning of the HH episode (mean = 6.19 ± 5.74) and the mean number of combined therapy visits made by the end of the HH episode studied (mean = 5.98 ± 5.49). There was not a significant difference between the mean number of combined therapy visits ordered at the beginning of the HH episode and the mean number of combined therapy visits made by the end of the HH episode (mean difference = 0.213 ± 4.10, t = 0.464, p = 0.644, 95% C.I., -0.700 – 1.125).

The third paired t-test evaluated the mean number of combined therapy visits predicted as needed at the initial assessment on the OASIS-C2 M2200 (mean = 4.10 ± 3.98) and the mean number of combined therapy visits ordered subsequently on the plan of treatment (mean = 6.19 ± 5.74). There was a statistically significant difference between the mean number of combined therapy visits predicted at the initial assessment on the OASIS M2200 and the mean number of combined therapy visits ordered post-assessment on the plan of treatment (mean difference = -2.09 ± 4.49, t = -4.156, p = 0.000, 95% C.I., -3.087 - -1.088).

## Univariate Analyses in Two Readmission Models

### 30-day Readmission to the Hospital from HH

Univariate, logistic regression analyses for the 30-day readmission model produced 13 statistically significant variables with a significant, unadjusted odds ratio with alpha set at 0.05 (see Table 10). There were eight additional variables demonstrating statistical significance with alpha set at 0.10. The original 13 variables showing significance in univariate analysis with 30-day readmission were: the number of total combined therapy visits made, the number of high risk medications, homebound status by medical contraindication, frontloaded contacts rate in the first week of HH service, the number of total visits made in the first week of HH service, the ability to plan and prepare meals (OASIS M1880), the number of total visits made in the HH episode, overall status (OASIS M1034), Braden score at SOC or ROC, the ability to feed self and eat (OASIS M1870), the number of combined therapy visits ordered on the 485 plan of treatment, the ability to use phone (OASIS M1890), and upper body dressing ability (OASIS M1810).

Several of the variables demonstrating significance with 30-day readmission contained inherent meaning around home health visits and therefore demonstrated multicollinearity among themselves. Multicollinearity was investigated using Pearson correlation testing. Figure 7 shows the correlation matrix, and due to visit-related variables demonstrating significant, strong correlation, the decision was made to remove all but one visit-related variable: frontloaded contacts rate in the first week.

| variable itself (1.00) | low or no correlation (-0.399 to 0.399) | moderate strength correlation (-0.699 to -0.400 and 0.400 to 0.699) | high-moderate, very strong or perfect correlation (-1.000 to -0.700 and 0.700 to 1.000) |
|---|---|---|---|

| | TVM | VFW | VE | HRM | FL | %CON | TVO | M1034 | M1810 | M1870 | M1880 | M1890 | HBmed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Therapy visits made | 1.00 | | | | | | | | | | | | |
| Tot visits first week | 0.7 (0.00) | 1.00 | | | | | | | | | | | |
| Tot visits episode | 0.837 (0.00) | 0.701 (0.000) | 1.00 | | | | | | | | | | |
| High risk meds | -.034 (0.766) | 0.002 (0.988) | 0.069 (0.545) | 1.00 | | | | | | | | | |
| Front-load yes/no | 0.478 (0.00) | 0.770 (0.000) | 0.486 (0.000) | -0.105 (0.355) | 1.00 | | | | | | | | |
| % contacts first week | 0.701 (0.00) | 1.00 (0.00) | 0.702 (0.000) | 0.002 (0.983) | 0.767 (0.00) | 1.00 | | | | | | | |
| Therapy visits ordered | 0.734 (0.00) | 0.622 (0.000) | 0.524 (0.00) | -0.053 (0.640) | 0.399 (0.000) | 0.623 (0.00) | 1.00 | | | | | | |
| M1034 overall status | -0.122 (0.279) | -0.174 (0.124) | -0.058 (0.612) | 0.234 (0.037) | -0.247 (0.027) | -.173 (0.126) | -0.171 (0.129) | 1.00 | | | | | |
| M1810 upper body dress | -0.014 (0.901) | 0.137 (0.227) | 0.101 (0.373) | 0.075 (0.508) | -0.002 (0.985) | 0.139 (0.218) | 0.098 (0.386) | 0.181 (0.107) | 1.00 | | | | |
| M1870 feed/eat | -0.107 (0.346) | 0.113 (0.320) | 0.077 (0.495) | 0.303 (0.006) | 0.122 (0.282) | 0.113 (0.318) | -0.081 (0.476) | 0.313 (0.005) | 0.233 (0.037) | 1.00 | | | |
| M1880 meal prep | -0.091 (0.424) | -0.025 (0.823) | -0.032 (0.777) | 0.157 (0.165) | -0.074 (0.516) | -.024 (0.834) | -0.084 (0.459) | 0.136 (0.229) | 0.467 (0.000) | 0.284 (0.011) | 1.00 | | |
| M1890 phone use | -0.021 (0.854) | 0.072 (0.528) | -0.021 (0.854) | -.076 (0.505) | 0.005 (0.966) | 0.072 (0.526) | 0.114 (0.316) | 0.323 (0.003) | 0.536 (0.000) | 0.309 (0.005) | 0.331 (0.003) | 1.00 | |
| HB medical | -0.217 (0.053) | -0.066 (0.563) | -0.131 (0.246) | 0.265 (0.017) | -0.143 (0.206) | -.066 (0.561) | -0.088 (0.436) | 0.337 (0.002) | 0.111 (0.327) | 0.103 (0.361) | 0.101 (0.372) | 0.077 (0.497) | 1.00 |

*Key*:
TVM=therapy visits made, VFW=total visits first week, VE= total visits in episode, HRM=high risk meds, FL=frontload yes/no, TVO=therapy visits ordered, M-items are standardized from the OASIS assessment, HB medical = homebound reason by medical contraindication, Diagonal cross-outs indicate variables removed from the 30-day readmission model due to multicollinearity

*Figure 7: Correlation Matrix for 30-day Readmission Model*

The decision to remove five out of six visit variables resulted in eight, final variables that demonstrated statistically significant univariate results with 30-day readmission from HH. Unadjusted odds ratio results for the eight variables are as follows. Participants prescribed and taking high risk medications demonstrated 1.678 times higher risk of 30-day readmission to the hospital during HH services for each one additional high risk medication (p = 0.004). Those assigned a homebound status determination of medical contraindication (also called medical necessity) were 4.160 times more likely to experience a 30-day readmission to the hospital during HH services than those who were not assigned homebound status due to medical contraindication (p = 0.005). With every one percent rate increase in frontloaded contacts made in the first week of HH services, there was a 2.1% decreased risk of 30-day readmission to the hospital from HH services (p = 0.013). Ability to plan and prepare meals, ability to feed self and eat, ability to use the phone and ability to dress one's own upper body, all reflected level of self-management and motor coordination at home. For every one unit increase in score indicating more dependency and less ability to plan and prepare meals, participants were 2.185 times more likely to experience 30-day readmission to the hospital from HH (p = 0.022). For every one unit increase in score indicating more dependency and less ability to feed self and eat, participants were 1.801 times more likely to experience 30-day readmission to the hospital from HH (p = 0.032). For every one unit increase in score indicating more dependency and less and ability to use the phone at home, there was a 1.274 times increased risk for 30-day readmission to the hospital during HH services (p = 1.274). For every one unit increase in score indicating more dependency and less ability to dress one's own upper body at home, there was a 1.951 times increased risk for 30-day readmission to the hospital during HH services (p = 0.047). The overall status (M1034) measure is an OASIS-specific determination of medical complexity and prognosis. For every one unit increase in overall status score indicating higher medical complexity and worsened prognosis, there was a 2.413 increased risk of 30-day readmission to the hospital during HH services (p = 0.026).

