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Resident and Facility Factors Associated with Rehospitalization from Skilled Nursing Facilities

Angelina M. Flores-Montoya
University of New Mexico

Mark B. Parshall
University of New Mexico

Marie L. Lobo
University of New Mexico

Stephen H.A. Hernandez
University of New Mexico

Christine A. Mueller
University of Minnesota

Angelina Flores-Montoya

Candidate

University of New Mexico College of Nursing

Department

This dissertation is approved, and it is acceptable in quality and form for publication:

Approved by the Dissertation Committee:

Mark B. Parshall , Chairperson

Marie L. Lobo

Stephen H. A. Hernandez

Christine A. Mueller

RESIDENT AND FACILITY FACTORS ASSOCIATED WITH REHOSPITALIZATION FROM SKILLED NURSING FACILITIES

by

ANGELINA FLORES-MONTOYA

B.S.N., Nursing, University of New Mexico, 2004
M.S.N., Nursing University of New Mexico, 2010

DISSERTATION

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DEDICATION

This dissertation is dedicated to those who have supported and inspired me throughout my career in nursing and during my Ph.D. journey.

To my dear husband, Michael, who was an unfailing source of optimism and has unconditional patience. Thank you for reminding me to enjoy the outdoors, for your commitment to us, and for cheering me along. I cannot imagine this journey without you.

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ABSTRACT

Older adults often require short-term nursing home care after an acute hospital stay to receive skilled nursing or rehabilitation services. Rehospitalization after a skilled nursing facility (SNF) admission is a potential indicator of poor nursing home quality that is associated with substantial risks of complications and increased costs of care. This study examined resident and facility factors associated with 30-day rehospitalizations during a one-year study period from SNFs in New Mexico. The Minimum Data Set 3.0 was used to explore resident factors and Nursing Home Compare data was used for facility factors. Among residents admitted to the SNF from an acute care hospital for 30-days or fewer (n = 2,370), 317 (13.4%) were rehospitalized. In bivariate analyses, several resident characteristics during their SNF stay were associated with significantly increased probability of rehospitalization, including an unhealed pressure ulcer, delirium, shortness of breath, and oxygen use. In multivariable models, the relative odds of rehospitalization were increased in those who identified as American Indian or Alaska Native, residents who rejected care, those with symptoms of delirium, and those who required greater mobility assistance with activities of daily living. The relative odds of rehospitalization were

decreased in women and in residents with dementia. However, overall, none of the models improved prediction of rehospitalization. The Nursing Home Compare 5-star rating showed a decline in nurse staff ratings from 2015 to 2016. Policy implications include value-based penalties linked to high SNF rehospitalization rates and policies focused on reducing Medicare costs, while improving nursing home quality.

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CHAPTER 1: Background, Theoretical Model, and Purpose

Despite medical advances and increased government oversight, nursing homes are inconsistent in their ability to produce high quality healthcare (Government Accountability Office, 2015; Institute of Medicine, 1986; Office of Inspector General, 1999; Office of Inspector General [OIG], 2014). For example, based on 2011 data, the Office of Inspector General estimated that 20% of Medicare beneficiaries had a post-acute care skilled nursing facility (SNF) stay, of whom approximately 22% experienced an adverse event related to medical care, and 11% experienced a temporary harm event during the stay. A majority of those events were deemed preventable (Office of Inspector General [OIG], 2014).

Adverse events might require a return to the hospital for treatment, with one quarter of SNF residents transferred to a hospital after a SNF admission (Office of Inspector General, 2013a). Rehospitalizations are an indicator of poor care quality in nursing homes. High unplanned rehospitalization rates were associated with approximately $14.3 billion in Medicare costs in 2011 (Office of Inspector General, 2013a). Accordingly, unplanned rehospitalizations from SNFs have received increased attention from policymakers and stakeholders. Even so, information is lacking regarding factors that influence rehospitalizations and how to prevent them.

Background

The United States has more than 15,000 nursing homes, offering skilled nursing, rehabilitation, or long-term care services for 1.4 million residents (Centers for Disease Control and Prevention [CDC], 2016). An older adult might require short-term nursing home care after an acute hospital stay to receive skilled nursing or rehabilitation services,

such as physical therapy after a knee replacement surgery. Medicare is the primary payer for short-term SNF nursing home care, which cost $28.6 billion and accounted for 21% of a facility's revenue in 2014 (MedPac, 2016, March).

Long-term care might be necessary for persons with a disability or chronic illness to assist with activities of daily living, such as bathing. Medicaid is the primary payer source for long-term care services. Medicaid also covers the SNF co-pays for low-income Medicare beneficiaries. Total fee-for-service Medicaid expenditures for long-term care came to $45.5 billion in 2015 (Kaiser Family Foundation, 2017). The joint funding from Medicare and Medicaid to pay for nursing homes services magnifies the policy implications and challenges for policymakers to address the quality of care in nursing homes.

Recent discoveries in medicine and technology have improved health and longevity. There were 40 million adults older than 65 in 2010, representing 13% of the U.S. population (Ortman, Velkoff, & Hogan, 2014).These numbers are projected to double to 83 million by 2050. Although a small percentage (3.4%) of adults 65 or older reside permanently in a nursing home or other institution (Administration on Aging, 2014), approximately 84% of nursing home residents are at least 65 (Centers for Disease Control and Prevention [CDC], 2016). The percentage of people needing nursing home care increases considerably with age. Spillman and Lubitz (2002) estimated that by 2020, adults who live to be at least 65 have a 46% lifetime risk of a nursing home admission before they die. Based on the population growth trends, the United States is expected to have the largest older adult population in recent history, escalating the demand for

nursing home services. There is a great need for high quality research to understand and improve nursing home quality.

The enactment of Medicare and Medicaid in 1965 dramatically changed the landscape for U.S. nursing homes. Medicare provided federal financing for universal health insurance for all Americans 65 and older. Medicare covers outpatient medical care, acute hospital care, and short-stay skilled nursing care following hospitalizations. Medicaid is jointly administered by federal and state governments and provides assistance for the poor and medically needy to cover long-term care and other services (Watson, 2009). Accordingly, the passage of Medicare and Medicaid in the 1960s fueled rapid growth in the nursing home industry, doubling the number of nursing home beds to more than one million by 1973, exceeding the total number of hospital beds in the United States (Watson, 2009). Expansion of Medicare and Medicaid required organized efforts to run and manage these programs; thus, the Health Care Financing Administration was established in 1977 (Anonymous, 2005). Today this federal agency is known as the Centers for Medicare and Medicaid Services (CMS). Among a wide range of responsibilities, CMS establishes regulations and oversees the standards for nursing facilities to promote safe and high quality care. CMS also has authority to sanction facilities—such as withholding or debarring from Medicare reimbursement—that persistently fail to meet safety standards.

Nursing Home Quality

Role of Medicare and Medicaid. Complaints of poor quality care in nursing homes prompted Congress to be involved in improving nursing home conditions with early amendments to the Medicare and Medicaid programs. For example, in 1967, new

Medicaid provisions required 24-hour nursing services in a SNF with full-time supervision from a registered nurse and stricter building code requirements to improve fire and safety codes (Watson, 2009). Two decades later, the release of the Institute of Medicine (1986) report, *Improving the Quality of Care in Nursing Homes,* revealed evidence of inadequate nursing home care, including abuse and negligence of residents. The report emphasized the need for the government to establish standards to protect older adults in nursing homes and provided regulatory recommendations to address the observed issues. The standards directed that any person in a certified nursing home would receive appropriate patient rights, quality of care, and quality of life ("Key Milestones", 2005; Morford, 1988). The release of this 1986 landmark report led to major nursing home reform as part of the Omnibus Budget Reconciliation Act (OBRA) of 1987.

Although subsequent evidence was published exposing the poor quality care in nursing homes (Government Accountability Office, 2015; Institute of Medicine [IOM], 2001; Office of Inspector General, 1999, 2013a; Office of Inspector General [OIG], 2014), the 1986 IOM report remains influential. Many of the regulations still exist. For example, numerous regulations were developed and implemented to improve quality, such as detailed rules for nursing home certification and increased federal-state surveillance. Once certification conditions were introduced, nursing homes increased efforts to meet requirements, and now 95% of U.S. facilities are certified by Medicare or Medicaid (Centers for Disease Control and Prevention [CDC], 2016). Certified facilities must meet more than 180 regulatory standards and can receive a deficiency citation or pay penalties when not in compliance (Medicare.gov, n.d.-c). Survey inspections are conducted at least annually by trained personnel from state health departments to evaluate

the adherence to regulations. An inspection team observes care delivery on-site, conducts health and fire safety inspections, and reviews complaints. Achieving Medicare or Medicaid certification authorizes a nursing home to receive federal and state funds for reimbursement.

Given the number of residents with medical complexities or cognitive impairments, nursing home residents might not be able to advocate effectively for themselves and, therefore, constitute a vulnerable population. Since OBRA 1987, nursing home conditions have improved and state survey deficiencies have decreased (Wiener, Freiman, & Brown, 2007). However, despite rigorous certification regulations, nursing home quality remains an issue. For instance, the number of complaints and investigations about resident care in nursing homes grew nationally by 21% from 2005 to 2014 and is one indicator of decreased quality (Government Accountability Office, 2015).

Determining nursing home quality. Nursing home quality is determined by assessing a number of structural, process, and outcome indicators (Castle & Ferguson, 2010). Specifically, CMS assesses nursing home quality by examining the following three categories: (a) health inspections, (b) nurse staffing, and (c) quality measures. Health inspections are completed during the onsite state survey and can include structural or process indicators. For example, health inspections include examination of the process of care (e.g., medication management), storage and preparation of food, and physical characteristics of the facility (e.g., adherence with building and fire codes) (Medicare.gov, n.d.-c). Nurse staffing is a structural component of quality assessing the facility's resources to deliver appropriate care. Nurse staffing is measured by the number of hours per resident per day a nurse or nursing assistant spends with a resident. Quality

measures include process and outcome indicators. For example, the percentage of nursing home residents who receive the influenza vaccine is a process quality measure, whereas the percentage of nursing home residents with a new or worsening pressure ulcer is an outcome indicator.

Quality measures include short-term and long-stay information gathered from resident assessments and health records to determine how well the nursing home is meeting the residents' needs. A short-term stay is defined as 100 or fewer cumulative episode days in SNF (Smith et al., 2012). Long-stays are nursing facility episodes of at least 101 cumulative days that are focused on long-term needs of residents (Smith et al., 2012).

The number of quality measures changes over time; in 2016 there are 24 quality measures. Nine measures focus on short-stay residents, and 15 are directed at long-stay residents. A list with descriptions of indicators is provided in Appendix A. Each quality measure must be reliable and valid (Smith et al., 2012), and some measures go through an additional rigorous assessment to be endorsed by the National Quality Forum. Quality measures are continuously being added, addressing relevance, consumer concerns, and the ability to measure quality of care to meet resident needs.

Every U.S.-certified nursing home is given an overall quality score using a five-star rating system that is published on the Nursing Home Compare website (Medicare.gov, n.d.-d). The website is a public, online platform for consumers to access quality information about nursing homes to support informed decision making. Resident assessment and facility data are used to generate the quality ratings. One star indicates low quality, and five stars indicate high quality. A rating is given to each health

inspection, staffing, and quality measure category and an overall rating is calculated using compiled data from all three categories (Medicare.gov, n.d.-b).

The routine collection of resident assessment data and submission of facility reports are major requirements from CMS. Resident assessments include information such as physical and clinical conditions, functional abilities, and resident preferences for care. Resident assessments are completed by nurses at routine intervals using the Minimum Data Set (MDS), which is considered a reliable and valid tool (Saliba & Buchanan, 2008; Smith et al., 2012). Facility data are gathered through a variety of methods, such as survey health inspection reports, state complaint investigations, and facility reports entered into the CMS online data systems (Medicare.gov, n.d.-a; Zhang, 2009). Resident and facility data are reported to CMS for several reasons, including public reporting purposes, the development of quality measures, and to create quality reports for facilities to monitor and improve their quality efforts.

Policies. After several years of evidence indicating the need to change policies to improve care quality, nursing home reform was comprehensively addressed with the passage of the 2010 Patient Protection and Affordable Care Act (ACA). The ACA was the first major reform for nursing homes since OBRA 1987 and included several new provisions to improve nursing home quality. The Nursing Home Transparency and Improvement Act of 2009 increased the transparency of nursing home expenditures and required them to disclose detailed information, such as ownership, finances, and operations (Kaiser Family Foundation, 2013). The 2010 Elder Justice Act and the Patient Safety and Abuse Prevention Act aimed to protect nursing home residents from fraud, abuse, and other crimes by mandating background checks as well as education and

training requirements for nursing home employees (Kaiser Family Foundation, 2013). The Improving Medicare Post-Acute Care Transformation Act of 2014 (IMPACT Act) required skilled nursing facilities to submit patient information using standard definitions and to establish a quality reporting program (CMS, 2015). The 2014 Protecting Access to Medicare Act directed CMS to institute financial penalties for nursing homes exceeding a set rehospitalization rate starting in 2018 (Carnahan, Unroe, & Torke, 2016). Although an exhaustive review of nursing home regulations is beyond the scope of this dissertation, the ACA provisions are expected to impact quality and transform nursing home care.

Rehospitalization

In 2014 and in 2015, approximately 20% of Medicare beneficiaries who were admitted to an acute care hospital were discharged to a SNF. In each of those years, SNFs provided services for 1.7 million fee-for-service Medicare beneficiaries (MedPac, 2016, March). A skilled nursing facility offers short-term rehabilitation services, such physical, occupational, or speech therapy and skilled nursing care, such as wound treatments. Individuals can be approved for SNF admission when their hospital stay is three or more days and they need advanced nursing or therapy services. For instance, after a hospital stay for pneumonia, an individual might need continued medical care or assistance with getting dressed. Medicare covers 100% of the first 20 days of a SNF stay, and beneficiaries are responsible for a co-pay from days 21-100 (MedPac, 2016, March).

Patients who are discharged to a SNF after an acute hospital stay are significantly more likely to be rehospitalized compared to a discharge to the community (Allen et al., 2011; Hain, Tappen, Diaz, & Ouslander, 2012; Kind, Smith, Pandhi, Frytak, & Finch, 2007; Mor, Intrator, Feng, & Grabowski, 2010; Office of Inspector General, 2013a;

Office of Inspector General [OIG], 2014). When a resident requires a higher acuity of care than the nursing home is able to provide, a nurse or physician might determine that a hospitalization is necessary.

Rehospitalizations from nursing homes create higher Medicare spending, are known to cause harm, and many are potentially preventable. Approximately 59% of nursing home adverse events were considered to be clearly or likely preventable and attributable to inadequate medical treatment or nursing care, inadequate monitoring, or to a failure to deliver essential care (Office of Inspector General [OIG], 2014). Rehospitalization into a hospital can expose residents to iatrogenic disease and harm (Ouslander, Weinberg, & Phillips, 2000; Permpongkosol, 2011). Specifically, older adults who are hospitalized are at higher risk of developing a hospital-acquired infection (Cairns et al., 2011; Magill et al., 2014; Solis et al., 2015) and hospital induced delirium (Fong, Tulebaev, & Inouye, 2009). Moreover, nursing home residents who are rehospitalized are at greater risk for mortality compared to those not rehospitalized (Ahearn, Jackson, McIlmoyle, & Weatherburn, 2010; Burke, 2016; Hussain, Cha, & Takahashi, 2009). More information is necessary to explore factors that influence rehospitalizations and how to curtail their numbers.