Figure 8 that follows provides a brief depiction of the results with the frontloaded contacts rate in the first week removed, replaced with one of the visit variables that were significant in univariate analyses and removed due to multicollinearity. Model multiple logistic regression (MLR) shows similar results among the comparative models, when removing frontloaded contacts rate in the first week from the 30-day readmission MLR model, and replacing it with one of the other significant visit variables, one at a time: (a) therapy visits ordered, (b) therapy visits made and (c) total visits made per episode. Those results were that the same six contrast variables did not demonstrate significant, unique contribution to the 30-day readmission model, and the same two variables did demonstrate significant, unique contribution to the 30-day readmission model with protective effect: (1) the visit variable as discussed herein and (2) high risk medications (HR meds). The purpose of this demonstration is to show relevance of these variables for consideration in future study, and in practice, as possibly significant and protective against 30-day readmission.

| Variable replacing *frontloaded contacts rate** | AOR | p-value | HR meds AOR | HR meds p-value | Cox & Snell R-square | Omnibus model p-value |
|---|---|---|---|---|---|---|
| Number total therapy visits made | 0.821 | 0.005 | 1.726 | 0.019 | 0.345 | 0.000 |
| Number total therapy visits ordered | 0.896 | 0.036 | 1.611 | 0.025 | 0.289 | 0.001 |
| Number total visits made in episode (visits per episode) | 0.909 | 0.013 | 1.713 | 0.016 | 0.314 | 0.000 |

*Figure 8: Variable Replacement Demonstration: Replacing Frontloaded Contacts Rate in the First Week in the 30-day Readmission MLR Model**

*Note: MLR was run three times, replacing the *frontloaded contacts rate* variable with one of the above visit-oriented operational variables. All other variables in the model remained non-significant in both p-value and 95% confidence interval, hence are not included in the table, for brevity. However the Cox & Snell R-square values and omnibus model p-values are representative of eight variables in the 30-day readmission model in each instance.

**Readmission to the Hospital at Anytime from HH**

Univariate, logistic regression analyses for the readmission anytime model produced six variables with statistically significant, unadjusted odds ratios with alpha set at 0.05 (see Table 11): homebound reason by medical contraindication, number of high risk medications, HH total LOS, number of medications total and full code status. There were eight additional variables demonstrating statistical significance with alpha set at 0.10, of which four variables were extremely close to p=0.05 (ranging 0.054-0.056). The decision was made to use simultaneous entry with the original six variables significant at alpha 0.05. The readmission anytime model did not suffer multicollinearity.

Unadjusted odds ratios results of the six, significant variables with readmission anytime, are as follows. Those assigned a homebound status determination of medical contraindication (also called medical necessity) were 4.265 times more likely to experience a readmission to the hospital at anytime during HH services than those who were not assigned homebound status due to medical contraindication ($p = 0.006$). Participants prescribed and taking high risk medications demonstrated 1.678 times higher risk of readmission to the hospital at anytime during HH services for each one additional high risk medication ($p = 0.006$). For every one day increase in HH total length of stay, there was 1.022 times increased risk of readmission to the hospital at anytime during HH services ($p = 0.016$). The number of medications total demonstrated a 1.110 times increased risk of readmission to the hospital for every one more medication prescribed and taken ($p = 0.027$). Participants declaring a full code status were 2.778 times more at risk for readmission to the hospital at anytime during HH services than participants not declaring a full code status ($p = 0.027$). There was a 1.110 times increased risk of readmission for every one visit increase in the number of nursing visits made ($p = 0.041$).

## Predictors of Two Readmission Models: Influence of Operational and Clinical Risks

### 30-day Readmission to the Hospital from HH

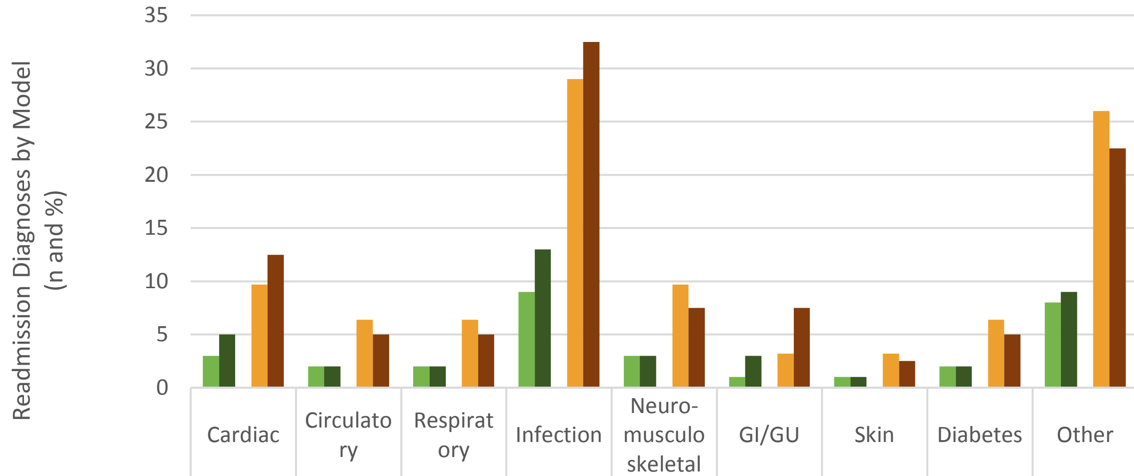
Multiple logistic regression was performed with eight predictor variables entered into the model simultaneously. Results are shown in Table 12. The 30-day readmission model was significant (chi-square = 32.058, df = 8, $p = 0.000$), with a Cox and Snell R-square = 0.330 and a Nagelkerke R-square = 0.448. Two variables continued to demonstrate unique contribution to the 30-day readmission model. The frontloaded contacts rate in the first week of HH service demonstrated 3% less risk of 30-day readmission to the hospital during HH service with every one percent rate increase in contacts made in the first week of HH care, holding all other variables in the model constant (p = 0.005). Also, for every one additional high risk medication prescribed and taken by participants, the risk of 30-day readmission to the hospital increased by 1.638 times (p = 0.027).

**Readmission to the Hospital Anytime from HH**

Multiple logistic regression was performed with six predictor variables entered into the model simultaneously. Results are shown in Table 13. The readmission anytime model was significant (chi-square = 29.565, df = 6, p = 0.000), with a Cox and Snell R-square = 0.309 and a Nagelkerke R-square = 0.412. Two variables continued to demonstrate unique contribution to the readmission anytime model, adjusting for the all other variables in the model. Participants designated as homebound by medical contraindication were 5.058 times more likely to be readmitted to the hospital at anytime during HH services, holding all other variables in the model constant (p = 0.011). Also, for every one day added to HH length of stay, participants' risk of readmission to the hospital anytime during HH service increased by 1.034 times, holding all other variables in the model constant (p = 0.033).

## Diagnostic Reasons for Readmission

Reasons for readmission were derived from HH clinicians' documentation of a transfer OASIS (see Figure 9 below) and validated as many times as possible through readmission history and physical or discharge summary documentation streaming from the hospital setting upon re-entry to HH. Home health is often uncertain of the reasons for hospital transfer from home due to not being present with the patient at the time of transfer, and not having access to emergency department or discharge summary documentation in real time. Therefore efforts were made in-study to validate readmission diagnoses from hospital discharge summary data when the patient returned to HH services.  In some cases, this data was missing so the home health transfer data were utilized in lieu.  The diagnostic category of *other* was utilized when diagnoses could not be verified or a diagnosis did not fit inside the other systems.  It should also be noted that the 30-day readmission cohort and the readmission anytime cohort are not independent samples.  The 30-day readmission cohort is repeated inside the readmission anytime cohort with the addition of 9 cases readmitted after 30 days on HH services, hence the close approximations of data below.  The goal was not to have two models; this was a surprise element at analysis worthy of investigation.  Clearly, regardless of time to readmission, infections required return to the hospital, and a higher percentage of readmissions were in the other category.  The other category for 30-day readmission consisted of liver failure (n = 1), nausea and vomiting with unknown etiology (n = 2), unspecified pain (n = 2) and unknown diagnoses (n = 3).  The other category for readmission anytime was the same as above with the inclusion of 1 more unknown diagnosis.




| | Cardiac | Circulatory | Respiratory | Infection | Neuro-musculoskeletal | GI/GU | Skin | Diabetes | Other |
|---|---|---|---|---|---|---|---|---|---|
| 30-day Readmit (n) | 3 | 2 | 2 | 9 | 3 | 1 | 1 | 2 | 8 |
| Readmit Anytime (n) | 5 | 2 | 2 | 13 | 3 | 3 | 1 | 2 | 9 |
| | | | | | | | | | |
| 30-day Readmit (%) | 9.7 | 6.4 | 6.4 | 29.0 | 9.7 | 3.2 | 3.2 | 6.4 | 26.0 |
| Readmit Anytime (%) | 12.5 | 5.0 | 5.0 | 32.5 | 7.5 | 7.5 | 2.5 | 5.0 | 22.5 |

*Figure 9:  Diagnoses by System as Reasons for 30-day Readmissions and Readmission Anytime*

## References

Bergstrom, N., Braden, B. J., Laguzza, A., & Holman, V. (1987). The Braden Scale for Predicting Pressure Sore Risk. *Nurs Res*, *36*(4), 205-210.

Calys, M, Gagnon, K & Jernigan, S. (2012). A Validation Study of the Missouri Alliance for Home Care Fall Risk Assessment Tool. *Home Health Care Management & Practice*, 25(2): 39-44. https://doi.org/10.1177/1084822312457942

Table 8
*Participant Sociodemographics and Clinical Risk Characteristics (n = 80)*

| Variable | Frequency (% if applicable) | Min | Max | Mean | Md | SD |
|---|---|---|---|---|---|---|
| *Sociodemographics* | | | | | | |
| Age | 80 | 64 | 100 | 80.69 | 80 | 9.49 |
| Gender female | 48 (60%) | | | | | |
| Race | | | | | | |
| Asian | 32 (40%) | | | | | |
| Black or African American | 3 (3.8%) | | | | | |
| Hispanic or Latino | 17 (21.3%) | | | | | |
| Native Hawaiian or Pacific Islander | 2 (2.5%) | | | | | |
| White | 26 (32.5%) | | | | | |
| Marital status married | 33 (41.3%) | | | | | |
| Marital status widow(er) | 20 (25%) | | | | | |
| Payment source Medicare | 20 (25%) | | | | | |
| Payment source Medicare Advantage (Md and mode) | 58 (72.5%) | | | | | |
| Caregiver living permanently in the home (OASIS M1100 score of 6 = Md and mode) | 64 (80%) | | | | | |
| *Clinical Risk Characteristics* | | | | | | |
| 30-day readmission occurred | 31 (38.8%) | | | | | |
| Readmission at any time in HH stay | 40 (50%) | | | | | |

| Variable | Frequency (% if applicable) | Min | Max | Mean | Md | SD |
|---|---|---|---|---|---|---|
| HH episode length of stay (LOS) (HH episode maximum is 60 days) | 80 | 2 | 60 | 31.04 | 24.50 | 19.37 |
| HH total LOS (from start of care to discharge) | 80 | 2 | 560 | 46.03 | 24.50 | 72.01 |
| Prior hospital LOS | 80 | 1 | 21 | 6.19 | 4.00 | 5.00 |
| Number medications total | 80 | 0 | 26 | 11.84 | 11.00 | 5.26 |
| Number high risk medications | 80 | 0 | 7 | 1.59 | 1.00 | 1.49 |
| Number of risks in M1036 (OASIS-defined hospitalization risks) | 80 | 0 | 2 | 0.43 | 0.00 | 0.59 |
| Number safety risks (non-OASIS) | 80 | 0 | 6 | 0.56 | 0.00 | 0.98 |
| Number of sanitation risks (non-OASIS) | 80 | 0 | 2 | 0.14 | 0.00 | 0.38 |
| Number functional limitations (non-OASIS) | 80 | 0 | 5 | 2.61 | 3.00 | 1.11 |
| Prognosis* | 79 | 0 | 4 | | 3.00 | |
| Rehabilitation Potential* | 71 | 1 | 4 | | 2.00 | |
| Overall Status (M1034)* | 80 | 0 | 3 | | 1.00 | |
| Pain score at SOC or ROC | 80 | 0 | 9 | 3.82 | 4.00 | 2.95 |
| Pain score at discharge OASIS* | 54 | 0 | 6 | 1.07 | 0.00 | 1.74 |
| Fall risk score at SOC or ROC* | 80 | 2 | 10 | 5.72 | 5.50 | 1.72 |
| Braden score at SOC or ROC* | 76 | 8 | 23 | 17.76 | 18.00 | 2.51 |
| PHQ2 depression score at SOC or ROC* | 74 | 0 | 5 | 0.28 | 0.00 | 0.84 |

*Fewer pain scores at discharge represent participants who did not return to HH from the hospital, or other reasons preventing a discharge OASIS with in-person pain assessment being rendered. Fall risk scores were measured using the Missouri Alliance for Home Care Tool (MAHC-10) (Calys, Gagnon & Jernigan, 2012). The Braden Scale measures risk of pressure ulcer and is reverse scored in that a high score represents less risk (Bergstrom, Braden, Laguzza & Holman, 1987). Fewer Braden scores at SOC or ROC were retrospectively missing items; due to the missing four cases, this variable was pulled from the multiple regression analysis to refrain from reducing the sample size. Some participants did not participate in the depression assessment, which is an OASIS embedded element with the PHQ-2 scale. Prognosis (non-OASIS) was missing from 1 case and the Md of 3.00 means "fair". Rehabilitation potential (non-OASIS) was missing from 9 cases and the Md of 2.00 means "fair". Overall status is an OASIS-C2 measure (M1034) and the Md of 1.00 means "temporary high health risk, likely to return to stability". All three of these prognostication measures, whether in OASIS or not, are scored by the HH clinicians based on their assessment that day.

Table 9
*Operational Results (n = 80)*

| Variable | Frequency (% if applicable) | Min | Max | Mean | Md | SD |
|---|---|---|---|---|---|---|
| Time to start of care (SOC) or resumption of care (ROC) in days – timeliness of care | 80 | 0 | 12 | 1.53 | 1.00 | 1.65 |
| Number nursing visits made | 80 | 0 | 22 | 6.45 | 6.00 | 4.97 |
| Number nursing visits ordered | 80 | 0 | 32 | 6.50 | 6.00 | 4.62 |
| Number therapy visits made | 80 | 0 | 26 | 5.98 | 5.50 | 5.49 |
| Number therapy visits ordered | 80 | 0 | 23 | 6.19 | 6.00 | 5.74 |
| Predicted therapy visits (M2200)* | 80 | 0 | 17 | 4.10 | 2.00 | 3.98 |
| Number combined visits made in HH episode (all disciplines) | 80 | 1 | 44 | 12.89 | 11.00 | 8.82 |
| Number total visits made in first week (all disciplines) – frontloading | 80 | 1 | 11 | 4.44 | 4.00 | 2.20 |
| Frontloaded contacts rate in first week (all disciplines) | 80 | 14 | 157 | | 57.00 | |
| Care coordination among HH personnel (dichotomous; % yes) | 38 (47.5%) | | | | | |
| Care coordination with primary provider (dichotomous; % yes) | 35 (43.8%) | | | | | |