Hospitalizations are a fundamental focus of the IMPACT Act. Overall objectives of the IMPACT Act are to increase accountability among providers and to achieve the Institute for Healthcare Improvement's Triple Aim: improve the quality of care, improve health, and reduce the cost of care (CMS, 2015). Among the means to that end, a key purpose of this legislation was to standardize information and definitions across post-acute care facilities. The goal is to develop and implement new measures to provide

facilities with longitudinal data in efforts to improve transfers from hospitals to post-acute care facilities, including SNFs (CMS, 2015). Post-acute care facilities are now required to report measures regarding resource use, hospitalizations, and discharges to the community (CMS, 2015).

Rehospitalizations are among a number of nursing home quality indicators that are relevant to Triple Aim goals. CMS created a new nursing home quality measure in 2015 to track rehospitalizations. The skilled nursing facility rehospitalization measure (SNFRM) is an outcome indicator "designed to capture the outcome of unplanned all-cause rehospitalization of SNF patients occurring within 30 days of discharge from the patient's prior proximal acute hospitalization" (Smith et al., 2015, p. 4). The SNFRM is risk-adjusted for patient characteristics and statistical estimates of facility effects to calculate the number of SNF episodes with unplanned rehospitalizations over a one-year period (Smith et al., 2015). In July 2016, nursing homes began reporting this information publicly on the Nursing Home Compare website. The SNFRM is used to calculate quality measure scores and the overall five-star rating quality score. The SNFRM is quickly becoming a priority for nursing homes and hospitals to actively explore this issue as financial penalties approach.

New Mexico Nursing Homes

Currently, there are 75 certified and licensed nursing homes in New Mexico and approximately 7,000 SNF beds. In 2013, adults 65 and older constituted 14.7% of the population in New Mexico, which was similar to the overall percentage of that age group in the United States (Administration on Aging, 2014), and the proportion of Medicare beneficiaries in New Mexico (15%) and the United States (17%) were also similar

(Kaiser Family Foundation, 2016). However, a higher proportion of older adults in New Mexico was living below the poverty line (11.7%) compared with the overall U.S. figure (9.5%) (Administration on Aging, 2014). In 2011, New Mexico Medicare expenditures totaled $2.77 billion with $188 million going to skilled nursing facilities (CMS, 2011), and nationwide, total Medicare reimbursement for SNF care was $27 billion (MedPac, 2016, March). In 2006, New Mexico's rehospitalization rate from nursing homes was 22.1%, with total Medicare expenditures of $3.72 million (Mor et al., 2010). New Mexico's nonadjusted rehospitalization rates were comparable to national rates percent of 26.8% in 2006 (Mor et al., 2010) and 24.8% in 2011 (Office of Inspector General, 2013a). Similarly, in the last quarter of 2016, the average national rehospitalization rate was 22.6%, and New Mexico had a corresponding rate of 21.3% (Medicare.gov, n.d.-d).

The Medicare.gov Nursing Home Compare website rates nursing homes on a one to five star quality rating, with the majority of New Mexico nursing homes (61%) rating between one and three stars, indicating average or below average quality (Medicare.gov, n.d.-d), with national comparisons at 55% of nursing homes having a rating of between one and three stars (Boccuti, Casillas, & Neuman, 2015). Alternatively, 37% of New Mexico nursing homes had a rating of four or five stars, indicating a higher or much higher than average quality rating compared with nursing homes nationally at 45% (Boccuti et al., 2015).

Gap in Literature

Relatively little is known about factors that influence rehospitalizations. Most research has been focused on frequency of rehospitalizations, and few studies have explored factors associated with rehospitalizations. The rehospitalization literature

commonly focuses on medical disorders to explain resident risk factors. The literature lacks exploring alternate resident-risk factors for rehospitalizations, such as social determinants of health. Nursing home quality and structure are frequently explored, but relatively little information is available about facility factors or processes of care associated with rehospitalizations. In addition, most recent research on rehospitalization has used large national data sets; few have used electronic health records. The use of electronic health records as a data source can provide detailed information about nursing home processes and facility-specific resources that might be relevant to rehospitalizations.

Theoretical Model

Several definitions of quality exist, with the most well-cited definition developed by the Institute of Institute of Medicine (2001) as "the degree to which healthcare services for individuals and populations increase the likelihood of desired outcomes and are consistent with current professional knowledge" (p. 44). It has become a cliché to assert that healthcare quality involves delivering the right healthcare services to the right person at the right time, every time. However, "right" has various meanings. Quality is a multidimensional concept that is challenging to define or measure (Castle & Ferguson, 2010). A theoretical model provides structure for characterizing nursing home quality and for efforts to develop empirical knowledge about quality that has potential to improve care and inform policy.

The Structure Process Outcome (SPO) model developed by Avedis Donabedian (1988) proposed an approach to define, assess, and evaluate the quality of healthcare which focused on relationships among three key concepts: structure, process, and

outcomes (Donabedian, 1988). Donabedian (1988) defined *structure* as "the attributes of the setting in which care occurs," *process* as "what is actually done in giving and receiving care," and *outcome* as "the effects of care on the health status of patients and populations" (p. 1745). The Institute of Institute of Medicine (2001) asserted that Donabedian's model contributed valuable insight for quality measurement and conceptualization that "will continue to guide efforts to improve quality well into the coming century" (p. xi).

Structure can refer to the setting in which the healthcare is delivered and includes the resources of the facility, such as staff qualifications or staffing ratios, fiscal organization of resources, and the case-mix of the patients in a facility. Process examples include actions performed to provide care, including patient or provider activities to implement treatment and staff activities to deliver care. Outcomes are described as effects of the care delivered measured by improvements in knowledge, changes in behavior, improvements in health, or satisfaction with care (Donabedian, 1988). The Donabedian model implies that good structure leads to good processes and that good processes lead to good outcomes (Figure 1). The SPO model is widely accepted for assessing healthcare quality across various settings with consistent results in the literature on nursing home quality. The nursing home system is already positioned to align with the model. For example, SPO data are collected for regulatory purposes and quality improvement (Castle & Ferguson, 2010; Institute of Medicine, 2001). The SPO model has been used in nursing home research, such as in a study of the influence of the resident's race on a nursing home's financial performance (Chisholm, Weech-Maldonado, Laberge, Lin, & Hyer, 2013) and in a study of whether changes in structure (staffing and wages) affected

process of care and quality outcomes (Hyer, Thomas, Johnson, Harman, & Weech-Maldonado, 2013).

Figure 1. Donabedian Structure-Process-Outcome Model to Assess Healthcare Quality (Shekelle, MacLean, & Ouslander, 2017)

The SPO model provides a foundation to explore components involved in nursing home quality and to develop potential targets for intervention to improve quality. Quality can be evaluated through relationships among the structural, process, and outcome elements. The model defines a playing field for identifying variables likely to be relevant to quality that can be used to inform and evaluate nursing home policies. The model also provides a capacity to provide ongoing evaluation of quality as changes are introduced into nursing homes and how they align with quality improvement goals.

The SPO model is adaptable to quality inquiry to inform policy at all levels. For example, the model can be used to assess quality at a state level by exploring resource shifts across states or at the state or federal levels, it can be used to support the development of regulations. In addition, the model can be used to guide research to develop, implement, or evaluate policies as a means to improve care and reduce costs.

With the development of specific quality improvement strategies, the SPO model has the potential to improve health outcomes for nursing home residents.

Poor care quality remains a concern for U.S. nursing homes. However, there are far fewer studies of interventions to improve quality in the nursing home setting compared with either hospitals or physician practices (Alexander & Hearld, 2009). Exploring a complex concept, such as quality, using a well-known theoretical model facilitates communication of findings across multiple disciplines. The model offers opportunity to generate new knowledge in the literature on nursing home quality. For example, describe the relationship between which processes improve health outcomes and then explore quality outcomes outside of clinical or physical measures. The SPO model provides a pragmatic approach to grasp a complex concept and offers a well-defined theoretical foundation to guide research.

In this study, various structural elements, such as staffing or resident characteristics, and processes of care, such as influenza vaccine administration or health assessments, will be analyzed in relation to 30-day rehospitalizations (outcomes) in New Mexico nursing homes. Results of the study will have the potential to identify particular structure-process components that are associated with the outcome of SNF 30-day rehospitalizations (residents who are rehospitalized from the SNF and within 30 days of a hospital discharge). The findings can be used to inform policy and provide recommendations to reduce rehospitalization rates and to improve the quality of healthcare for nursing home residents. A glossary of words and operational definitions used in this study are provided in Appendix B.

Purpose

The purpose of this study is to determine which resident and facility factors are associated with 30-day rehospitalization from New Mexico nursing homes. The study will analyze existing data from three sources: electronic health records (EHR), the Minimum Data Set, and Nursing Home Compare data pertaining to 10 for-profit nursing homes in New Mexico. The 10 homes are located in Albuquerque and Rio Rancho. They were identified by the nursing home corporation's research team as facilities with EHR data for the proposed study period. The EHR data will pertain to residents admitted from an acute care setting into one of the 10 nursing facilities from July 2015 through July 2016.

Specific Aims

The specific aims of the study:

1. To explore which resident risk factors are more likely to predict a rehospitalization from a nursing home within 30 days of a discharge from an acute hospital stay.
2. Assess the structural-process differences among nursing homes that can influence the rates of 30-day rehospitalizations.
3. Evaluate policy implications for nursing homes of factors associated with 30-day rehospitalizations.

Research Questions and Hypotheses

1. Which nursing home factors are most strongly associated with 30-day rehospitalizations in residents?

i) Hypothesis: Nursing homes with greater survey deficiencies will have higher 30-day rehospitalization rates.

ii) Hypothesis: Nursing homes with higher registered nurse staffing hours will have lower 30-day rehospitalization rates.

2. What resident factors predict the likelihood that a resident will be rehospitalized within 30 days of their discharge from an acute hospital and subsequent admission into a nursing home?

i) Hypothesis: Residents with acute or chronic cognitive impairment (e.g., delirium, dementia, or severe mental illness) will have higher 30-day rehospitalization rates.

ii) Hypothesis: Residents with an advance directive in place will have a lower 30-day rehospitalization rate compared with residents who do not have advance directives.

Limitations

There are several limitations to this dissertation study. First, all 10 nursing homes are located in New Mexico and are owned by the same corporation. The facilities are also in an urban setting, which means that data were not collected from rural facilities or from residents of rural facilities. Second, because this study is using existing data sources, I will have no control over data definitions or entry, hence, little control over missing data. Because of this, the data might not contain the necessary information to answer all research questions or to adequately test each hypothesis. I will attempt to determine whether data are missing at random, in which case it might be possible to impute missing

values. Finally, the Minimum Data Set is likely to be entered correctly because it is a known documentation record with clear guidelines in frequency of documentation and is a regulation requirement. However, electronic health records are not required and only fairly recently were implemented by these nursing homes. Therefore, there might be little or no way to identify or control possible data entry mistakes.

Policy Implications

Several policy implications exist relating to nursing home rehospitalizations. First, rehospitalization can cause or result from preventable harms to vulnerable residents living in nursing homes. Second, the rising cost of nursing home care is a major concern. Avoiding preventable hospitalizations and associated costs contributes to Medicare sustainability. Third, rehospitalization rates impact a nursing home's overall quality report; thus, it is important to consider how the reporting of rehospitalization rates would impact consumers' decisions and market competition. Hospitals might encourage patients to choose a specific home or discharge patients based on the publicly reported rates.

With increasing movement toward pay for performance or value-based purchasing, hospitals and nursing homes are seeking strategies to improve systems of care and might begin to endorse facilities based on public ratings. In fact, many nursing homes across the country are already participating in a demonstration to receive payment awards for high performance in select quality measures (cms.gov, 2015). Nursing homes are confronted with impending financial penalties for exceeding a set rehospitalization rate. An unintended consequence of imposing penalties could be that nursing homes avoid sending residents to a hospital when they need advanced care that the nursing home lacks the resources to deliver. Conversely, public reporting is associated with improved

post-acute care quality measures (Werner et al., 2009) and has the potential to reduce rehospitalization rates and to improve the overall quality of care in nursing homes. The policy implications of rehospitalizations as a quality indicator are significant; therefore, it is critical to understand the factors that influence rehospitalizations from nursing homes.

Subsequent Chapters

In Chapter 2, I review the literature pertaining to the outcome of 30-day rehospitalizations from nursing facilities, focusing on evidence of resident characteristics and nursing facility factors related to that outcome. Chapter 3 provides a more detailed account of the study methods, including the specific data sources, key variables to be extracted from each of the data sources, and plans for how those data will be analyzed. Chapter 4 delivers the results of the statistical analysis completed. Chapter 5 is the discussion chapter to analyze the results, outlines the limitations of the study, and discusses policy implications.

CHAPTER 2: Literature Review of Resident and Facility Factors Associated with 30-day Rehospitalization

The issue of rehospitalizations has generated increased attention, with particular concern focused on rehospitalizations from nursing homes. Rehospitalizations for residents are not only costly, they have the potential to cause more harm to patients (e.g., potential exposure to iatrogenic disease or worsening functional decline (Grabowski, Stewart, Broderick, & Coots, 2008; Ouslander et al., 2010), and significantly higher mortality than for patients not readmitted into a hospital (Ahearn et al., 2010; Burke, 2016; Hussain, Cha, et al., 2009). Approximately 20% of Medicare recipients hospitalized for any cause are discharged to a nursing home for short-term skilled nursing care (Office of Inspector General [OIG], 2014), and approximately 20% of Medicare Part A nursing home admissions are rehospitalized within 30 days (Ouslander, Diaz, Hain, & Tappen, 2011). Approximately two thirds of all rehospitalizations from nursing homes are potentially preventable, and the proportion of potentially preventable rehospitalization is similar for Medicare Part A patients (all of whom are short-stay) and residents with other payers (most of whom are long-term care residents) (Ouslander et al., 2010).

In 2014, the United States had more than 15,000 nursing homes that provided care for approximately 1.4 million residents (Centers for Disease Control and Prevention [CDC], 2016). Nearly all U.S. nursing homes offer both long-term care and skilled nursing facility (SNF) services. Long-term care is needed for management of chronic illness or disability, and skilled nursing provides rehabilitation services or advanced nursing care after an acute hospital stay. An individual might require SNF services after a hospitalization to recover from a medical illness, such a pneumonia, or from a surgical

procedure, such as hip or knee replacement. Medicare Part A covered 2.4 million SNF stays for 1.7 million residents annually in 2014 and also in 2015, with close to $28.5 billion in expenditures in 2014 and $29.8 billion in 2015 (MedPac, 2016, March, 2017). The number of Medicare beneficiaries totaled more than 55 million in 2015 (Kaiser Family Foundation, 2016), and with the population of older adults growing at a notably faster rate in the United States than any other age group, the need for nursing home services is expected to rise. Between 2010 and 2014, the rate of potentially avoidable 30-day rehospitalizations during a Medicare Part A SNF stay decreased modestly, from 13% to 11% of all SNF stays, but rehospitalizations following discharge from a SNF stay increased (MedPac, 2016, March).