*M2200 is an OASIS assessment item

Table 10

*Univariate Results with 30-day Readmission (n = 80)*

| Variable | OR | p-value | 95% C.I. for OR Lower Upper | Wald |
|---|---|---|---|---|
| Number total combined therapy visits made | 0.810 | 0.001 | 0.731-0.920 | 10.549 |
| Number high risk meds* | 1.678 | 0.004 | 1.175-2.395 | 8.126 |
| Homebound status by medical contraindication* | 4.160 | 0.005 | 1.547-11.188 | 7.975 |
| Frontloaded contacts rate in first week HH service* | 0.979 | 0.013 | 0.962-0.995 | 6.233 |
| Number total visits made in first week HH service | 0.738 | 0.013 | 0.580-0.938 | 6.186 |
| Ability to plan and prep meals (OASIS M1880)* | 2.185 | 0.022 | 1.119-4.264 | 5.246 |
| Number total visits made in HH episode | 0.929 | 0.023 | 0.873-0.990 | 5.197 |
| Overall status (OASIS M1034)* | 2.413 | 0.026 | 1.112-5.237 | 4.962 |
| Braden score at SOC or ROC (pressure ulcer risk) | 0.793 | 0.030 | 0.643-0.977 | 4.733 |
| Ability to feed self and eat (OASIS M1870)* | 1.801 | 0.032 | 1.053-3.080 | 4.616 |
| Number combined therapy visits ordered on 485 | 0.907 | 0.036 | 0.828-0.993 | 4.416 |
| Ability to use phone (OASIS M1890)* | 1.274 | 0.043 | 1.007-1.611 | 4.081 |
| Upper body dressing (OASIS M1810)* | 1.951 | 0.047 | 1.010-3.770 | 3.957 |
| Toilet self-hygiene ability (OASIS M1845) | 1.848 | 0.054 | 0.989-3.451 | 3.707 |
| Difference between nursing visits made and ordered | 0.863 | 0.058 | 0.741-1.005 | 3.606 |
| History of diabetes yes/no (any type) | 2.286 | 0.078 | 0.911-5.735 | 3.102 |
| Prior oral med management (OASIS M2040a) | 1.807 | 0.078 | 0.935-3.493 | 3.098 |
| Prior hospital LOS | 1.086 | 0.079 | 0.991-1.191 | 3.094 |
| Difference between therapy visits made and ordered | 0.892 | 0.080 | 0.785-1.014 | 3.060 |
| Toilet transfer ability (OASIS M1840) | 1.459 | 0.087 | 0.946-2.250 | 2.290 |
| Prognosis | 0.666 | 0.099 | 0.410-1.080 | 2.716 |

Key: SOC=start of care; ROC=resumption of care; LOS=length of stay; 485=HH comprehensive order form with the plan of treatment and medication list, signed by the doctor; OASIS assessments are comprised of measures, each encoded with an M-item; *eight variables accepted and entered into the multiple logistic regression 30-day readmission model

Table 11

*Univariate Results with Readmission Anytime to Hospital from HH (n = 80)*

| Variable | OR | p-value | 95% C.I. for OR Lower Upper | Wald |
|---|---|---|---|---|
| Homebound by medical contraindication* | 4.265 | 0.006 | 1.531-11.886 | 7.695 |
| Number high risk medications* | 1.678 | 0.006 | 1.164-2.420 | 9.361 |
| HH total LOS* | 1.022 | 0.016 | 1.004-1.040 | 5.793 |
| Number of medications total* | 1.110 | 0.027 | 1.012-1.217 | 4.915 |
| Full code status* | 2.778 | 0.027 | 1.123-6.868 | 4.893 |
| Number nursing visits made* | 1.110 | 0.041 | 1.004-1.227 | 4.185 |
| Prior hospital LOS | 1.102 | 0.054 | 0.999-1.215 | 3.726 |
| Predicted therapy visits (OASIS M2200) | 0.888 | 0.055 | 0.786-1.002 | 3.688 |
| Ability to prepare meals (OASIS M1880) | 1.827 | 0.055 | 0.987-3.383 | 3.682 |
| Overall status (OASIS M1034) | 2.122 | 0.056 | 0.980-4.594 | 3.646 |
| HH episode LOS (≤60 days) | 1.022 | 0.069 | 0.998-1.047 | 3.308 |
| History of diabetes yes/no (any type) | 2.296 | 0.073 | 0.927-5.687 | 3.224 |
| Rehabilitation potential | 0.500 | 0.079 | 0.231-1.083 | 3.092 |
| Nursing visits ordered | 1.114 | 0.079 | 0.987-1.257 | 3.079 |

Key: LOS = length of stay; HH episode is a maximum of 60 days long; *six variables accepted and entered into the multiple logistic regression readmission anytime model

Table 12
*Multiple Logistic Regression Results with 30-day Readmission (n=80)*

| Variable | AOR | p-value | 95% C.I. for AOR Lower Upper | Wald |
|---|---|---|---|---|
| Frontloaded contacts rate in the first week | 0.970 | 0.005 | 0.949-0.991 | 7.737 |
| Number of high risk medications | 1.638 | 0.027 | 1.057-2.537 | 4.878 |
| Homebound by medical contraindication | 3.423 | 0.060 | 0.951-12.327 | 3.544 |
| Ability to use phone (OASIS M1890) | 1.288 | 0.165 | 0.901-1.839 | 1.931 |
| Ability to feed self and eat (OASIS M1870) | 1.494 | 0.267 | 0.735-3.036 | 1.231 |
| Upper body dressing (OASIS M1810) | 1.409 | 0.497 | 0.524-3.786 | 0.462 |
| Ability to prepare meals (OASIS M1880) | 1.275 | 0.591 | 0.526-3.095 | 0.289 |
| Overall status (OASIS M1034) | 0.821 | 0.733 | 0.264-2.552 | 0.116 |
| Constant | 0.273 | 0.248 | | 1.335 |

Omnibus test of model coefficients for the 30-day readmission model with 8 variables simultaneously entered, demonstrated a model chi-square of 32.058 (df = 8, p =0.000). Cox and Snell R-square = 0.330 and Nagelkerke R-square = 0.448.

Table 13

*Multiple Logistic Regression Results with Readmission Anytime (n=80)*

| Variable | AOR | p-value | 95% C.I. for AOR Lower Upper | Wald |
|---|---|---|---|---|
| Homebound by medical contraindication | 5.058 | 0.011 | 1.451-17.634 | 6.473 |
| HH total LOS | 1.034 | 0.033 | 1.003-1.067 | 4.531 |
| Number high risk medications | 1.449 | 0.097 | 0.937-1.176 | 0.696 |
| Full code status | 2.413 | 0.115 | 0.807-7.215 | 2.484 |
| Number of medications total | 1.050 | 0.404 | 0.937-1.176 | 0.696 |
| Number nursing visits made | 0.938 | 0.441 | 0.798-1.103 | 0.593 |

Omnibus test of model coefficient for the readmission anytime model with 6 variables simultaneously entered, demonstrated a model chi-square of 29.565 (df = 6, p = 0.000). Cox and Snell R-square = 0.309 and the Nagelkerke R-square = 0.412.

## CHAPTER VI

## DISCUSSION

This chapter discusses impressions of the study findings, implications for practice, recommendations for future research, limitations and conclusions. This research was a secondary analysis of data from one home health (HH) agency in northern California, which investigated predictors of readmission to the hospital from the HH setting. Operational, sociodemographic and clinical predictors were investigated for their influence on readmission to the hospital during HH services, at two different time points. However, of highest interest was the context of the agency, and/or clinician working for the agency, and measures that were or were not taken operationally that may have influenced readmission at different time frames. Operational predictors included visits made, disciplines involved, and timeliness of care after an initial hospitalization. Clinical predictors included diagnoses, risk factors such as fall risk, and code status. Sociodemographic factors included age, race and gender. The sample included 80 de-identified HH participants, with electronic health data retrospectively analyzed. Participants were aged 64 to 100 years, a majority were female and primarily insured by Medicare Advantage. A small majority were married but a preponderance lived permanently with a caregiver such as an adult child or a spouse.

### Summary of Results

Two readmission models emerged from the sample, 30-day readmission to the hospital from HH and readmission to the hospital from HH at anytime. In this convenience sample of 80 participants, the goal was to investigate influences on readmission and did not determine an agency rate of readmission within the study period. For each readmission group, there were numerous, statistically significant results on univariate analyses (with alpha set at 0.05).

Findings for the 30-day readmission multiple logistic regression (MLR) model demonstrated influence from the frontloading of HH visits as being protective and medical complexity via the number of high risk medications as being predictive of 30-day readmission.  Findings for the readmission at anytime MLR model demonstrated influence from homebound status due to medical contraindication (also referred to as medical necessity) and longer HH total length of stay (in days) both being predictive of readmission anytime.  A discussion of the principal results will be presented including specific significant univariate results, as these data represent findings of operational or clinical interest that warrant continued study.  Finally, collateral findings demonstrating agency performance will be examined as demonstration of ongoing HH operational and research value.

## Visits

In univariate analysis, several operational variables demonstrated protective results with 30-day readmission to the hospital from HH, most of which revolved around the number of visits and the type of visits made or ordered by HH.  Home visit frequency, the disciplines involved and the length of time that a patient remains on home health is determined in large part by the home health clinicians assessing the client's condition and goals, but coordinated with each patient's doctor and signed on the plan of treatment (Centers for Medicare Services (CMS), 2017a).  Visits must be reasonable and necessary to work toward all disciplinary goals (CMS, 2011).  Home health visit plans lack standardized approach and the general guidance is to individualize each plan of care to the patient's clinical picture.  While we lack consistent data and a standard approach to creation of visit plans per episode, we have some insight into the aggregate average visits per episode as collected by the CMS.  In 2010, U.S. HH agencies held an aggregate average visits per episode of 17.6 (Medicare Payment Advisory Commission

(MedPAC), 2014), and the range of agency-based average visits per episode in 2015 was between 5.4 and 111.2, with a median of 17.4 (CMS, 2018b). The average agency visits per episode within this study was 12.89 (SD = 8.82, Md = 11.00) during the study period of July 2016 to December 2017, considerably lower than both of these retrospective, national benchmarks. While there is no data provided nationally on visits ordered (whether made or not made), the median of the U.S. average combined total HH therapy visits made per episode in 2015 was 0.79 (below 1.00 visit due to the preponderance of 0.00 visits for occupational and speech therapies listed in the data) (CMS, 2018b). Using this same data to sequester physical therapy only, the median of the U.S. average total HH physical therapy visits made per episode in 2015 was 4.98. The median of the agency-based average combined total HH therapy visits made per episode in this study was 5.50 (inclusive of physical, occupational and speech therapies), more reflective of the U.S. 2015 physical therapy median of the average data.

The visits made per episode, number of combined therapy visits ordered and number of combined therapy visits made, were all significant and protective within univariate analyses with 30-day readmission to the hospital from HH within this study. This indicates that influence for reduction or protection against 30-day readmission from HH, is derived not solely from the number of visits, but also the type of visits (all disciplines combined and therapy-specific). However, due to the amount of multicollinearity in the 30-day readmission model, the reflection of these visit-based variables was removed in multiple logistic regression (MLR) in favor of one visit-based contrast variable, *frontloaded contacts rate in first week.* In Chapter V, the significant influence of these variables in the 30-day MLR was demonstrated. The message around the statistical significance of therapy visits and number of visits should not be lost because of multicollinearity. These variables have meaning in practice and can influence readmission, therefore are worthy of further consideration. The choice favoring retention of frontloaded contacts rate in first week was that the level of univariate significance was high enough, and the variable was of interest operationally to reflect and validate the influence of frontloading visits. Frontloading is something that every U.S. HH agency can perform, with every discipline involved. It will be discussed in greater detail in later in the chapter.

One visit-based variable was significant in univariate analysis with the dependent variable, readmission anytime: number of nursing visits made in episode. The number of nursing visits made was predictive of readmission anytime (AOR = 1.110, $p = 0.041$) demonstrating that as the number of nursing visits rise, so does the risk of being readmitted to the hospital at anytime during HH services. When this variable enters the MLR in the presence of the five other variables, the AOR flipped to protective, or an inverse relationship (AOR = 0.938, $p = 0.441$) for reasons undiscovered in this research. This variable did not maintain statistical significance and unique contribution to the readmission anytime MLR model with the other five variables in place. There is likely clinical and operational applicability behind this variable being present in the model, however further research will be needed to determine its true relationship with readmission to the hospital from HH at anytime.

## Frontloading Variable

One of the foci for this research evolved in-study. Determining a consistent, working measure of frontloading visits was a priority, with intent for use as the study measure for identifying an affirmative frontloaded case. Frontloading provides clinical oversight, connection and services to a patient/caregiver/family designed to reduce rapid clinical decline and risks of subsequent readmission. A standard definition or formula for frontloading visits is still lacking in HH systematics despite its inception since the early 2000s, as an operations intervention to reduce potential readmission from HH (Boyce and Feldman, 2007; Home Health Quality Initiative (HHQI), 2016; Health Services Advisory Group (HSAG), 2015; Rogers, Perlic and Madigan, 2007). Instead there is a description of the design and purpose, and a variety of operational definitions utilized in our small body of HH literature, leaving HH operations to determine their best use of the technique. O'Connor, Bowles, Feldman, St. Pierre, Jarrin, Shah and Murtaugh (2014) performed a review of literature to determine the state of the science regarding frontloading of HH visits. Visit intensity, disciplines involved, the types of cases frontloaded and the outcomes were all examined. They concluded that there was enough evidence that frontloading of visits contributes to reduced readmissions, however two issues were highlighted: (a) there were possible confounders not controlled for in the study designs and (b) there were excessive differences in the calculations of frontloading among the studies to allow for a standard approach in conclusion.

This study developed the working measure *frontloaded contacts rate in first week* as the measure of frontloading, explained in greater detail in Chapter IV. Frontloaded visits have some variance in definition and practice in HH, therefore it was important to create some substantive definition to identify the threshold within-study where frontloading occurred (and did not occur) and to attempt form a working definition that could be utilized from the ground, once tested. As described in the prior chapters, the lexicon usage of “contacts” was necessary to include visits, consultative phone calls with patients/caregivers and telemonitoring (with and without video). The HHQI campaign (2016) discusses alternate outreach available today surrounding telemonitoring and phone contacts, but there may be expanded ways we support patients into the future that are currently undetermined. This frontloading definition allowed for that stretch. However, this study setting did not yet utilize telemonitoring technology and the sample did not have evidence of consultative phone calls. (There was evidence of care coordination and of phone calls of a non-consultative nature.) Hence for this sample and study, frontloaded contacts rate in the first week of care investigated the singular contact of “visits”. The measure is also an accessible, simple calculation that can be performed by clinicians or administrators from the start of HH care. Despite this particular study being retrospective, the calculation is intended to also be useful moving prospectively.