Nursing homes have receive federal and state revenues, with Medicaid primarily covering long-term care and Medicare covering skilled nursing services. Accordingly, nursing homes have federal oversight from the Centers for Medicare and Medicaid Services (CMS) and from state departments. These agencies establish the regulatory guidelines and standards nursing homes must follow to be eligible for certification and reimbursements. To ensure the delivery of high quality care and to assess for adherence to guidelines, nursing homes are subject to routine inspections as part of their certification process. Nursing home quality is assessed by a mix of structural, process, or outcome quality indicators and measures (Castle & Ferguson, 2010). Specifically, in 2016, nursing homes were evaluated on nine short-stay quality indicators for residents who stayed fewer than 100 days in a SNF and 15 long-stay quality measures for long-term care residents who stayed longer than 101 days. These quality measures are continuously evaluated by CMS to determine relevance and to ensure they are effective

in assessing nursing home quality. Details of each quality measure are provided in Appendix A.

Despite CMS setting high quality criteria for nursing facilities, substandard care remains a concern. A 2014 OIG report confirmed that 22% of Medicare SNF residents experienced an adverse event, which is described as "harm to a patient or resident as a result of medical care, including the failure to provide needed care" (OIG, 2014, p. 2). Furthermore, the physicians examining these cases determined that 59% of the adverse events reviewed were clearly or likely preventable. Other studies have found similar rates of preventable rehospitalization among nursing home residents for whom the payer was Medicare Part A (Ouslander et al., 2010).

Rehospitalization

In general, individuals discharged to a nursing facility after an acute hospital stay are more likely to be readmitted to the hospital compared with patients discharged elsewhere (e.g., home/community) (Allen et al., 2011; Bogaisky & Dezieck, 2015; Hain et al., 2012; Kind et al., 2007; Lavernia, Villa, & Iacobelli, 2013; Mor et al., 2010; Silverstein, Qin, Mercer, Fong, & Haydar, 2008). Based on Medicare claims data from 2003-2004, approximately 20% of all hospitalized Medicare beneficiaries were rehospitalized within 30 days of a hospital discharge (Jencks, Williams, & Coleman, 2009). Nationwide, the 30-day rehospitalization rate among Medicare beneficiaries discharged to a SNF increased from 18.2% in 2000 to 23.5% in 2006, a 29% relative increase (Mor et al., 2010). However, in recent years, among Medicare beneficiaries, rehospitalizations from SNFs decreased from 12.4% in 2011 to 10.4% in 2015 (MedPac, 2017).

In the 2014 Office of Inspector General report, *Adverse Events in Skilled Nursing Facilities: National Incidence Among Medicare Beneficiaries,* the majority of adverse events (79%) caused a category F level of harm which comprises a prolonged SNF stay, a transfer to a different SNF or post-acute facility, or a hospitalization (see Appendix C for explanation of the categorization scheme). A hospitalization is defined as an admission to an inpatient care unit, to a hospital observation unit, or to an emergency department (Office of Inspector General [OIG], 2014). Based on a representative sample of SNF stays in August 2011 for which Medicare was the payer, approximately 60% of residents who experienced a harmful event were sent to a hospital for treatment (19% of all Medicare beneficiary SNF stays). The estimated Medicare expenditures for that month were $208 million, which translates to approximately $2.8 billion annually (Office of Inspector General [OIG], 2014). Previous evidence suggests these hospitalizations could be avoidable with appropriate treatment in the nursing home (Grabowski et al., 2008; Ouslander et al., 2010).

In a 2011 national analysis, unadjusted hospitalization rates varied in nursing homes across the country from less than 1% to 68.7% with the average at 25% (Office of Inspector General, 2013a) and prompted a closer examination of hospitalizations from nursing homes. Based on their findings, the OIG offered two recommendations to CMS: (a) develop a quality measure for nursing homes that describes resident hospitalization rates and (b) include this measure as a part of the state survey process for certification (Office of Inspector General, 2013a). Further supporting this effort, Congress passed two important pieces of legislation as part of the Affordable Care Act to improve outcomes of hospital transfers and to reduce rehospitalizations in an effort to increase nursing home

accountability. First, the Improving Medicare Post-Acute Care Transformation Act of 2014 (IMPACT Act) required SNFs and other post-acute care facilities to submit uniform patient data using standard definitions and to establish a quality reporting program with overall aims to improve quality of care, improve health, and reduce costs of care (CMS, 2015). Second, the 2014 Protecting Access to Medicare Act included provisions for SNFs to be financially penalized for exceeding a set rehospitalization rate, with penalties expected to begin in 2018 (Carnahan et al., 2016).

Following the passage of these significant pieces of legislation, CMS followed OIG recommendations to develop a new nursing home quality measure, the Skilled Nursing Facility Rehospitalization Measure (SNFRM). The SNFRM "estimates the risk-standardized rate of all-cause, unplanned rehospitalizations for SNF Medicare FFS [fee-for-service] beneficiaries within 30 days of discharge from their prior proximal short-stay acute hospital discharge" (Smith et al., 2015, p. 3). The measure includes a SNF admission within one day of discharge from an acute hospital stay from an inpatient system, from a critical access hospital, a psychiatric hospital, or from a cancer hospital, and it excludes planned rehospitalizations and certain SNF stays (Smith et al., 2015).

Given the sizable disparity in hospitalization rates among nursing homes, it is necessary to examine resident and facility factors associated with rehospitalizations. Previous knowledge indicates specific resident-level factors increase risk for hospitalization, such as medical conditions (Grabowski et al., 2008; Jencks et al., 2009), and similarly, facility-level factors are associated with rehospitalizations (Grabowski et al., 2008; Office of Inspector General, 2013a). For example, a common reason for rehospitalization is cardiovascular disease (e.g., chest pain, heart failure) even when that

was not the reason for the initial hospitalization (Ouslander et al., 2011). However, with the recent development of the specific SNFRM guidelines, only a few studies have sought to use this new outcome measure to simultaneously examine resident and facility factors associated with rehospitalizations. The literature was reviewed to determine the current state of knowledge about the risk factors and predictors of rehospitalized SNF residents and the facility characteristics associated with rehospitalizations. Specific goals were to: (a) summarize the literature on resident risk factors associated with 30-day rehospitalizations, (b) summarize the literature on facility characteristics associated with 30-day rehospitalizations, (c) identify the gaps in the research, and (d) provide evidence for independent variables to guide this dissertation study.

Literature Review Methods

Databases and search terms. Comprehensive literature searches were conducted using the Academic Complete, CINAHL, PubMed, and PscyhInfo databases for peer-reviewed academic journal articles under the guidance of a librarian. Keyword search combinations included: [“long term care” OR “nursing home” OR “nursing facility” OR “nursing facilities”] AND [“rehospitalization” OR “rehospitalization”]. No parameters were set for dates; thus, dates started with the earliest date available for each database. An additional search was conducted using the Grey Literature Report database and Google searches to include research for health services, such as technical reports and official or noncommercial published government reports.

Selection of Articles for Review. The review was limited to studies that (a) included U.S. nursing homes; (b) focused on the 30-day rehospitalization outcome from a nursing facility, nursing home, or SNF; (c) described risk factors or predictors of a 30-

day rehospitalization, (d) was published in a peer-reviewed journal, and (e) was a primary study. Studies were included if they evaluated multiple groups in their study, such as hospitalizations in nursing home residents and community-dwelling older adults. Studies were excluded from this review when they (a) did not analyze rehospitalizations in nursing facility residents; (b) included rehospitalizations from a setting other than a nursing home, such as a long-term care hospital; (c) examined predictors beyond 30 days or did not specify the time period of the hospitalization; and (d) were editorial or opinion articles, narrative review articles, dissertations, or theses.

The search returned 800 articles published between 1992 and November 2016. An additional 12 studies were identified from reference lists and the grey literature. Among the 812 articles identified, titles were screened for relevance, and duplicates were excluded. From these, 309 abstracts were reviewed for relevance, 56 articles were identified as potentially relevant, and 34 were excluded during the full-text review. The final review included 22 peer-reviewed articles published between 2005 and 2016 (See Appendix D for PRISMA flow of information diagram for this literature review).

A data extraction table was used to document author, study design, data source with year studied, and the number of participants or number of nursing homes with resident factors (Appendix E) and facility factors (Appendix F) associated with a 30-day rehospitalization after an acute hospital stay. Many of the articles had overlap in their analysis, including both resident and facility factors in their findings.

Resident Factors

Resident characteristics are commonly reported in exploring risk and are an identified outcome. Individual resident differences have the potential to explain risk in

specific health conditions or in demographic factors and offer information such as medical diagnoses or reasons for rehospitalization. The availability of claims and enrollment data provides greater access to this type of information for national analysis. Because nursing homes are required to complete resident assessment information, these assessments offer additional insight into resident characteristics, such as physical abilities or cognitive assessments. Lastly, to understand risk and predictors of rehospitalizations, recent utilization of electronic health records in nursing homes provides a new opportunity to examine detailed health information.

Medical Conditions

Among residents rehospitalized after a SNF admission, the most common medical diagnoses were congestive heart failure, (Bogaisky & Dezieck, 2015; Lima et al., 2012; Ouslander et al., 2011; Ouslander et al., 2016), chronic obstructive pulmonary disease (Bogaisky & Dezieck, 2015; Lima et al., 2012; Ouslander et al., 2016), and chronic kidney disease-renal failure (Bogaisky & Dezieck, 2015; Dombrowski, Yoos, Neufeld, & Tarshish, 2012; Ouslander et al., 2011). Dombrowski et al. (2012) compared rehospitalizations within four to 30 days of a SNF admission, with controls matched for resident age, sex, and admission who were discharged from a SNF with no rehospitalization. The following diagnoses were significant predictors of 30-day rehospitalizations: malignant solid tumors (24% of those rehospitalized compared with 2% of controls, $P < .001$; anemia (78% vs. 46% $p = .001$) and initial hospitalization for any gastrointestinal (GI) diagnosis or procedure (34% vs. 8%, $p = .001$). In a multivariate model, the strongest predictors of rehospitalization were malignant solid tumors (OR = 10.1), initial hospitalization for GI diagnosis or procedure (OR = 4.6), and serum albumin

(OR = 4.1 per unit decrease) (Dombrowski et al., 2012). Among older Medicare beneficiaries (≥ 75 years), the highest 30-day rehospitalization rates were among patients whose index hospitalization diagnoses were genitourinary and cardiovascular disorders, particularly urinary tract infection and heart failure; rehospitalization was also common for those whose initial hospitalization had been related to chronic kidney disease or chronic obstructive pulmonary disease (Ouslander et al., 2011). Bogaisky and Dezieck (2015) found that a diagnosis of heart failure, chronic obstructive pulmonary disease, renal failure, or pressure ulcer significantly increased relative odds of rehospitalization by 40% to 60% among patients discharged from a hospital to a nursing home.

Other health conditions observed to a greater degree in rehospitalized residents included greater physical impairments assessed on nursing home admission (Li, Glance, Yin, & Mukamel, 2011) and comorbidity level (Charlson Index) (Dombrowski et al., 2012). Approximately half of SNF residents transferred back to a hospital in less than 30 days had multiple comorbid conditions (Ouslander et al., 2016).

Polypharmacy is common among hospitalized Medicare beneficiaries subsequently admitted to SNFs. Lima et al. (2012) found approximately two thirds of more than 18,000 such patients had used more than nine medications in the previous seven days. Polypharmacy was identified in more than one third of SNF patients with a hospital transfer within 48 hours (34%) and within 30 days (38%, n.s.) after admission (Ouslander et al., 2016). Pain was identified as a common reason related to rehospitalization in 17% to 20% of residents readmitted within 30 days (Dombrowski et al., 2012) but did not discriminate between those who were readmitted and those who were not (Dombrowski et al., 2012).

Cognitive Factors

Marcantonio and associates (2005) compared outcomes of post-acute care residents admitted into a SNF and classified them into three categories based on the Confusion Assessment Method criteria: delirious, subsyndromal delirium, or no delirium. The authors determined that individuals in whom delirium was present were twice as likely to be rehospitalized compared with those in whom it was absent (30% versus 13%, $P < .001$) and were more likely to have a preexisting dementia diagnosis (Marcantonio et al., 2005). Among patients who had a hip arthroplasty, those with a mental health issue were more likely to be readmitted compared to those without, 10% and 5%, respectively (Lavernia et al., 2013). Thirty-day rehospitalization rates were 25.3% for older adults with dementia discharged to a nursing facility (Callahan et al., 2012) while rates of White and Black residents with cognitive impairment admitted into a SNF were 16.1% and 21.2%, respectively (Li et al., 2011).

Among nursing home residents who were readmitted within 30 days, the relative odds of a dementia diagnosis were 40% higher compared with those who were not readmitted after adjusting for age, sex, and select medical conditions (Bogaisky & Dezieck, 2015). However, Ouslander et al. (2016) found that residents transferred to a hospital more than 30 days after a SNF admission were approximately twice as likely to have dementia compared with those readmitted within 30 days (10.8% versus 5.4%, respectively $p < .001$). Among individuals rehospitalized within 30 days, Lima et al. (2012) found that 8% of residents had severe cognitive impairment on the cognitive performance scale.

Social and Demographic Factors

Higher rehospitalization rates have been found among residents who were unmarried (Li, Cai, & Glance, 2015), Black (Li et al., 2015; Li et al., 2011), older (<75 years) in age (Hain et al., 2012; Ouslander et al., 2011), and female (Hain et al., 2012; Ogunneye et al., 2015; Ouslander et al., 2011). However, Dombrowski et al. (2012) did not find significant differences in age, sex, race, or education among residents who were rehospitalized within 30 days compared with those who were not rehospitalized.

Li et al. (2011) showed that among White and Black Medicare patients admitted into a SNF in 2008, the unadjusted rates of 30-day rehospitalization were 14.3% and 18.6%, respectively, and indicated Black residents had an overall 40% higher odds of being rehospitalized (OR = 1.37; 95%, CI = 1.35-1.40, P < .001). After adjusting for facility and resident covariates, the relative odds were 20% higher for Black residents compared with White residents but remained statistically significant (OR = 1.2, $p < .001$). Both White and Black residents were more likely to be rehospitalized when they were younger than 65, male, and had lower educational attainment (less than a high school diploma). Similarly, Li et al. (2015) conducted a national analysis of Medicare beneficiaries admitted to a SNF from acute care and found all-cause rehospitalizations higher for Blacks (21.9%) compared with Whites (17.7%) with 30% increased relative odds of rehospitalization for Blacks (OR = 1.30, 95%, CI 1.28-1.33) in unadjusted analysis, but after adjusting for resident and facility characteristics, the relative odds of rehospitalization decreased to 9% greater for Black residents compared with White residents. Compared to the White residents in this study, Black residents were less likely to be married and had higher rates of Medicare-Medicaid dual eligibility, 42.9% versus

17.8%. Lavernia et al. (2013) concluded that self-pay, Medicaid, and Medicare residents had higher rehospitalization rates compared with those with commercial insurance. However, another study showed that those who were dual eligible were equally likely to experience a 30-day rehospitalization when compared to Medicare-only beneficiaries after controlling for observed characteristics (Rahman, Tyler, Thomas, Grabowski, & Mor, 2015).

Results of a root cause analysis established that the resident or their families insisted on a hospital transfer in 17% of cases and that residents without an advance directive in place accounted for 7% of hospital transfers within 30 days of a SNF admission (Ouslander et al., 2016). A majority (62%) of rehospitalized residents did not have a do-not-resuscitate order in place (Lima et al., 2012), and residents with this order in place were less likely to be rehospitalized (Grabowski, Feng, Intrator, & Mor, 2010). Similarly, Bogaisky and Dezieck (2015) found nursing home residents with a discharge plan for hospice or palliative care were associated with a 90% lower relative odds of rehospitalization (OR = .11, 95% CI = 0.1-0.5).