The literature review performed by O’Connor, et al. (2014), examined studies between 1994 – 2005, when the HH marketplace was different in reimbursement and regulation, where frontloading was performed within the first two weeks of HH care. The development of frontloading visits in HH arose greater than ten years ago, before healthcare reforms, in the early days of strategizing reductions of hospital readmissions. The study performed here-in had a time-period from July 2016 to December 2017, with primary reimbursement from Medicare Advantage, with a mean episode length of HH stay being 31.04 days (SD = 19.37) and a mean total length of HH stay being 46.03 days (SD = 72.01). Hence the measurement of a frontloaded contacts rate occurring in the first *week* of care being more congruous to modern day HH services. Rationale centered around the mean episode length of stay being closer to 30 days (instead of a full 60 day episode), therefore two weeks of frontloading would become half-loading the episode in many cases, so the time frame was adjusted for the sample. Finally, having a denominator (and not solely counting the number of visits planned or made in the first week) weights the calculation by a definitive calendar week of 7 days, disallowing different interpretations of the length of a week. O’Connor et al. (2014) reported other studies calculating frontloading using seven (7) as the weight, however these calculations were not fully revealed and utilized primarily retrospective knowledge of the visits made in the entire episode. A solid and useful frontloading calculation should be easy for clinicians, schedulers or administrators to reproduce on the ground, and should be accurate when projecting contacts from start of care or resumption of care, not depending on retrospective review. In other words, as a community engaged in outcome improvement, any consideration to a frontloading measure ought to be designed for prospective care planning and not solely for retrospective study. It may also be flexible to have different denominators depending on the length of a project or actual episode, for instance in episodes of a 60-day length, perhaps the frontloaded contacts rate ought to be calculated with a 14-day weight in the denominator and shorter episodes (such as those seen with Medicare Advantage visit-approvals) should be considered as this study, with a 7-day weight in the denominator. Currently, this is entirely hypothesized and should be considered as an implication for further research and validation.

## Clinical/Medical Complexity

Clinical complexity is reflected by the readmission anytime model with six contrast variables: homebound status by medical contraindication, HH total length of stay, number high risk medications, number of medications total, full code status and number of nursing visits made in episode. Patient cases designated by homebound status via medical contraindication, requiring longer length of stay, having polypharmacy with both high risk medications and total number of medications are arguably describing elements of potential readmission risk from a clinical and operational perspective. Home health length of stay is rarely studied and, to the best of knowledge, has not been tested as a readmission predictor. Two studies reported a mean population HH length of stay at approximately 40 days which is six days shorter than the mean length of stay for this sample (46.03 days) (Murtaugh, Peng, Moore and Maduro, 2008; Dierich, Mueller and Westra, 2011).

Medications are known to be a risk for readmission, regardless of setting. In characterizing medications as a measure of complexity, especially in the elderly, Housley, Stawicki, Evans and Jones (2015) utilized the comorbidity-polypharmacy score to determine a measure of patient frailty and association with readmission in a sample of elderly physical trauma patients. Results showed that patients readmitted within 30-days had a higher comorbidity-polypharmacy score than patients not readmitted, and concluded that comorbidity-polypharmacy score was a better determinant of frailty than age for their population. While this study did not utilize the comorbidity-polypharmacy score, polypharmacy alone characterized risk for readmission. Masnoon, Shakib, Kalisch-Ellet and Caughey (2017) performed a systematic review of polypharmacy definitions in 110 healthcare articles and found that the definitions varied by numerical and descriptive content, but a majority utilized the numeric identifier of ≥5 medications as part of their definition. Using that threshold determines that 78/80 (97.5%) participants in this study met the definition of polypharmacy. We unfortunately have not determined a mutually agreeable working definition of polypharmacy that is used consistently. The Project Boost initiative, designed by the Society of Hospital Medicine (n.d.), created an adverse events tool called the 8P Screening Tool which lists their definition of polypharmacy as ≥10 routine medications or the presence of high risk meds such as insulin. It seems a stretch to wait for their threshold of ten or more routine medications before declaring polypharmacy, especially for elderly and caregivers self-managing at home. However what is favorable in their definition is the inclusion of one high risk medication determining a patient's medication listing as polypharmacy risk. This study included high risk medications, which demonstrated a range of 0 – 7 and a mean of 1.59 (Md = 1) high risk medications per case. High risk medications were a significant contributor to 30-day readmission in this study, and present in readmission at anytime model (NS at alpha 0.05). Dierich, et al. (2011) studied the outcomes of medications taken by elderly at home, during HH services. Results reported that patients readmitted to the hospital during HH services were significantly more likely to be taking >9 medications. In this study, there was no significant difference in the mean number of total medications taken between the readmitted cohort (mean = 13.00 meds) and the non-readmitted cohort (mean = 11.10 meds) in the 30-day readmission model ($t = -1.587$, $p = 0.117$). However, there were significant differences between the mean total number of medications in the readmission at anytime model, as well as the number of high risk medications in both models, and these results were illuminated within univariate analyses.

Despite the afore-mentioned medical and clinical complexity descriptors for readmission, participants readmitted at anytime from HH had a preponderance of declaring full code status, desiring full application of medical response teams if an emergent situation arose (AOR = 2.778 univariate, $p = 0.027$, not significant in MLR). Literature search for previous studies and review articles regarding the influence of code status or POLST (POLST.org, n.d.) declaration on readmission potential netted zero applicable results. Expanding terms to include advanced directives and prognosis was more forthcoming, albeit out of alternate settings. Hussain, Cha and Takahashi (2009) found that patients living in skilled nursing facilities with various co-morbidities and experiencing 30-day readmissions, were more likely to die at all time points between 6 months and 2 years. Patients with 30-day readmission were 3.8 times more likely to die within 2 years after skilled nursing facility admission. One of their conclusions was that clinicians should consider end of life discussions with patients exhibiting advanced age and comorbid health condition. Prognostication variables within the dataset for this study were inconsistently scored, sometimes even missing entirely. One illuminating study discovered low inter-rater reliability of OASIS items covering rehabilitation potential and prognosis in earlier versions of the tool (Kinatukara, Rosati and Huang, 2005), indicating that HH clinicians may not be well trained on determinants of prognosis, thus the variances. Inter-rater reliability between cases may have been a factor in this study, therefore only two variables relating to end of life were considered, (a) code status and (b) the OASIS measure overall status M1034. Overall Status M1034, contains elements of prognosis and rehabilitation potential and was more consistent in scoring such that there was significant differences between non readmitted participants and readmitted participants for both models.

## Agency Performance

### Non-Significant Items

Timeliness of care was not significantly different between readmission and non-readmission groups for both models. Also the mean differences between two discipline visits ordered and made, was not significantly different. We tend to seek statistical significance in research, however there are occasions where non-significance indicates a positive outcome. This is the circumstance with the timeliness and mean difference in visits findings presented in this section, and is a reflection of the work of the home health agency studied. While not generalizable to all U.S. agencies, the message should be acknowledgment of the continued importance of measuring these variables in future home health readmission studies and the possibilities of outcome improvement when these functions become part of daily operations in the HH setting. Other non-significant results will also be discussed briefly to support the suggestion of continued research.

**Timeliness of Care.** The CMS regulates HH agencies to complete starts and resumptions of care within 48 hours (2 days) of referral completion or from the point of hospital discharge if the complete referral was received prior to discharge (CMS, 2011; 2017b). If a referring doctor specifies the exact date for HH services to begin (for example, when a medication must be delivered or a wound dressing is scheduled to be changed), then the regulation is to follow that order and start or resume care on the ordered date (CMS, 2017b; 2018a). The findings of this study complied with timeliness of care for most cases such that there was no significant difference between groups. Care was initiated as regulated for start or resumption of care with a mean timeliness of 1.53 days (Md = 1.00 day, SD = 1.65 days) between hospital discharge and the start of HH care, or on the date ordered by the doctor, within the whole sample. Operational challenges to timeliness of care can be demanding and include daily staffing, caseload volume and other HH variables such as geographical distance between patient homes. The finding of timeliness on average complies with the regulation and reduces chances of timeliness being a confounder in readmission results.