Preceding Hospital Stay

Recent analyses examined resident factors during the index hospital stay prior to the SNF admission with 30-day rehospitalizations. A gastrointestinal condition during the hospitalization such as abdominal surgery or clostridium difficile colitis, was found in 34% of rehospitalized residents (Dombrowski et al., 2012). The highest rehospitalization rates based on index hospital admission diagnosis were genitourinary disorders in 30% of the rehospitalization and 25% had cardiovascular disorders (Ouslander et al., 2011). In adjusted models, Bogaisky and Dezieck (2015) found patients discharged from a hospital

to a nursing home had significantly higher rates of 30-day rehospitalization compared with patients discharged to the community when the index hospitalization was for CHF or pneumonia (40%, P < .001, 19.5%, P = .008 respectively). Lima et al. (2012) reported two thirds of rehospitalized residents had an index hospital stay of seven or fewer days; against a reference category of index hospitalization lasting no more than two days, index hospitalization of eight days or more (approximately one in three) was significantly more likely to result in rehospitalization, whereas those lasting between three and seven days (approximately three in five) were not. Similar proportions of index hospitalizations lasting two days or fewer, between three and seven days, and longer than seven days were reported by Ouslander et al. (2011). Finally, patient complexity was positively associated with 30-day rehospitalization as measured by length of stay, diagnosis-related group, and comorbidities with Charlson/Deyo and Elixhauser indices (Rahman, McHugh, Gozalo, Ackerly, & Mor, 2016).

Reasons for Hospitalization

Dombrowski et al. (2012) found that most patients (62%) were rehospitalized for the same condition that led to the hospitalization preceding the SNF admission. However, Ouslander et al. (2016) reported that fewer than half of rehospitalizations were related to the index hospital admission. A common reason for a hospital transfer within 30 days of a SNF admission was some abnormality in vital signs, which was noted in 35% to 38% of 30-day rehospitalizations (Dombrowski et al., 2012; Ouslander et al., 2016). Abnormal diagnostic test results were also present in 18% of transfers back to a hospital (Dombrowski et al., 2012), in particular, anemia (10.2%, $p = .001$), radiograph (5.2%, $p < .001$), urinalysis or urine culture (2.8%, $p < .001$) (Ouslander et al., 2016). A study that

reviewed reasons for rehospitalization in patients who underwent a hip arthroplasty in Florida found that the most common reasons for rehospitalization were infections and complications related to the procedure or implant; however, among patients discharged to a SNF, the most common reason for rehospitalization was anemia or other hematologic abnormality (Lavernia et al., 2013).

Other reasons for a hospital transfer from a SNF were the symptoms of shortness of breath or respiratory distress in 25.5% and 18% percent of residents, respectively (Dombrowski et al., 2012; Ouslander et al., 2016). Dombrowski et al. (2012) reported the primary reason for hospitalization was infection or pneumonia, which were present in more than a quarter of readmitted residents. In a national Medicare analysis, 13% of transfers back to a hospital were for septicemia and 7% were for pneumonia (Office of Inspector General, 2013a). Likewise, infection was the rehospitalization hospital diagnosis in approximately 35% of rehospitalized residents from a SNF (Hain et al., 2012; Ouslander et al., 2011) while 22% had a readmitted hospital diagnosis related to a cardiovascular disorder (Ouslander et al., 2011). Two studies indicated the reason for rehospitalization was symptoms of altered mental status in approximately 30% of readmitted SNF residents (Dombrowski et al., 2012; Ouslander et al., 2016).

Facility Factors

Literature on nursing home quality explores various structural and process factors. Structural elements include size, ownership type, or the number and types of staff in a facility. Process factors include decisions related to clinical care or interventions performed in the nursing home. Differences in nursing home structural components and processes of care interventions contribute to variances in rehospitalization outcomes.

Structural Elements

Neuman, Wirtalla, and Werner (2014) found that 30-day rehospitalization rates were inversely related to the number of SNF beds (17.6% for ≤ 50 beds, 19.9% for 51-100 beds, 21.3% for 101-150 beds, 22.5% for ≥ 151 beds, $p < .001$) and were higher in for-profit facilities (21.9%) compared with either not-for-profit facilities (19.1%) or government-owned (18.9%) facilities $p < .001$). Bogaisky and Dezieck (2015) also found significantly lower 30-day rehospitalization rates in not-for-profit SNFs (28%) compared with for-profit facilities (45%, $p < .001$). Rahman, McHugh, et al. (2016) also found an association between ownership status and rehospitalization rates (SNFs in the highest quartiles compared with the lowest quartiles of adjusted rehospitalization rates were more likely to be in the for-profit facilities). In contrast, Lima et al. (2012) found no significant association between for-profit status and rehospitalizations, despite a similar percentage of for-profit status (68%) compared with the studies by Neuman et al. (2014) and Rahman, McHugh, et al. (2016).

Hospital affiliation, described as a hospital-owned SNF or a hospital-SNF collaboration, is another point of interest to understand rehospitalizations. At least three studies found SNFs that were hospital-based had lower 30-day rehospitalization rates compared with free-standing facilities (Li, Cai, Yin, Glance, & Mukamel, 2012; Rahman, Foster, Grabowski, Zinn, & Mor, 2013; Stearns, Dalton, Holmes, & Seagrave, 2006). However, another study by one of those groups of investigators found that after adjusting for a number of resident characteristics, SNF, and geographic factors, hospital affiliation was associated with a slightly increased likelihood of all-cause rehospitalizations (OR 1.08, $p = .014$) but not of preventable rehospitalizations (OR = 1.04, ns) (Li et al., 2015).

Findings from studies exploring rehospitalization rates from SNFs that are hospital owned or affiliated have found results in both directions.

Facility characteristics were explored based on the proportion of Black residents and White residents within a nursing facility, and two studies determined that nursing facilities with more Black residents than White residents had higher rehospitalization rates for both White residents and Black residents (Li et al., 2015; Li et al., 2011). More specifically, Li et al. (2015) indicated that SNFs with higher concentrations (≥ 25%) of Black residents had higher rates of all-cause rehospitalizations (20.1% for Whites, 22.9% for Blacks) compared with SNFs with lower concentrations (< 3%) of Blacks (16.7% for Whites, 17.5% for Blacks); however, after adjusting for resident characteristics, these disparities were mostly related to facility factors.

Compared to facilities with lower proportions of Black residents, the SNFs with higher proportions of Black residents had higher percentages of Medicaid residents (44.3% versus 37%), were more likely to be for-profit (83.5% versus 62.9%), and were mostly in an urban location (82.4% versus 59.8%) (Li et al., 2015). However, in their full model, the effects of Medicare and Medicaid as the payer were similar (approximately 1% increase in relative odds of all cause or preventable rehospitalizations for a 10% increment of the nursing home population with either payer) (Li et al., 2015). Neuman et al. (2014) found higher unadjusted rates of 30-day rehospitalizations in SNFs in the 75th percentile for the percentage of residents with Medicaid as the payer compared with SNFs in the 25th percentile (23.7% versus 19.6%, respectively). Adjusted 30-day rehospitalization rates for SNFs are inversely related to the percentage of SNF residents for whom Medicaid is the payer (55% to 56% Medicaid for the lowest two quartiles

versus 59% to 65% Medicaid for the highest two quartiles of adjusted rehospitalization rates for SNFs (Rahman, McHugh, et al., 2016).

Staffing and Organization

Several studies included physician or nurse staffing factors with 30-day rehospitalizations. Using the Five-Start Quality Rating System designed by CMS, an unadjusted risk of a 30-day rehospitalization among SNF Medicare beneficiaries was inversely related to the star rating for staffing (22.9%, 22.3%, 21.5%, 19.9%, and 18.0% for one through five stars, respectively $p < .001$); however, after adjusting for numerous performance measures and facility characteristics, the association was no longer statistically significant (Neuman et al., 2014).

Medical staff organization was assessed by Lima et al. (2012) using the presence of a *formal appointment process* for physicians that included written contracts, direct hiring by the facility, and detailed medical staff bylaws. After adjusting for resident, hospitalization, and facility characteristics, the presence of a formal appointment process for physicians was associated with fewer rehospitalizations ($B = -.043$, $OR = .65$) compared with facilities without a formal appointment process ($p < .001$). In addition, the relative odds of 30-day rehospitalization were higher when the average percentage of residents under the care of a single physician was greater than 20% against a reference category of no greater than 10% ($B = .18$, $OR = 1.2$, $p = .025$) (Lima et al., 2012).

A different study indicated that residents who were admitted into nursing facilities with lower registered nurse staffing levels (hours per resident per day) were more likely to experience a rehospitalization by 0.19 percentage points (Thomas, Rahman, Mor, & Intrator, 2014). Thomas, Mor, Tyler, and Hyer (2013) conducted an analysis in Florida to

examine licensed nurse turnover and retention rates with 30-day rehospitalization rates over an eight-year period; after controlling for resident, market, and facility characteristics, they found that lower retention rates were significantly associated with 30-day rehospitalization rates, but the magnitude of the effect was small; there was no significant association between nurse turnover and 30-day rehospitalization.

Performance Measures

In addition to staffing and organization, overall quality performance measures, such as deficiencies or specific quality measures, have been investigated in relation to rehospitalizations.

Deficiencies. Based on the CMS Five-Star Quality Rating System, unadjusted rates of 30-day rehospitalizations were inversely related to the star rating for inspection rating (deficiencies) (22.5%, 21.6%, 20.8%, 20.3%, and 19.3% for one through five stars, respectively, $p < .001$); after adjusting for numerous performance measures and facility characteristics, the association was still statistically significant (Neuman et al., 2014). Patients admitted into lower quality nursing homes, as measured by higher state-adjusted, weighted deficiency scores (Thomas et al., 2014) or by greater numbers of healthcare deficiencies (Li et al., 2015) were more likely to be hospitalized within 30 days from their hospital discharge. In another study of patients hospitalized for acutely decompensated heart failure (N = 603) who were discharged to SNFs, Nursing Home Compare overall quality ratings were used to group the 17 SNFs into one star (seven SNFs, n = 295) and SNFs with two or more stars (10 SNFs, n = 308). The one-star SNFs had higher all-cause unadjusted (21.7%) and adjusted rehospitalization rates (22.2%) compared with the higher-rated SNFs (18.5% and 18.1%, respectively) (Ogunneye et al.,

2015); however, the differences in rehospitalization percentages were not statistically significant.

Other performance indicators. Neuman et al. (2014) reported fewer rehospitalizations in facilities in the 25th percentile versus the 75th percentiles for new or worsening pressure ulcers (19.5% versus 22.0%, $p < .001$) in unadjusted analyses, but their research also found nonsignificant inverse relationships by quartiles of post-acute care residents with delirium and with moderate to severe pain in unadjusted analyses. In models that counted for sex, race, age, reasons for admission and discharge, for hospital characteristics, and for SNF performance and facility characteristics, the direction of adjusted risks of hospitalization were positive for pressure ulcers ($p = .04$), and remained negative for moderate to severe pain ($p = .01$) and delirium (ns) (Neuman et al., 2014).

Process Elements

Staff. Bogaisky and Dezieck (2015) reported a lower 30-day rehospitalization rate in two nursing homes in which a physician was present seven days a week compared with four nursing homes that did not have a physician present seven days a week (30% versus 38%, $p = .04$). Bogaisky and Dezieck (2015) found that nursing home residents discharged by a hospitalist geriatrician had significantly lower rehospitalization rates (30.7%) compared with residents who were discharged by a nonhospitalist geriatrician (43.6%).

A single study analyzed the association of a hospital transfer within 30 days from a SNF admission with the annual volume of Medicare SNF admissions by tertiles: low volume (fewer than 45 admissions per year), medium volume (45-107 admissions per year), and high volume (108 or more admissions per year) (Li et al., 2012). The results of

multivariable analyses adjusted for resident characteristics and showed significantly lower hospital transfer rates in high-volume SNFs (14.3%) compared to medium volume (15.9%) or low volume SNFs (16.4%, $p < .001$); however, the magnitude of differences was small because each tertile included more than 4,900 facilities. Based on the multivariable Cox proportional hazards model, controlling for a large number of patient demographic and clinical variables, the hazard ratio was 13% lower for high-volume SNFs relative to low-volume SNFs (HR = .87, 95% CI .79 to .97, p = .01) and 11% lower for medium-volume compared with low-volume SNFs (HR = .89, 95% CI .79 to .99, p = .03) (Li et al., 2012).

In a root cause analysis study, the primary care provider (physician, nurse practitioner, or physician assistant) authorized the transfer in 88% of the cases (Ouslander et al., 2016). In this same study, the SNF staff identified their opportunities for improvement in processes in relation to rehospitalizations including managing the condition at the SNF with available resources (31.4%) and resources were not available to manage the change in condition (26.6%). The staff also indicated that detecting changes in condition or discussion with the resident or family about preferences at an earlier stage might have helped avoid approximately one in five to one in six 30-day rehospitalizations. Better communication in general was also identified as an opportunity for improvement in approximately one in six 30-day rehospitalizations (Ouslander et al., 2016).

Interventions. Ogunneye et al. (2015) examined targeted processes for the treatment of heart failure (n = 603 hospital discharges for 489 patients) in 17 Massachusetts SNFs over a three-year period and found no significant association of

rehospitalization with any processes of care (e.g., weight monitoring, dietary salt restriction, acute decompensated heart failure program) or structural characteristics (e.g., turnaround times for diagnostic tests or imaging, bed size, physician and licensed nurse staffing). The Ouslander et al. (2016) root cause analysis was the only study in this review to describe the medical interventions provided for SNF residents before a 30-day hospital transfer. The most common medical interventions provided to residents prior to a transfer to a hospital was the administration of oxygen (21.3%), new medication(s) (14.6%), and administration of intravenous or subcutaneous fluids (3.8%) (Ouslander et al., 2016). Beyond medical interventions, a variety of diagnostics tests were performed for residents prior to a hospital transfer, with the most common identified as a blood test in 15.6% of residents and a radiograph test in 7.2% of hospital transfers (Ouslander et al., 2016). However, a major limitation of this study is that there was no comparison group of residents who were not readmitted (Ouslander et al., 2016). The majority of 30-day rehospitalizations involved transfer to a hospital during a weekday (76.7%), with 42.6% transferred between noon and 7 p.m. and 29.6% transferred between 7 a.m. and noon. Fewer were transferred in the evening between 7 p.m. and midnight (17.4%) or during the night from midnight to 7 a.m. (10.4%); 29.2% were transferred during a weekend (Ouslander et al., 2016).

Discussion

Rehospitalizations after a nursing home admission have potential negative health outcomes for residents and are costly for Medicare. Concern about rehospitalization has been growing among policymakers and stakeholders. The Protecting Access to Medicare

Act in 2014 that included provisions for SNFs to reduce rehospitalizations by means of financial penalties and incentives (Carnahan et al., 2016).

Nearly all of the studies contributing to this review were retrospective cohort studies. To assess resident characteristics, most of the studies used large Medicare claims or enrollment data, and some used medical records or resident assessment data. The facility structure and process factors were examined using the Online Survey Certification and Reporting (OSCAR) data or survey tools (e.g., for root cause analysis). Most studies reviewed for this chapter included some data on individual resident factors; others centered on facility characteristics, and many included both factors in their analysis. Most studies were descriptive; fewer studies used statistical modeling to estimate predictors of rehospitalization or the influence of multiple covariates on the strength and direction of prediction.