**Visit Differences.** Paired t-tests were performed to test mean differences between some variables of operational interest, apart from readmissions analysis. These tests reflected performance of the agency of study, which could illuminate some potential confounders, if present. The mean difference in visits ordered and made were compared, as these represented the same variable at two different time points: visits ordered was the projection during plan of care development, and visits made was the look-back on the plan of care at the close of the episode. Both nursing visits ordered versus made, and therapy visits ordered versus made, were evaluated. The mean differences were not statistically significant. This suggests that the agency performed with consistent accuracy in both planning and making visits to achieve patient goals, and also suggests that nursing and therapy episodes of care were completed as ordered, on average.

**Pain Scores**

Paired t-tests were performed to test mean differences between the patient's stated pain score at the beginning of the episode studied and then again at discharge, also tested apart from readmission. This analysis was performed as a reflection of agency performance in reducing patient's level of pain during the plan of care, on average. Pain is likely a combination variable, meaning that pain can change with time, the patient and caregiver can affect pain level at home, and the patient's primary provider is exerting effect on pain with their own plan of treatment. However, the HH agency also has influence clinically within the HH plan of treatment, reflecting some success in assessing and treating pain throughout the HH length of stay if the mean differences in pain scores were significantly different on average. Results demonstrated significant differences between mean pain scores (mean difference = 2.43, $t = 7.61$, $p = 0.000$), which reflects some consistent reduction in pain among cases and between HH clinicians.

## Implications for HH Practice, Policy and Recommendations for Further Research

Implications from this study include protective and predictive effects of readmission at two time periods, within 30-days and at anytime. Results showed protective effect, meaning reduced risk of 30-day readmission in the presence of frontloaded contacts, as measured by a frontloaded contacts rate of 57% or more within the first week of HH care. Despite thorough investigation into this frontloading measure and the threshold of 57% frontloaded contacts rate indicating a frontloaded case (4/7 contacts), it bears replication in further study with greater sample sizes before general implications in practice can be endorsed. This is especially important to test other intentional types of contacts than visits as being protective in reducing the risk of readmission, as well as testing different time frames (denominator) with different episode lengths. As discussed in Figure 8 (Chapter V), when the frontloaded contacts rate in the first week variable was replaced by therapy visits ordered, therapy visits made or total number of visits made in episode, results also showed protective, risk-reducing effects within the 30-day model. These visit variables have implications for further research before translation to practice can be asserted. A cautionary implication is that the finding of therapy being protective against readmission in this study, is not stated as a method that can potentially reduce 30-day readmission. It is possible that cases requiring more therapy over nursing are less complex medically, resolve with a shorter length of stay and therefore experience less readmission risk.

Results showed predictive effects increasing risk for both 30-day readmission and readmission at anytime, from the number of high risk medications. Also uniquely contributing to readmission risk at anytime was the designation of homebound status by medical contraindication. In general, the higher the medical complexity of a case, the higher the risk of readmission. High risk medications as relating to the HH setting needs clearer definition in the U.S., which could assist improved identification of high risk medications in the home bearing influence on readmission from the HH setting. CMS (2018a) has attention on medication risk through the OASIS assessment M2000s, especially M2010 High Risk Drug Education, relating to medication reconciliation and coordinated care with the doctor. However, many of these measures are process questions with a yes/no response, requiring existing knowledge of the level of risk and access to resources to determine each patient's high-risk medications. The Institute for Safe Medicine Practices (ISMP) (2011) guidance used within this study was not well inclusive, as medications such as the Seroquel™ on one case, come with prominent box warnings for use in the elderly with dementia on the professional monograph (U.S. Food & Drug Administration (FDA), 2013). Oxygen at home has increasingly been indicated as a potentially hazardous substance due to flammability, such that The Joint Commission added oxygen home safety to their National Patient Safety Goals in 2015 (NPSG 15.02.01) (The Joint Commission, 2018). Yet, neither of these medications are on the ISMP listing for home health. This implication to further validate a working, inclusive, HH-setting-specific definition of high risk medications (fully acknowledging that this is an ever-developing target as medications change) likely exceeds that of individual organizations and should be elevated to continued robust research and policy or standards level nationally.

Infection appeared in the top four diagnostic categories for HH start of care and was the primary reason for readmission to the hospital from HH. This category was scored to include all system infections, including pneumonia, acknowledging the current preponderance of sepsis (Stoller, Halpin, Weis, Aplin, Qu, Georgescu & Nazzal, 2016). Sepsis has become problematic in the U.S, achieving status as the most expensive admission in hospitals through 2013 such that a hospital-based outcome bundle for sepsis monitoring in hospitals was added by CMS in July 2015 (Septimus, Coopersmith, Whittle, Hale, Fishman & Kim, 2017). To the best of knowledge, HH does not have a standard approach to plans of treatment specifically targeted for infection, nor with focus on sepsis prevention. Infection emerging in this analysis, as prominent for readmission reasons from HH and within the top three categories for reason for starting HH services, was an unexpected finding. However, no diagnostic category demonstrated significance on analysis with readmission. It will be important to continue to monitor this in further study.

Some regulatory and practice implications revolve around OASIS changes and prognostication competency of HH clinicians. CMS plans to remove the overall status M1034 measure from the OASIS data in an upcoming revision 2019, as well as ability to feed self and eat M1870, ability to plan and prepare meals M1880 and ability to use the phone M1890 (CMS, 2017b). All of these OASIS items demonstrated higher risk for readmission in univariate analyses. Their removal will dissipate operational ability to use these measures as readmission determinants from HH. Overall status M1034 was the most consistently scored prognostication measure by agency clinicians in this study, and as illuminated by other OASIS reliability study results, inter-rater reliability for prognosis items tends to underperform. At a minimum, an operational implication is to consider harmonizing HH clinicians' abilities to prognosticate cases based on assessment findings, and care plan to prevent readmission based on the prognosis results as a reflection of medical complexity.

Full code status demonstrated prediction of risk for readmission at anytime in this study. Our current language for advanced directives and the inclusion of multiple levels of resuscitation efforts now in the POLST declarations (POLST.org, n.d.), along with evident medical complexities of patients shared amongst all settings, should awaken our collective desire to assure a standard sharing of code status information between patient, caregiver, hospital and home health at a minimum. The results inside this study, sensitive enough to produce statistically significant, univariate results between full code status and readmission anytime, despite a small sample, is indication of a potential novel predictor being revealed to the readmission discussion. The code status data was missing from a fair number of records (designated as not stated within study). HH is not well-included in the loop regarding end of life wishes, and this study revealed the potential importance of full code status as a potential predictor for readmission from HH. Future research needs to include code status as a variable of interest in readmission studies from HH, with caution that this data may need to be validated with physician or hospital settings.

Finally, there are several variables that did not demonstrate statistical significance in this study however in larger samples inside other studies, have shown significant results with readmission from HH. Diagnoses would be an example, as well as care coordination, Braden score and pressure ulcers, and timeliness of care. Perhaps in a larger study sample, these variables would add to the readmission models explaining further variance and predictability.

## Limitations

In this age of big data, we are accustomed to having access to large swaths of relatively clean datasets, which allow for statistical power and generalizability. This study aimed directly at the level of the HH agency to conduct secondary analysis of data, to allow inclusion of non-OASIS information such as referral data, orders, and care coordination. Therefore, sampling was constrained by the cleaning of many highly detailed variables, cross-validation of data and one researcher. Study limitations included the small sample size of 80 participants and non-random selection of the retrospective convenience sample. Generalizability of findings was also a limitation of the study. History effects may have occurred, such as the Braden scores not being present for four participants during a time of transition, resulting in needing to drop the variable from study. Also, retrospective design disallows certain control over process variables, for instance of code status handovers at referral.