Demographic factors showed residents who were female, older (> 75 years) in age, and those who were Black had higher rates of rehospitalization. The risk for rehospitalizations among residents who were dually eligible for Medicare and Medicaid had mixed results, with some evidence indicating higher risk and others indicating an equal likelihood of rehospitalization with Medicare-only residents. Nonetheless, in general, dual-eligible individuals were more likely to have higher rehospitalization rates because they had complex clinical conditions and functional impairments (Bennett & Probst, 2016; Walsh et al., 2012). The presence or absence of an advance directive order or initiation of palliative care also influenced rehospitalization decisions, with major implications for assessing and adhering to resident preferences and end-of-life goals when planning care or making decisions about hospitalization (Ahearn et al., 2010;

Wang, Wang, Wang, Laird, & Agnihotri, 2016). Marital status or family support was not a factor related to hospitalization in this review but has been correlated to rehospitalization rates in African Americans with heart failure and might warrant further exploration (Lu et al., 2016).

The most common resident characteristic explored with 30-day rehospitalization was medical diagnosis. Specifically, residents with congestive heart failure, pulmonary conditions, chronic kidney disease, or a diagnosis of cancer had higher rates of rehospitalizations in most studies. Nursing homes with specific cardiac protocols were found to reduce rehospitalization related to heart failure, which could serve as a model for commonly rehospitalized conditions. Residents with impaired physical function and cognitive disorders, such as dementia, and those with multiple comorbidities or polypharmacy had higher rehospitalization rates.

There is an opportunity to identify residents at increased risk for rehospitalization at an early point in the SNF stay to avoid preventable hospitalizations. However, little is known about valid assessment tools for this purpose or what kinds of resources or processes of care might contribute to reducing preventable rehospitalizations. Changes in vital signs, laboratory results, or mental status were the most frequented reasons to prompt a transfer to a hospital from a nursing home, but often such changes became evident only after a resident's condition changed. In the Ouslander et al. (2016) study, staff identified an opportunity to assess a change in condition earlier to avoid hospitalizations, while Lamb, Tappen, Diaz, Herndon, and Ouslander (2011) proposed identifying changes sooner with more information by utilizing family members and providing the staff with resources to improve physician access.

Structural facility factors associated with higher rehospitalization rates included facilities with more beds (Neuman et al., 2014), for-profit status (Bogaisky & Dezieck, 2015; Neuman et al., 2014; Rahman, McHugh, et al., 2016), and higher proportions of Black residents (Li et al., 2015; Li et al., 2011). Higher levels of nurse staffing lowered the risk of rehospitalization but did not remain significant after adjusted analysis (Neuman et al., 2014), while nurse retention rates were significantly associated with 30-day rehospitalization rates (Thomas et al., 2013). Worse performance in quality measures, including nurse staffing (Neuman et al., 2014; Thomas et al., 2014) and deficiency scores were associated with higher rehospitalization rates.

Nursing homes with a hospital affiliation showed mixed results in most studies, indicating lower rehospitalization rates in hospital-affiliated homes (Li et al., 2012; Rahman et al., 2013; Stearns et al., 2006); however, after adjusting for a variety of factors, higher rehospitalization rates were found in hospital-affiliated facilities (Li et al., 2012), and SNFs with higher adjusted 30-day rehospitalization rates were less likely to be hospital affiliated (Rahman, McHugh, et al., 2016). For instance, one study showed that younger patients with no cognitive impairments and certain medical conditions might be preferentially selected for a hospital-based SNF referral for quick recovery (Stearns et al., 2006), but that potentially influences the SNF rehospitalization rates of free-standing nursing homes to the extent they receive older and sicker patients. In the past, only hospitals were held to account for rehospitalizations; with recent legislation and regulations, nursing homes also are held accountable. As a result, there may be greater opportunity for hospital-SNF collaborations in the future that might target specific conditions or communities to reduce preventable rehospitalizations.

Processes and interventions related to rehospitalizations from nursing homes are minimally explored in the literature. Lower rehospitalization rates were found in facilities with a physician present seven days a week (Bogaisky & Dezieck, 2015) and in facilities that had higher volumes of admissions (Li et al., 2012). Offering education for nurses to enhance their ability to perform advanced medical skills has not resulted in statistically significant reductions of rehospitalization rates (Hovey, Kim, & Dyck, 2015). Variations in nursing home resources, such as on-site X-ray or laboratory services, might influence rehospitalizations by providing necessary information to treat residents on-site rather than transferring them to a hospital for similar services. To reduce and avoid rehospitalizations, additional research is necessary to explore specific processes and interventions in nursing homes.

Communication was another brief point of interest identified by staff as needing improvement in one study (Ouslander et al., 2016); more specifically, failure to communicate was a major source for error with potential harm and negative outcomes such as a hospitalization (Institute of Medicine, 1999; Naylor, Kurtzman, & Pauly, 2009). Residents transferred to a nursing home have complex medical and physical needs that require diligent information sharing during discharge and transfer to the nursing home. This information is used to individualize care plans to meet specific medical treatments and daily care needs. For instance, one study found that a quarter of recommendations from a hospital at discharge were not performed by the nursing home (Caruso, Thwin, & Brandeis, 2014). Likewise, nurses reported multiple episodes of inaccurate or insufficient information about resident health history and medications when receiving residents from hospitals, and that increased the risk of rehospitalization and potential harm (King et al.,

2013; Naylor et al., 2009). Involving resident caregivers and families during the transition from hospital to SNF in conjunction with structured communication tools can help to reduce communication errors (Cortes, Wexler, & Fitzpatrick, 2004; Gilmore-Bykovskyi, Roberts, King, Kennelty, & Kind, 2016).

While not all rehospitalizations are preventable, it is important to understand the risk factors to design interventions to avoid them. For example, the Intervention to Reduce Acute Care Transfers (INTERACT) is an interdisciplinary quality-improvement program designed to identify, assess, document, and communicate resident change of status in nursing facilities to reduce hospitalizations or to avoid potential transfers (Ouslander, Bonner, Herndon, & Shutes, 2014). Another intervention, the Project Re-Engineered Discharge (RED) initiative reduced rehospitalization in SNFs by including families and residents in their plan of care (Berkowitz et al., 2013). Project RED integrated resident data with a plan of care on an electronic data system, reviewed the plan, and provided a copy for residents and families and also contained detailed information of medications, advance directives, and follow-up appointments (Berkowitz et al., 2013). Further exploration of interventions to reduce rehospitalization is needed.

Policy Implications

Rehospitalizations from nursing homes are a significant concern because there is potential harm to residents and is costly to Medicare. Increased focus on rehospitalizations among policymakers creates emphasis on the policy implications of this issue, such as financial penalties, public reporting of rehospitalization rates, and goals to reduce Medicare spending. An important policy concern for using rehospitalizations as an SNF quality measure is whether it can capture true differences

between SNFs or whether the rehospitalization rate primarily reflects patient severity. Using an instrumental variable approach, Rahman, Grabowski, Mor, and Norton (2016) found that SNF rehospitalization rates based on data from 2009-2012 could be used to predict 2013 SNF rehospitalizations independent of patient severity. A second concern is whether reserving beds for a hospitalized Medicaid resident affects hospitalization rates and, if so, whether that effect varies across states. One study found that states with more-generous policies toward reserving nursing home beds for residents on Medicaid led to greater SNF rehospitalizations (Grabowski et al., 2010).

Although the evidence in this review suggests nursing homes have greater influence on rehospitalizations than does the discharging hospital, there is opportunity to explore how restructuring hospital transfers and hospital-SNF partnerships can impact rehospitalization rates (Naylor et al., 2012). Furthermore, there is a need to address barriers to improved transitions from hospitals to nursing homes (Cortes et al., 2004; Gilmore-Bykovskyi et al., 2016; King et al., 2013; Naylor et al., 2012). This includes shorter hospital stays, variations in state policies reimbursements, and systems for sharing important clinical information and staff training. Ongoing evaluation is also necessary to measure outcomes of policies aimed at improving transitions of care and to allocate resources accordingly.

As with previous quality measures that are publicly reported on the Nursing Home Compare website, the SNFRM is now a part of the information provided on this site as of July 2016. Public transparency of the rehospitalization rates can provide incentives for nursing homes to implement strategies to reduce rehospitalization rates because these results impact overall quality ratings (Werner et al., 2009). Policymakers

should also consider the potential for unintended consequences of the rehospitalization policies (Naylor et al., 2012). For instance, nursing homes might select to rehospitalize high-risk residents to improve quality measure scores used for public reporting (Konetzka, Polsky, & Werner, 2013). Nursing homes also might avoid transferring residents to a hospital, even when higher acuity care is required, to reduce reportable rehospitalization rates or penalty payments; if so, then penalties ultimately could contribute to harm. Lastly, as financial penalties are imminent, nursing homes have more incentive to understand resident and facility factors that influence rehospitalizations.

Limitations

This review has several limitations. First, it was limited to studies that focused on rehospitalization within 30 days from a hospital discharge to a SNF, but some studies included all 30-day rehospitalizations, regardless of whether the discharge was to the community or to a SNF, and at least one study included all rehospitalizations from a SNF, regardless of when the rehospitalization took place. Second, the primary data source for many of the studies in this review was Medicare claims or enrollment data. This data source is rich with resident characteristics, from which population generalizations can be inferred. However, most studies used existing data rather than prospectively collected data, and not all studies in the SNF setting compared readmitted residents with those who were not readmitted over the same interval. This type of study design is appropriate for exploratory purposes but is prone to various biases and generally is a weak basis for inferring causal relationships. Another limitation was the paucity of qualitative research that examined staff, resident, or family perceptions, attitudes, and

beliefs related to rehospitalizations. Lastly, relatively few of the studies tested any interventions designed to reduce avoidable rehospitalizations.

Conclusion

Rehospitalizations from nursing homes are associated with high costs and adverse patient outcomes. The policy implications of rehospitalization are substantial for improving nursing home quality and because of impending financial penalties. Rehospitalizations within 30 days from an acute hospital discharge are commonly linked with various resident and facility factors, but differences in study designs and data sources make it difficult to compare findings across studies. More studies are needed to further explore the influence of nursing home structure and processes of care, in addition to resident-level characteristics, on outcomes such as rehospitalization to develop effective approaches to improving care and reducing avoidable hospitalizations.

In Chapter 3, I outline the methods for this dissertation research. A retrospective cohort research design is used for a secondary analysis of existing nursing home data from three sources: electronic health records, the Minimum Data Set, and Nursing Home Compare (Medicare.gov, n.d.-d), that pertain to 10 for-profit nursing homes in New Mexico. The data sample will include residents admitted into any of the 10 facilities following an acute care hospitalization from July 2015 through June 2016 and includes facility-level Nursing Home Compare data from the same time period. The primary outcome variable is 30-day rehospitalization. Various resident and facility variables will be used as independent variables directed by the findings in this literature review. Basic descriptive statistics will be done to explore different facility and resident characteristics. A logistic regression will be used to explore which resident characteristics are associated

with a 30-day rehospitalization. A multilevel modeling approach will be used to explore resident factors and facility factors with residents nested within the nursing homes.

CHAPTER 3: Methods

Research Design

The purpose of this retrospective cohort study was to determine which resident and facility factors are associated with 30-day rehospitalization from New Mexico nursing homes. The study originally proposed to analyze existing data from three sources: electronic health records (EHR), the Minimum Data Set (MDS), and Nursing Home Compare data (Medicare.gov, n.d.-d) pertaining to 10 for-profit nursing homes in New Mexico. Data were obtained from two sources and analyzed. The retrospective cohort design has been the primary research design used to explore this topic in the existing literature on nursing home rehospitalization. Previous studies served as a model for this study's research design and variables of interest. This approach allowed for the analysis of a large amount of data obtained from different data sources (e.g., administrative data, public data sources).

Specific Aims

The specific aims of the study were:

1. To explore which resident risk factors more likely predict a rehospitalization from a nursing home within 30 days from an acute hospital discharge.
2. Assess the structural-process differences among nursing homes that might influence the rates of 30-day rehospitalizations.
3. Evaluate policy implications of factors associated with 30-day rehospitalizations for nursing homes.

Research Questions and Hypotheses

1. Which nursing home factors are most strongly associated with 30-day rehospitalizations in residents?

    i) Hypothesis: Nursing homes with greater survey deficiencies will have higher 30-day rehospitalization rates.

    ii) Hypothesis: Nursing homes with higher registered nurse staffing hours will have lower 30-day rehospitalization rates.

2. What resident factors predict the likelihood that a resident will be readmitted into a hospital within 30 days of an acute hospital discharge and a nursing home admission?

    i) Hypothesis: Residents with acute or chronic cognitive impairment (e.g., delirium, dementia, or severe mental illness) will have higher 30-day rehospitalization rates.

    ii) Hypothesis: Residents with an advance directive in place will have a lower 30-day rehospitalization rate compared with those who do not have an advance directive.

Procedures

A preliminary written proposal (Appendix G) was sent to a specific nursing home corporation to request access to the MDS and EHR data to provide the details of resident characteristics. Data from the EHR was not known in advance because it is considered proprietary information, and therefore, a list of requested data was sent to the nursing home corporation (Appendix H). The third source of data, Nursing Home Compare, is a

publicly available dataset (Medicare.gov, n.d.-d). The proposal was sent to the nursing home corporation research team on September 14, 2016. The team approved and accepted the proposal, with specific conditions, on September 23, 2016, via email. The Data Use and Data Transfer Agreement between the nursing home corporation and the University of New Mexico was entered after approval of the proposal by the dissertation committee. Ethical approval was obtained on June 2, 2017, from the University of New Mexico's Health Sciences Human Research Review Committee.

Setting

This study used deidentified data pertaining to 10 nursing homes located in the greater metropolitan area of Albuquerque, N.M. All 10 facilities were owned by the same company, provided long-term care and rehabilitation services, and were Medicare and Medicaid certified.

Overall, the state of New Mexico census was more than 2 million people in 2016. A combined census for Albuquerque and Rio Rancho was more than 600,000, and 12% of this population consisted of persons 65 and older (U.S. Census Bureau, 2016). In total, New Mexico had 75 nursing homes, a third of which were located in Albuquerque and Rio Rancho. Nine of the study facilities were located in Albuquerque and accounted for half of the nursing homes in the city. The tenth facility was located in Rio Rancho and was one of three nursing homes in that city. Together, the 10 nursing homes constituted approximately13% of all nursing homes in New Mexico.

Sample

The study sample data consisted of deidentified MDS and EHR data with residents admitted into any of the 10 facilities following an acute care hospitalization

from July 2015 through June 2016 and facility-level Nursing Home Compare data from the same time period. The time frame was selected because facilities had recently introduced electronic health records into their facilities, and this time period ensured access to electronic health records data.

For a simple power analysis for specific aim No. 1, considering 30-day rehospitalization as a binary outcome and assuming the base rehospitalization rate was approximately 20% (Rahman, Grabowski, et al., 2016), a sample size of 400 residents was an adequate estimate for 80% power to detect an odds ratio of 1.5 for the change in the outcome for a unit change in a given predictor variable (e.g., the change of a binary X from 0 to 1) at $\alpha = 0.05$. This was feasible because each nursing home allocated 20% to 30% of approximately 100-plus beds to residents newly admitted from an acute care setting with a continuous influx of new resident admissions each month for the estimated 11-month time period of this study. Based on preliminary discussions with the nursing home corporation, the number of SNF admissions over the study period was calculated to be substantially more than that.

Data Sources

There were three sources of data planned for this study. The EHR data were to provide a mix of resident health information and internal facility processes. Examples of information found in electronic health records included lists of resident medications, medical diagnoses, laboratory results, and vital signs. A number of nursing home personnel, including physicians, nurses, and nursing assistants, input data into the EHR. The benefit of considering this data source was the possibility of offering unique insights into specific processes and interventions performed by nursing home staff. A

disadvantage of this data source was that there could be missing or incomplete data. The second data source, the MDS 3.0 Quality Indicator report, included a variety of resident clinical assessments, and it is a federally mandated requirement that nursing homes complete these assessments. Data were collected by licensed nurses upon admission into the nursing home and at standard intervals, including at the time of discharge. The MDS has been reported to be valid and reliable for measuring quality in nursing homes (Saliba & Buchanan, 2008; Smith et al., 2012). The benefit of this data source was that because it was required, there was less likelihood of incomplete data.

The third data source was the Nursing Home Compare dataset, which focused primarily on facility characteristics. It contained facility identification information such as provider number, county location, and ZIP codes. It also included a variety of facility characteristics, such as quality of care measures, staffing measures, and reports from the annual survey visits. The dataset is generated quarterly and was available online via the Data.Medicare.gov website. The key advantage of this data source was that it is a publicly accessible dataset. The weakness of this dataset was that it did not provide information related to processes, interventions, or types of resources available in the nursing facilities. This dataset was not used for resident-level statistical analysis because rehospitalization measures were not included in the data at the time of this study and that there was a shift in how variables were reported over the course of this study, with annual measures provided in 2015 and quarterly measures provided in 2016.

The EHR data were received as comma-separated values in a text file and imported into Microsoft Excel for screening. Due to extensive incomplete and missing data, and based on consultation with a statistician, these data were not used. The MDS

database was received in extensible markup language (.xml) format and imported into statistical software for screening and analysis. Nursing Home Compare data were downloaded as comma-separated values in an Excel-readable text file. Data were screened for missing or out-of-range values. Cases with missing data for an analyzed variable were excluded casewise from that analysis but were not excluded otherwise.

Assessment for Rehospitalization

The primary-outcome variable was the resident-level 30-day rehospitalization. For individual resident data, this was analyzed as a discrete event (e.g., yes/no). This information was collected from the MDS records using the date difference from the admission date to discharge date (≤ 30 days) for residents who entered a SNF from an acute or psychiatric hospital. Such residents were considered to have a 30-day rehospitalization if their discharge status was to an acute hospital within 30 days and were considered not to have a 30-day rehospitalization if they were not discharged within 30 days or if they were not discharged to an acute hospital–e.g., they were discharged to a private home or a group home. Deaths were excluded from the sample during the study period. As noted, licensed nurses are required to complete the MDS on admission, at specific intervals during the nursing home stay, and at discharge. These records have been reported to have a high degree of accuracy in recording deaths and rehospitalizations of nursing home residents (Rahman, Tyler, Acquah, Lima, & Mor, 2014).

Data Analysis

Choices of resident-level and facility-level independent variables were informed by theoretical considerations and empirical literature reviewed in Chapter 2. Specifically,

for the first research question, which pertains to facility factors, independent variables included measures of quality of care and staffing. Quality of care measures included results of state inspection surveys from Nursing Home Compare data. Nurse staffing was originally proposed to be measured by hours per resident per day by facility in relation to rehospitalization rates; however, due to a lack of detailed rehospitalization data, the five-point Nursing Home Compare star rating, for which lower numbers indicate poorer quality, was used instead. Additional facility-level covariates included the number of SNF admissions during the study period, health survey, quality measures, and nurse staffing.

For the second research question, which pertains to resident factors, independent variables included various medical diagnoses and conditions (e.g., gastrointestinal diagnosis or renal failure) and clinical symptoms or behaviors. The study originally proposed advance directives as an independent variable; however, this information was not included in the MDS data, which meant that care planning variables were used instead. Resident-level covariates included gender, race/ethnicity, marital status, medical diagnoses, activities of daily living assistance, and whether the resident received specialized medical treatments while in the SNF.

Data analysis was conducted using Stata 14 statistical software. For resident-level continuous variables, descriptive statistics included means and standard deviations. Categorical data were assessed with frequencies and proportions or with percentages and modal category.

Statistical analyses relevant to the research questions and hypotheses began with calculating bivariate associations with 30-day rehospitalization. For example, to test for

relationships of rehospitalization rates across categories of nominal independent variables, such as presence of a particular diagnosis or whether a patient received special medical treatments, chi-square tests for independence were used. To test bivariate associations of continuous variables with 30-day rehospitalization, independent sample *t*-tests were used, and Cohen's *d* was calculated to determine effect size. A logistic regression model was used to assess the impact of a set of resident-level predictors on rehospitalization. Variables were entered into the logistic regression based on information from the Chapter 2 literature review and other variables identified in this study for which the bivariate association with rehospitalization (yes/no) had a *p*-value of 0.05 or less. Four model specifications were used to assess the consistency of the estimates as additional variables were included. Also, to test whether there were any observable significant facility level impacts on resident-level rehospitalization risk, a logistic regression model with fixed effects for facilities was fit. A multilevel logistic regression model was also explored to assess the degree of intracluster correlation for residents within facilities.

Several exploratory analyses pertaining to facility processes and rehospitalizations were originally proposed. This information was captured in the EHR data, but due to incomplete or missing data, this exploratory analysis was not conducted.

Validity Threats

There were several potential threats to internal, external, construct, and statistical conclusion validity (Shadish, Cook, & Campbell, 2002). The first potential threat to internal validity was a selection threat with risk of participating nursing homes having homogenous characteristics (Shadish et al., 2002), such as being from the same

corporation and all located in the same metropolitan area. One potential external validity threat was that the results of this study might not hold true for other care settings or nursing homes outside of New Mexico. A potential threat to construct validity was that use of existing data meant that the definitions and measurement of variables were determined for purposes other than those of the study.

There were several potential threats to the validity of statistical conclusions. First, missing data could compromise the ability to run certain analyses, especially if data were not missing at random. Secondly, as noted above, at the resident level, sample size was large, whereas at the facility level, it was small. Accordingly, at the resident level, even very small effects, too small to be clinically meaningful or practically useful, might be statistically significant, whereas at the facility level, low statistical power could mean that some effects large enough to be meaningful were not statistically significant, in which case their meaning would be indeterminate in terms of true or false negative conclusions (Shadish et al., 2002).

Ethical considerations

The study proposal was reviewed and approved as an exempt study by the Human Research Review Committee of the University of New Mexico's Health Sciences Center and by the research and IT departments of the nursing home corporation prior to the release of data to the investigator. This study involved existing data from human subjects, but the researcher had no direct interaction with residents, staff members, or families in this study. In fact, the proposal for this study specifically indicated and requested that the data the nursing homes provided be deidentified. Although the data were not individually identifiable, the linking between data sources required some form of consistent identifier.

This risk was minimized by preassigned and anonymous study numbers to residents and facilities. Data were provided by the nursing home corporation as a HIPAA-compliant limited dataset. Any linkages were performed and anonymous case and facility codes were applied by IT personnel by the nursing home corporation prior to data transfer. The data were maintained on an encrypted data security management platform at the University of New Mexico's Health Sciences Center, and analyses were conducted on an encrypted, password-protected computer.

Limitations

There were several limitations to this study. First, this study used existing data, and the investigator was unable to define variables or select measures other than what was in the data sets. This limited the information available to answer the research questions. In addition, there was no investigator control over how data were collected or entered by facility personnel. It was not possible to obtain a detailed EHR codebook prior to receiving the data, which limited the ability to plan analyses in detail prior to receiving the data. Moreover, the extent of incomplete data in the EHR was far greater than anticipated, which prevented the use of this data source in the analysis. This was addressed by using the MDS data as a valid and reliable alternative data source.

CHAPTER 4: Results

There were 2,923 SNF admissions within the one-year study period from July 2015 to June 2016. Of those admitted into a SNF, 97.4% entered from a hospital, including acute or psychiatric hospitals, while 2.6% entered from another setting, such as the community, another nursing home, or an inpatient rehabilitation facility. Overall, 16% of SNF admissions resulted in discharge to a hospital from the SNF, whereas 79% were discharged to a setting other than an acute hospital, including a community setting, such as home or assisted living or hospice; approximately 5% died in the SNF.

Resident Factors for SNF Stays of 30 or Fewer Days

For those with SNF stays of 30 or fewer days (n = 2370/2923, 81% of all SNF admissions), the average length of stay was 22.9 days. Of those, 317 residents (13.4%) were rehospitalized within 30 days of the SNF admission. Demographic characteristics and the associated rehospitalization rates are displayed in Table 1. The percentages of men and women were nearly equal. Men were significantly more likely to be rehospitalized than women (difference = 3.9%, 95% CI for difference 1.2% to 6.7%), but the association between sex and rehospitalization was weak ($\phi = .06$). The two largest race and ethnicity categories were White (53.4%) and Hispanic or Latino (26%); 11.3% of the sample had no documentation for race or ethnicity. Race and ethnicity categories were not significantly associated with rehospitalization rates. A majority of the sample was not currently married (never married, widowed, separated, or divorced); marital status showed a weak, statistically significant association with rehospitalization, with married more likely than unmarried residents to be rehospitalized (difference = 3.0%, 95% CI for difference 0.10% to 6.05%, $\phi = .06$).

Table 1: Resident Demographics and Rehospitalization Rates

Resident Characteristic	Characteristic n (%)	Rehospitalization Rate n (%)	*p**
Gender			**0.005**
Male	1121 (47.3)	173 (15.4)	
Female	1249 (52.7)	144 (11.5)	
Race/ethnicity			0.231
American Indian or Alaska Native	158 (6.7)	25 (15.8)	0.350
Asian	12 (0.5)	1 (8.3)	1.000[a]
Black or African American	51 (2.2)	6 (11.7)	1.000[a]
Hispanic or Latino	617 (26.0)	88 (14.3)	0.452
Native Hawaiian or Pacific Islander	6 (0.25)	0 (0)	1.000[a]
No race or ethnicity identified	268 (11.3)	44 (16.4)	0.120
White	1265 (53.4)	154 (12.2)	0.066
Marital status			**0.040**
Not married	1430 (63.8)	170 (11.9)	
Married	811 (36.2)	121 (14.9)	

*Except as noted, *p* values calculated by χ^2 tests comparing proportion readmitted to hospital within 30 days of SNF admission versus those not readmitted within 30 days among those with a given characteristic. Bolded *p*-values < .05.

[a] Fisher's exact test.

Sample means for ratings of ADL-related mobility and self-care are shown in

Table 2. Effect size estimates for the observed differences were weak to moderate.

Table 2: ADL Mobility and Self-Care Ratings for Rehospitalized versus Not Rehospitalized

Resident Characteristic	*n*	*M*	*SD*	*p*	*Cohen's d*
ADL mobility[a]				**<.001**	0.43
Rehospitalized	301	2.69	0.76		
Not rehospitalized	2021	2.33	0.84		
ADL self-care[b]				**<.001**	0.35
Rehospitalized	305	2.30	0.79		
Not rehospitalized	2027	2.04	0.73		

ADL = Activities of daily living. Score derived from a functional status assessment and assessment of assistance with multiple ADLs such bed mobility, walking, dressing, eating, or toilet use. Scale is 0 to 4 with 0 indicating independent status and no assistance required, 1 requires supervision assistance, 2 is limited assistance, 3 is extensive assistance, and 4 is total dependence.
[a]Individual scores were mean of 6 items; [b]Individual scores were mean of 4 items

Among clinical characteristics or signs and symptoms, problems with bowel or bladder continence, shortness of breath, or presence of an unhealed pressure ulcer, swallowing disorder, or symptoms of delirium or psychosis showed significant associations with rehospitalization (Table 3). Risk of pressure ulcer, pain, body mass index, infection, and life expectancy of less than six months were not significantly associated with rehospitalization. Among behavioral characteristics, rejecting care and wandering were infrequent but were significantly associated with rehospitalization. In contrast, fall risk was increased in nearly half of the sample, but rehospitalization rates were nearly identical between those with and without increased fall risk.

Most residents were receiving high-risk medications, categorized by the MDS as medications with side-effect risks that can adversely affect health, safety, and quality of life (e.g., diuretics, hypnotics, anticoagulants, or psychotropic medications), and nearly half were receiving psychotropic medications (antipsychotic, antianxiety, antidepressant, or hypnotics), but neither was associated with rehospitalization. Approximately a third of

residents were receiving supplemental oxygen, which was significantly associated with rehospitalization. Special treatments (e.g., tracheostomy care, suctioning, or intravenous medications) were administered during approximately half of SNF admissions and were even more common during the 14 days prior to SNF admission; in either case, needing special treatments was associated with rehospitalization. Inability of a resident to participate in care planning, unplanned discharge, and a lack of a plan to discharge to the community were associated with rehospitalization (Table 3).

Table 3: Resident Characteristics and Rehospitalization Rates within 30 days of SNF Admission

Resident Characteristic	Characteristic n (%)	Rehospitalizations n (%)[a]	*p*
Diagnostic Categories			
Heart/circulation diagnosis			**0.007**
Yes	1376 (58.1)	162 (11.8)	
No	994 (48.9)	155 (15.6)	
Psychiatric/mood disorder			0.350
Yes	596 (25.1)	73 (12.3)	
No	1774 (74.9)	244 (13.8)	
Gastrointestinal diagnosis			**0.022**
Yes	422 (24.9)	49 (11.6)	
No	1271 (75.1)	101 (8.0)	
Pulmonary diagnosis			0.356
Yes	416 (21.1)	53(12.7)	
No	1556 (78.9)	173 (11.1)	
Renal failure/insufficiency or ESRD			0.085
Yes	267 (15.8)	31 (11.6)	
No	1426 (84.2)	119 (8.4)	
Dementia or Alzheimer's			0.100
Yes	201 (10.2)	16 (8.0)	
No	1771 (89.8)	210 (11.9)	
Cancer			0.306
Yes	143 (8.4)	16 (11.2)	
No	1550 (91.6)	134 (8.7)	

Clinical Characteristics/Signs and Symptoms			
Pressure ulcer risk			0.816
Yes	1661 (84.4)	191 (11.5)	
No	308 (15.6)	34 (11.0)	
Bladder/bowel continence			
Yes	1221 (57.6)	124 (10.2)	**0.019**
No	899 (42.4)	121 (13.5)	
Pain			0.489
None	745 (32.9)	95 (12.8)	
Mild	112 (5.0)	11 (9.8)	
Moderate	182 (8.0)	29 (15.0)	
Severe	1225 (54.1)	161 (13.1)	
BMI			0.144
Underweight	94 (7.7)	16 (17.0)	
Normal	409 (33.8)	50 (12.2)	
Overweight	350 (28.9)	32 (9.1)	
Obese	358 (29.6)	37 (10.3)	
Infection			0.816
Yes	467 (19.7)	64 (13.7)	
No	1903 (80.3)	253 (13.3)	
Shortness of breath			**0.001**
Yes	356 (15.1)	67 (18.8)	
No	2003 (84.9)	245 (12.2)	
Unhealed pressure ulcer			**0.002**
Yes	182 (7.7)	38 (20.9)	
No	2178 (92.3)	275 (12.6)	
Swallowing disorder			**0.014**
Yes	67 (3.4)	14 (20.9)	
No	1905 (96.6)	212 (11.1)	
Delirium symptoms			**<.001**
Yes	261 (11.5)	63 (24.1)	
No	1998 (88.5)	219 (11.0)	
Psychosis			**0.047**
Yes	44 (1.9)	10 (22.7)	
No	2250 (98.1)	284 (12.6)	
Life expectancy < 6 months			0.795
Yes	33 (1.4)	5 (15.2)	
No	2328 (98.6)	309 (13.3)	
Behavioral			
Fall risk			
Yes	853 (47.0)	94 (11.0)	0.786
No	963 (53.0)	110 (11.4)	
Rejects care			**<.001**

Yes	63 (2.8)	19 (30.2)	
No	2210 (97.2)	267 (12.1)	
Wandering behaviors			**0.019**
Yes	25 (1.1)	7 (28.0)	
No	2246 (98.9)	278 (12.4)	
Medications and treatments			
High-risk medication			0.132
Yes	2044 (86.5)	263 (12.9)	
No	320 (13.5)	51 (15.9)	
Psychotropic medication			0.898
Yes	1069 (45.2)	141 (13.2)	
No	1294 (54.8)	173 (13.4)	
Supplemental oxygen			**0.006**
Yes	684 (31.8)	110 (16.1)	
No	1464 (68.2)	173 (11.8)	
Special treatments in SNF			**<.001**
Yes	1006 (53.3)	133 (13.2)	
No	880 (46.7)	70 (8.0)	
Special treatments 14 days before SNF			**0.005**
Yes	1224 (65.0)	150 (12.3)	
No	660 (35.0)	53 (8.0)	
Care and Discharge Planning			
Resident participated in care plan			**0.005**
Yes	1859 (97.0)	198 (10.7)	
No	58 (3.0)	13 (22.4)	
Planned discharge			**<.001**
Yes	1887 (77.1)	47 (2.5)	
No	559 (22.9)	281 (50.8)	
Active discharge plan to community			**0.008**
Yes	2041 (89.6)	239 (11.7)	
No	238 (10.4)	42 (17.7)	

ESRD = end-stage renal disease. BMI = body mass index. Bold values are statistically significant ($p < .05$)
p values calculated by chi-square tests comparing for a given characteristic the proportion rehospitalized within 30 days of SNF admission to the proportion not rehospitalized within 30 days.
[a] Percentages are rates of rehospitalization for each row; column percentages do not add up to 100%.