## Conclusions

Home health operations can influence readmission to the hospital during HH services, in the presence of clinical/medical need of the patient. Thirty-day readmission to the hospital from HH was influenced by an operations variable, frontloaded contacts rate performed at a 57% (4/7 contacts) rate or higher, which reduced readmission risk. The clinical variable, number of high risk medications, also provided unique contribution to the 30-day readmission model through medical complexity and increased risk of readmission. Readmission to the hospital from HH at anytime was influenced clinically by homebound status by medical contraindication (also known as medical necessity) with a much higher risk of readmission than those without this designation of homebound status. Home health total length of stay also provided unique contribution to the readmission anytime model, and demonstrated influence via higher risk prediction of readmission at anytime. The HH total length of stay is considered an operational variable as the determination of length of stay depends on clinician assessment, coordination of care and even insurance coverage of HH services. For both models, medical complexity and the operational influence from plans of treatment were evident.

The burden of readmission is large, costly to the Medicare Trust Funds as well as to other insurers. This burden carries through to patients and families who can experience frequent medical instability with insufficient measures to prevent transfer to the hospital. The home health setting has unique influences on readmission and with patients that are not shared with other settings, which has value in continued study if we are to fortify the body of evidence with original research. While secondary analyses of large datasets are worthwhile and continuing to provide insights into home health science, it remains imperative to conduct research from the ground in home health to detect influences not represented in big data. Future research will be necessary to validate the findings of this study and the significant variables' influence on readmission from HH at different time points, as well as investigate the influence of similar determinants of interest such as therapy visits, diagnoses with a focus on infection, and code status.

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## Appendix A

## Operational Definitions

1. Medicare certified home health (HH): a home health agency certified to accept Medicare-insured referrals; agency has a Medicare provider number registered and is surveyed at least every three years to assure compliance with the Conditions of Participation for Home Health Agencies (CMS, 2011; 2017a; n.d.)
2. HH episode: a period of time not to exceed 60 days from the beginning of the HH care episode, with doctors orders specifying the plan of treatment and eligibility for HH services (CMS, 2018)
3. Start of care (SOC): A SOC is the first day of billable care for skilled services provided to a patient coming on to HH care (CMS, 2018). A synonym would be an "admission" to HH, however that terminology is typically reserved for inpatient settings and therefore HH uses alternate terminology.
4. Resumption of care (ROC): Patients who have had HH care disrupted due to a readmission to the hospital, are able to return to their HH agency to resume care if they want to and if they return before their prior episode of care has timed out (60-days) (CMS, 2018). For patients who are eligible for a ROC, an intake assessment it done once they are discharged home again, with new orders written for the remainder of the episode.
5. Recertification: Patients who have had HH care for an entire episode, who are still eligible for HH services and have skilled care needs, can continue to receive HH services. A recertification assessment must be performed with new orders for another episode of care (CMS, 2017b; 2018)

6. Home health (HH) operations variables: HH operations are daily administrative or clinical functions performed by a home health organization that potentially bear influence on readmission to the hospital during HH services. These are variables that can be directly improved or changed to alter or maintain the desired readmission outcome for each patient and for the agency on a macro level. Examples would be timeliness of care and number of visits ordered.
7. Clinical variables: Clinical variables are those pertaining clinically or medically to the patient, such as symptoms or diagnoses.
8. Sociodemographic variables: Sociodemographics are variables that describe characteristics of the patient, caregiver, family and/or home environment. Some cannot be altered such as race, or require more profound resources to change, such as hiring a live-in caregiver.
9. OASIS/OASIS assessment (considered synonymous): OASIS is an acronym for the standardized, CMS-developed assessment and outcomes tools which HH clinicians complete at specific time points, such as start of care or recertification (CMS, 2018). OASIS stands for Outcome and Assessment Information Set. OASIS is revised regularly by the CMS in conjunction with technical expert panels, and has been in place since the late 1990s; the current version is OASIS-C2 which is due for updates as soon as January 2019.
10. High risk medications (meds): HH clinicians are not prescribers, however are required to perform medication reconciliation for all medications within the home and resolve any issues with high risk medications within 24 hours of discovery (so scored on OASIS assessments, as well) (CMS, 2018). Home health does not have a standard high risk meds set. This study used a combination of sources to identify medications on each participant's medication list to validate or refute as high risk: a) the 2011 Institute for Safe Medicine Practices (ISMP) High

Alert Medications list, b) online professional monographs such as on Drugs.com, looking for label or box warnings, c) the OASIS guidance (CMS, 2018) and d) The Joint Commission (TJC) National Patient Safety Goals 2018. A high risk medication includes these descriptors, but are not limited to, drugs that increase the patient's and/or family's safety due to direct intravenous infusion, needles or contaminants in the home, drugs that can easily be confused as another more benign medication hence be too casually used, drugs that are flammable under the correct circumstances, medications which have demonstrated addictive qualities, drugs with potentially serious side effects and drugs where dosing is imperative for safety (too much or too little could cause an urgent/emergent situation such insulin producing drugs).

11. Homebound status and strata: Medicare patients referred to home health agencies must meet certain eligibility criteria to have skilled care paid for by Medicare. One criteria is that patients must be homebound during their home health episodes of care (CMS, 2014). This does not mean they are confined to bed or even to the home every day (CMS, 2013). Homebound criteria is certified upon referral to home health by a referring doctor and is also signed by the primary provider on the home health orders.
12. Readmission from HH/Readmission during HH services (considered synonymous): a patient re-admitted to any inpatient, acute care hospital, for any medical reasons, after an initial hospitalization (from which the re-admission is measured) while still on services with HH. Regulatory and measurement criteria for HH can be found online and CMS.gov (CMS, 2017c) and Horwitz et al., 2011. Readmissions from HH are measured in varying time frames; in this study there are two time frames: readmission to the hospital within 30-days of HH SOC and readmission to the hospital at anytime during HH services, indicating a

possible time period beyond the first 30-days after an initial hospitalization. Both time frames assume a prior, initial hospitalization verified by eligibility into the study.

13. How readmission measured in-study: All readmissions were measured in time frame by days, from the point of HH start or resumption of care after the initial hospitalization for any reason, to the point of readmission, if one occurred.

14. Frontloading: A function of making a higher frequency of home visits (or other types of purposed contacts with the patient and/or caregiver) at the beginning of HH care (Home Health Quality Initiative (HHQI), 2016).

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## Appendix B

## UCSF Institutional Review Board Letter of Approval Exempt Status

University of California
San Francisco

**Human Research Protection Program**
**Institutional Review Board (IRB)**

# Exempt Certification

*Principal Investigator*
Catherine Waters

*Co-Principal Investigator*
Irene S Cole

**Study Title:** 30-day Readmission from Home Health: Association and Impact of Home Health Operations Variables
**IRB #:** 17-24168
**Reference #:** 210306
**Committee of Record:** Parnassus Panel
**Type of Submission:** Submission Correction for Initial Review Submission Packet
**Certification Date:** 02/13/2018

**IRB Comments:**

**This research qualifies as exempt under the following category:**
(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

A limited dataset, that includes dates, will be received from XXXX (Researcher de-identified HH agency for manuscript)

**Modifications:** For exempt research only, researchers can make *minor* changes to the study without notifying UCSF IRB. However, significant changes must be submitted to the UCSF IRB. The UCSF IRB website includes examples of minor vs. significant changes. All changes must follow UCSF guidance, and some changes are not allowed in the consent materials.

**Study Closeout Report:** This study does not have an expiration date. However, you are required to submit a study closeout report at the completion of the project.

For a list of all currently approved documents, follow these steps: Go to My Studies and open the study – Click on Informed Consent to obtain a list of approved consent documents and Other Study Documents for a list of other approved documents.
**San Francisco Veterans Affairs Medical Center (SFVAMC):** If the SFVAMC is engaged in this research, you must secure approval of the VA Research & Development Committee in addition to UCSF IRB approval and follow all applicable VA and other federal requirements. The UCSF IRB website has more information.

**UCSF Publishing Agreement**

Publishing Agreement

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Author Signature ______________ Date 6.18.18