Predictors of 30-day Rehospitalization

Model 1. Logistic regression Model 1 (Table 4) was a base model predicting 30-day rehospitalization among SNF residents, controlling for gender and race / ethnicity. Predictors in Model 1 consisted of individual resident characteristics (i.e., diagnostic

categories or health conditions) that have been found in previous research (see Chapter 2) to be associated with 30-day rehospitalization from SNFs. In Model 1, controlling for other variables in the model, the relative odds of rehospitalization were 29% lower for women, compared with men (p = .05), and were approximately 66% to 100% higher for those in whom an unhealed pressure ulcer or delirium was present. However, the base rate of admission for the analyzable sample (i.e., those with a SNF stay of 30 days or fewer with complete data on all included variables) was approximately 8.8% (150/1690), and the model did not improve prediction of rehospitalization (sensitivity = 0%, positive predictive value not calculable; specificity = 100%, negative predictive value 91.1% = correct classification rate = percentage not readmitted).

Table 4: Resident Characteristics as Predictors of Rehospitalization within 30 days: Model 1 (n = 1690)

Resident Characteristic	OR	(95% CI)
Gender[a*]	0.71	(0.50 - 1.00)
Race/ethnicity[b]		
Hispanic	1.00	(0.65 - 1.52)
American Indian/Alaska Native	1.62	(0.90 - 2.92)
Asian, Black, Native Hawaiian or Pacific Islander	0.70	(0.21 - 2.31)
No race/ethnicity identified	1.65	(0.99 - 2.76)
Heart/circulation diagnosis[c]	1.14	(0.76 - 1.71)
Gastrointestinal diagnosis[c]	1.45	(0.99 - 2.10)
Cancer[c]	1.31	(0.75 - 2.28)
Pulmonary[c]	1.29	(0.86 - 1.92)
Renal failure/insufficiency or ESRD[c]	1.36	(0.88 - 2.10)
Delirium[c]**	2.01	(1.23 - 3.28)
Dementia[c]	0.55	(0.29 - 1.04)
Unhealed pressure ulcer[c]*	1.66	(1.00 - 2.74)
Constant***	0.07	(0.04 - 0.11)

CI = confidence interval; ESRD= end-stage renal disease; ADL = activities of daily living.
[a] Reference category = male
[b] Reference category = White

[c] Reference category = no diagnosis/condition
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for categorical variable or specific indicator.

Model 2. Logistic regression Model 2 (Table 5) augmented the Model 1 with additional predictors with a significant bivariate association with rehospitalization in the study sample. In Model 2, women were 36% less likely than men to be rehospitalized and residents with dementia were 54% less likely to be rehospitalized than those without this diagnosis. Residents who identified as American Indian or Alaska Native or who had no documented race or ethnicity were approximately twice as likely to be readmitted relative to residents who identified as White. In addition, residents who required greater assistance with mobility for activities of daily living had an increased relative odds of rehospitalization (OR = 1.55 for each one-point increase on the ADL mobility scale). For the analyzable sample for Model 2, the overall rehospitalization rate was 8.0% (114/1425), and, as with Model 1, the model did not improve the prediction of rehospitalization (sensitivity = 0.9%, positive predictive value = 0.50, specificity = 99.9%, negative predictive value of 92.1%, correct classification = 92.0% = percentage not readmitted).

Model 3. A potential issue with Model 2 was multicollinearity, particularly between the bowel and bladder continence variable and the activities of daily living mobility variable. To assess the robustness of Model 2, an alternative Model 3 (Appendix I) was run without the continence variable. Removing that variable had negligible impact on the other Model 2 variables in terms of magnitude, direction, and statistical significance of other estimates.

Table 5: Resident Characteristics as Predictors of Rehospitalization within 30 days: Model 2 (n = 1425)

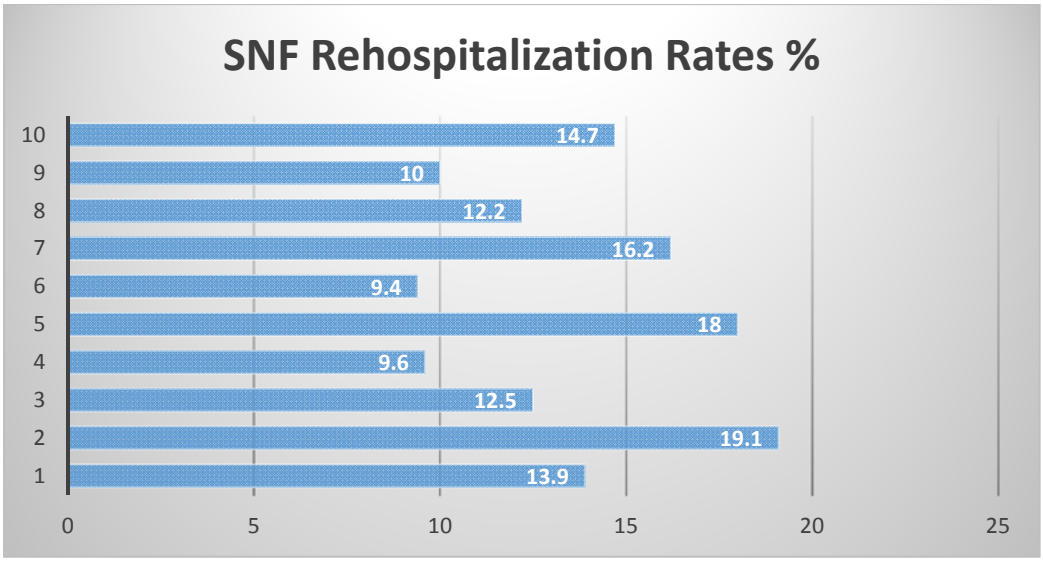
Resident Characteristic	OR	(95% CI)
Gender*[a]	0.64	(0.43 - 0.96)
Race/ethnicity[b]		
Hispanic	1.03	(0.63 - 1.69)
American Indian /Alaska Native*	2.11	(1.08 - 4.13)
Asian, Black, Native Hawaiian / Pacific Islander	0.33	(0.04 - 2.49)
No race/ethnicity identified*	1.86	(1.04 - 3.33)
Heart/circulation diagnosis[c]	0.90	(0.57 - 1.43)
Gastrointestinal diagnosis[c]	1.37	(0.88 - 2.14)
Cancer[c]	1.34	(0.68 - 2.65)
Shortness of breath*[c]	1.72	(1.03 - 2.87)
Renal failure/insufficiency or ESRD*[c]	1.73	(1.07 - 2.82)
Delirium*[c]	1.80	(1.01 - 3.21)
Dementia*[c]	0.46	(0.21 - 0.99)
Rejects care**[c]	5.13	(1.89 - 13.88)
Bowel/bladder continence[d]	0.87	(0.56 - 1.36)
Supplemental oxygen[e]	1.22	(0.78 - 1.90)
Unhealed pressure ulcer[c]	1.21	(0.63 - 2.35)
ADL mobility**[f]	1.55	(1.11 - 2.15)
Constant***	0.02	(0.01 - 0.06)

CI = confidence interval; ESRD= end-stage renal disease; ADL = activities of daily living.
[a] Reference category = male
[b] Reference category = White
[c] Reference category = no diagnosis/condition
[d] Reference category = continent of bowel/bladder
[e] Reference category = room air/no supplemental oxygen
[f] Scale 0-4 with higher scores indicating less mobility and greater ADL assistance; reference category = 0.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for categorical variable or specific indicator.

Model 4. A fourth model (Appendix J) accounted for facility-specific factors as fixed effects to test for any significant dependence of facilities with respect to differing rehospitalization rates (Figure 2). Results of the fixed-effects model showed a relatively narrow range of variance in rehospitalization rates across facilities that were not a

significant predictor of rehospitalization risk and did not alter conclusions from the previous models. Separate estimation of a multilevel model found essentially no intracluster correlation (ρ=.009) for residents within facilities for rehospitalization risk, supporting treatment of residents as statistically independent.

Figure 2. Rehospitalization Rates by Facility July 2015 – June 2016



Note: MDS data from study period July 2015 through June 2017 used to calculate values.

Facility Factors

A total of 10 nursing facilities were included in this study sample. All 10 nursing facilities were located in an urban setting within the greater Albuquerque, N.M., area. The facilities were owned by a single nursing home corporation with a for-profit ownership status.

Table 5 displays facility characteristics using Nursing Home Compare data from 2015 and 2016, respectively. The Nursing Home Compare star rating ranges from one to five stars with one star indicating below average quality, three stars is average quality,

and five stars indicates above average quality. All but one facility had 120 or more certified beds.

In 2015, four facilities had an overall star rating at one or two stars, with remaining facilities at ratings of three, four, or five stars. Similarly, four facilities had a health survey rating at one or two stars with remaining facilities at three, four, or five stars. All facilities achieved a star rating of three to five in the quality measure category. Nurse staffing ranged from one to four stars, with half of the facilities rated at three stars. Nine facilities were rated as either three or four stars in the RN staffing category in 2015.

Table 6: Facility Characteristics: Nursing Home Compare 2015 and 2016

Facility	Overall Star Rating		Health Survey Rating		Quality Measure Rating		Nurse Staff Rating		RN Rating	
	2015[a]	2016[b]	2015[a]	2016[b]	2015[a]	2016[b]	2015[a]	2016[b]	2015[a]	2016[b]
1	1	1	1	1	4	4	2	3	3	3
2	2	2	2	2	4	4	3	3	3	3
3	3	3	3	3	4	3	2	2	4	4
4	5	2	5	3	3	3	2	1	3	2
5	1	3	1	2	4	4	3	3	4	4
6	5	4	3	3	5	5	4	2	4	4
7	5	5	5	5	5	4	3	4	3	4
8	4	3	4	3	3	3	4	4	4	4
9	2	2	1	2	5	5	*	1	*	1
10	5	5	4	4	5	4	3	3	3	3

[a] Ratings from 2015 Nursing Home Compare data (1-5 rating, with higher scores indicating better quality).
[*] 2015 data missing.
[b] Ratings from 2016 Nursing Home Compare data (1-5 rating, with higher scores indicating better quality).

The 2016 overall ratings mirror the 2015 ratings with six of the 10 facilities in the three-, four- or five-star category. Notably, RN staff ratings declined slightly in 2016, with two facilities at one or two stars and the remaining facilities at a three-star or four-

star rating. During the study period, rehospitalization rates ranged from a low of 9.4% to a high of 19.1%, with an average rating of 13.4% across facilities.

Summary

The analysis primarily used MDS data to explore resident factors associated with SNF rehospitalization. Several bivariate associations had significant correlation with rehospitalizations, however no multivariate model improved the predictors of rehospitalization relative to the low baseline SNF rehospitalization rate. Facility factors associated with rehospitalization data were not analyzed due to data restrictions, however Nursing Home Compare data provided overall star ratings, quality measure ratings, and nurse staff ratings during the study period.

CHAPTER 5: Discussion

For more than 30 years, improving the quality of care for residents in nursing homes has been a focus for state and federal agencies, policymakers, and families (Government Accountability Office, 2015; Institute of Medicine, 1986; Office of Inspector General, 1999). Despite progress in improving nursing home quality in response to legislative and regulatory requirements, inadequate conditions and widespread concerns about quality remain. The Centers for Medicare and Medicaid Services (CMS) considers the 30-day rehospitalization rate of an SNF to be a marker inversely related to resident-care quality (Medicare.gov, n.d.-e). Among Medicare beneficiaries who were discharged to a SNF after a general acute hospital stay, approximately one in five was rehospitalized within 30 days (Rahman, Grabowski, et al., 2016). A rehospitalization during a SNF stay is considered an adverse event. Two thirds of SNF adverse events are determined to be likely or clearly preventable (Office of Inspector General [OIG], 2014). SNF residents who were rehospitalized were at increased risk for exposure to healthcare-associated infections or other harms compared with those who were not rehospitalized (Ouslander et al., 2000). The risk for harm coupled with the high costs to Medicare, estimated at $14.3 billion in 2011 (Office of Inspector General, 2013a), gained the attention of legislators to institute policies to avoid unnecessary rehospitalizations. The Patient Protection and Affordable Care Act (ACA; 2010) established several provisions designed to improve nursing home quality—one of which aimed to reduce adverse health events, such as SNF rehospitalizations.

This study was designed to (a) explore resident risk factors that predict a rehospitalization from a SNF within 30 days from an acute hospital discharge, (b) assess

the structural-process differences among nursing homes that can influence the rates of 30-day rehospitalizations, and (c) evaluate policy implications of factors associated with 30-day SNF rehospitalizations. The Donabedian structure-process outcome (SPO) model is widely used by nursing homes and government agencies for assessing care quality (Castle & Ferguson, 2010). The SPO model was selected to provide a framework to study facility characteristics, inclusive of resident characteristics, and processes of care in relation to the primary study outcome, 30-day rehospitalization. Given the data that were usable for this study, facility *structure* was represented in the analysis by resident characteristics of facilities such as medical diagnosis, clinical characteristics, and extent of ADL limitations indicative of case-mix; *process* related to interventions or treatments such as oxygen therapy, and the *outcome* was whether the resident was rehospitalized within 30 days of the initial hospital discharge to the SNF.

Resident Risk Factors and Predictors

Bivariate analyses. The only demographic characteristics with significant bivariate associations with rehospitalization were gender (M > F) and marital status (married > unmarried). ADL mobility and ADL self-care scores were significantly higher on average among those who were rehospitalized versus those who were not. The effect sizes for those differences were modest at best. However, ADL status can be determined early enough in the SNF stay to be potentially useful as a marker of rehospitalization risk, if these associations were replicable in subsequent research.

Several resident risk factors for rehospitalization that were identified in the literature review (Chapter 2) had statistically significant bivariate associations in this study with rehospitalization. Residents with gastrointestinal diagnoses were more likely

to be rehospitalized than were residents without such diagnoses. Residents in this sample with a heart or circulatory diagnosis were less likely to be rehospitalized than were those without, and therefore, the direction of the relationship differed from previous reports in the literature. Unlike previous studies, there was no significant association with rehospitalization for cancer, dementia, renal failure, or pulmonary diagnoses (Bogaisky & Dezieck, 2015; Marcantonio et al., 2005; Ouslander et al., 2011). However, it is likely that some differences between these results and those in the literature could be attributable to differences between the way diagnoses are grouped for MDS reporting and how diagnoses were operationally defined in earlier studies.

Consistent with previous studies, clinical characteristics of residents such as shortness of breath or symptoms of delirium in a SNF were associated with higher rates of rehospitalization relative to residents without those characteristics (Dombrowski et al., 2012; Marcantonio et al., 2005; Ouslander et al., 2016). Behavioral characteristics, such as wandering or rejecting care, which might be more common in residents with dementia, were significantly associated with rehospitalization, even though a diagnosis of dementia or Alzheimer's was not. However, wandering and rejecting care were uncommon (documented in 1% to 3% of residents).

Other newly identified variables with statistically significant bivariate associations with rehospitalization in this study were in categories of clinical signs and symptoms, specialized treatments (e.g., suctioning, dialysis, chemotherapy, oxygen therapy, and intravenous therapy), and care planning. Residents with bowel or bladder incontinence, an unhealed pressure ulcer, or swallowing disorder, those with special treatments in a SNF or within the two weeks prior to SNF admission, were statistically

significantly more likely to be rehospitalized than residents without those characteristics. Residents with these clinical symptoms, conditions, or treatments are often medically complex and can require advanced services and a highly trained team, such as skilled nursing care or rehabilitation services. In addition, all residents in this sample were admitted from an acute hospital, and it is common, prior to their SNF stay, to receive treatments or procedures in the hospital that the MDS classifies as "specialized."

Residents who were unable to participate in the care planning process had double the rehospitalization rates compared to those who did participate in care planning, though only 3% of the sample were unable to participate. Rehospitalization was significantly associated with an unplanned discharged versus a planned discharge, but that could be an artifact of most rehospitalizations being unplanned. SNFs are required to develop individualized care plans for each resident to outline and provide needed services and to document resident preferences. SNFs also are expected to develop a discharge plan to ensure safe transitions to the next care setting. However, a report published in 2013 revealed that 37% of SNF stays did not have a care plan or did not meet discharge plan requirements (Office of Inspector General, 2013b). Nearly 90% of the residents of this sample had an active discharge plan to the community, but the 10% who did not were significantly more likely to be rehospitalized. These associations between care or discharge planning and SNF rehospitalization have not been reported in previous research but are of sufficient concern regarding care quality to warrant attention in future research.

Multivariable models. The logistic regression Model 1 analysis consisted of variables previously reported in the literature as being associated with rehospitalization. Controlling for other variables in the model, men were approximately 40% more likely

than women to be rehospitalized, and residents with an unhealed pressure ulcer were approximately two thirds more likely to be rehospitalized than those without. Documentation of delirium doubled the relative odds of rehospitalization. However, the model as a whole did not improve classification.

In Model 2, other predictors found to have significant associations with rehospitalization in the sample were added. Controlling for other variables in the model, gender and delirium still had significant independent associations with rehospitalization of the same direction and a similar magnitude of association compared with Model 1. However, the independent association between unhealed pressure ulcers and rehospitalization was attenuated compared with Model 1 and was no longer statistically significant. In Model 2, controlling for other variables, the relative odds of rehospitalization were statistically significantly increased among: American Indian and Alaska Native residents and among residents with no documented race or ethnicity compared with White residents; those with shortness of breath or a diagnosis of chronic kidney disease compared with those without; those who rejected care compared with those who did not; and those with any mobility impairment on the ADL mobility rating. In contrast, those with a diagnosis of dementia were approximately half as likely to be rehospitalized as those without dementia.

Among the binary predictors, rejecting care was the strongest independent predictor of rehospitalization in the model, but the confidence interval around that estimate was wide. The association between the ADL mobility scale and rehospitalization has not been reported previously and is of potential interest. However, as with Model 1, the model as a whole did not improve classification relative to simply knowing the base

rehospitalization rate. Two other models were run to assess the possible impact of multicollinearity and to assess whether facilities as a whole were associated significantly with rehospitalization. In both cases, the observed effects were minimal.

Despite several significant bivariate associations and significant predictors in the statistical models, the models themselves were not strong enough to be useful for predicting SNF rehospitalizations. A number of factors could affect this finding in this study. Previous studies commonly reported bivariate and multivariate associations and used logistic regression models to predict SNF rehospitalization; however, strength, sensitivity, and model fit were not reported. Therefore, it is not possible to assess the models in this study compared with models from earlier studies. In 2016, the overall rehospitalization rate in this sample was 13.4% and was lower than the national average at 22.6% (Medicare.gov, n.d.-d). The rehospitalization rates in the logistic models were even lower, 8% to 9%, as sample size decreased (i.e., cases missing data on any model variable were not analyzed, so as variables were added, the size of the analyzable sample decreased). Although the rehospitalization rate was lower than anticipated, sample size was large enough for even small effects to be statistically significant, and the few larger odds-ratio estimates were for indicators that were uncommon or had wide confidence intervals.

Facility Factors

Facility characteristics were not fully analyzed with rehospitalization rates because accessible Nursing Home Compare data did not include these values during the study timeframe. Nursing Home Compare data provides overall quality ratings of the facilities, with most facilities in the sample having average to above average star ratings

during the study period. Although overall star ratings were similar in 2015 and 2016, rehospitalization rates ranged from 9% to 19% during this study period. This finding suggests potential facility-specific factors among facilities that impact rehospitalization rates. For example, using rehospitalization rates for this study, Facility 4 had the lowest rehospitalization rate (9.6%) with an overall star rating of five (in 2015), whereas Facility 2 showed a rehospitalization rate at 19.1% and an overall star rating at two (in 2015). However, the overall star rating for Facility 4 decreased from a five in 2015 to a rating of two in 2016, and therefore, there was no consistent direction of relationship between overall star rating and rehospitalization rate. The addition of a facilities fixed-effects model analysis did not show a statistically significant effect for facilities with respect to rehospitalization rate. Rehospitalization data via Nursing Home Compare files are now publicly accessible and feasible to explore in a future study.

In four facilities, the nurse staff ratings declined from 2015 to 2016. To improve accuracy of data, the ACA now requires facilities to submit actual staffing information using payroll hours rather than the nursing homes' self-reported hours, with July 2016 as the first reporting period (Centers for Medicare & Medicaid Services, 2018) and could account for the notable decline in nurse staff ratings. Given this information, it is plausible that nursing homes were reporting higher staffing hours than actual resident hours of nursing care and manipulating the system for their benefit. Using payroll data can offer a more objective and reproducible approach for assessing nursing home staffing in future research.

It is fundamental that facilities have the structures and processes in place to meet the care needs of medically complex residents to achieve high quality outcomes and

avoid unnecessary rehospitalizations. More specifically, nursing homes with lower staffing levels tend to have poorer quality outcomes (Harrington, Schnelle, McGregor, & Simmons, 2016), and those with higher staffing levels are shown to have lower rehospitalizations and deaths (Neuman et al., 2014). Currently, nursing homes are required to have a licensed nurse 24 hours a day and seven days a week with at least eight registered nurse hours a day seven days a week (Harrington et al., 2016). With these requirements, nursing homes consistently have fewer registered nurse hours per resident per day compared to overall nurse staffing hours per resident. Registered nurses are trained to implement evidence-based interventions to improve outcomes and have advanced training to properly manage medically complex residents who need specialized medical treatments during their SNF stay. Nurse staffing reliably has been found to have a positive association with quality in nursing homes (Bostick, Rantz, Flesner, & Riggs, 2006; Harrington et al., 2016; Harrington, Zimmerman, Karon, Robinson, & Beutel, 2000; Schnelle et al., 2004), and thus, registered nurses can serve as both structure and process elements to contribute to improved nursing home quality and to reduce unnecessary rehospitalizations.

Limitations

This study had multiple strengths, including a large sample of New Mexico nursing home residents across 10 facilities to explore several resident characteristics concurrently. Leveraging existing data allowed the examination of a sample of older adults who would likely be difficult to enroll and retain in large numbers for a prospective longitudinal study. Therefore, the study has advantages for large sample analysis. However, several limitations were present. First, the study was a secondary data

analysis. Therefore, collected data were retrospective, which means data were collected by someone other than the investigator, which increases the frequency of missing data and risks of data-entry error. Additionally, analysis was limited to the variables in the dataset and did not permit several analyses originally proposed for this study. This study initially proposed to use data from the EHR and the MDS to analyze relationships of resident characteristics with rehospitalization. Due to incomplete EHR data, the MDS was the primary data source for that purpose. Although MDS data were obtained, they did not include Resource Utilization Group scores that facilities use to calculate acuity or complexity of residents, which could have provided useful assessment information regarding residents' medical complexity for this analysis. Similarly, the proposal outlined the use of Nursing Home Compare data and EHR data to assess facility characteristics; however, insufficient EHR information and the absence of rehospitalization measures in Nursing Home Compare data during the study period prevented a complete analysis of facility factors. Nursing Home Compare's five-star ratings were analyzed instead. Second, this was a homogenous sample of residents and facilities in one urban geographic location in New Mexico owned by a single nursing home corporation, which means results in this study might not generalize to a more heterogeneous sample in terms of geography or ownership.

Policy Implications

Recent provisions in the ACA underscore the importance of nursing home quality in the current healthcare landscape, with several federal and state policy implications. Many rehospitalizations are preventable, and all are costly and place residents at higher risk for complications, such as healthcare acquired infections (Cairns et al., 2011; Magill

et al., 2014) and mortality (Ahearn et al., 2010; Burke, 2016; Hussain, Siddique, et al., 2009). In efforts to improve transitions of care, the IMPACT Act underscores the Healthcare Improvement's Triple Aim to (a) improve quality of care, (b) improve health, and (c) reduce care costs (CMS, 2015). Nursing facilities began publicly reporting rehospitalization data on the Nursing Home Compare website in 2016; the data will be used as a quality measure to calculate the overall star rating. The overall star rating has the potential to influence the market as consumers (e.g., hospitals, patients, or families) use this information to choose where to receive SNF services. Therefore, issues related to the accuracy and reliability of SNF reporting needs to be assessed and, where feasible, improved.

As a result of the ACA, policies are being integrated into practice and are at the forefront of the SNF agenda. For example, in November 2017, the Centers for Medicare and Medicaid Services implemented numerous regulatory requirements and guidelines that nursing homes must adhere to; they include a new survey process to monitor and assess quality of care (CMS, 2016). Moreover, nursing facilities can expect rehospitalization rates to directly impact reimbursements and payments. SNF payments are primarily from Medicare dollars, and federal agencies have started to extend rehospitalization accountability to nursing facilities or assume penalties for not achieving set targets to start in October 2018 (Carnahan et al., 2016). An unintended consequence of these provisions might be that nursing homes avoid hospitalizing residents who require a higher level of care to circumvent lower star ratings or reduced reimbursements. Thus, close observation of hospitalization activities and outcomes is recommended. There is an urgency to improve nursing home quality as a result of recent federal and state

regulations directing nursing facilities to enact policies to reduce avoidable SNF rehospitalizations.

Future Research

There are several areas of interest to consider for future research. Transitions of care, especially from a hospital to a SNF, provide an opportunity to explore partnerships and communication to reduce rehospitalizations as some studies indicate SNFs with a hospital affiliation had lower rehospitalization rates compared with free-standing facilities (Li et al., 2012; Rahman et al., 2013; Stearns et al., 2006). Care planning is an essential concept to consider exploring, i.e., how to avoid unnecessary hospitalizations or unnecessary treatments with advance directives in place and active care and discharge plans. This study provided new evidence in SNF rehospitalization disparities by race with residents who identified as American Indian or Alaska Native and a recommendation for continued research to further explore the relationship of race and rehospitalization disparities. Finally, as new data become available regarding nurse staffing hours and rehospitalization measures, the continued exploration of how nurse staffing is related to SNF rehospitalization is essential. In addition, for any future studies using existing data, larger and more heterogeneous datasets in terms of geography, ownership type, and rehospitalization rates might address some of the limitations of the present study.

Conclusion

Nursing home quality remains a concern given that one in five SNF admissions after a hospital stay will result in a rehospitalization. With a growing Medicare population, consumers will be utilizing SNF services at higher rates than in previous years, and improving care quality is a priority. It is well established that SNF

rehospitalizations result in poor outcomes for residents, they are costly, and many are preventable. Despite this evidence, a strong predictive model does not exist to consistently identify SNF residents who are at highest risk of rehospitalization. Results also highlight the concept of care planning as it relates to rehospitalization, with rejection of care showing higher rehospitalization rates while residents who participated in the care planning process had lower rehospitalization rates. Nurse staffing is associated with nursing home quality, and the relationship with rehospitalization should be explored further with recent additions to available data. Policy implications are numerous due to recent regulatory requirements and impending penalties tied to rehospitalizations. As more evidence about SNF rehospitalizations is generated, additional research is needed to identify strategies and interventions that nursing facilities can implement to prevent avoidable rehospitalizations.

List of Appendices

Appendix A: Nursing Home Quality Measures 2016

Short-stay quality measures Percentage of short-stay residents…	Long-stay quality measures Percentage of long-stay residents…
Who made improvements in function. *Higher percentages are better*	**Experiencing one or more falls with major injury.** *Lower percentage is better.*
Who were re-hospitalized after a nursing home admission. *Lower percentages are better*	**With a urinary tract infection.** *Lower percentages are better.*
Who have had an outpatient emergency department visit. *Lower percentage is better.*	**Who self-report moderate to severe pain.** *Lower percentages are better.*
Who were successfully discharged to the Community *Higher percentages is better*	**High-risk residents with pressure ulcers.** *Lower percentages are better.*
Who self-report moderate to severe pain. *Lower percentages are better*	**Low-risk residents who lose control of their bowels or bladder.** *Lower percentages are better.*
With pressure ulcers that are new or worsened. *Lower percentages are better*	**Who have/had a catheter inserted and left in their bladder.** *Lower percentages are better.*
Assessed and given, appropriately, the seasonal influenza vaccine. *Higher percentages are better.*	**Who were physically restrained.** *Lower percentages are better.*
Assessed and given, appropriately, the pneumococcal vaccine. *Higher percentages are better.*	**Whose ability to move independently worsened.** *Lower percentages are better.*
Who newly received an antipsychotic medication. *Lower percentages are better*	**Whose need for help with daily activities has increased.** *Lower percentages are better.*
	Who lose too much weight. *Lower percentages are better.*
	Who have depressive symptoms. *Lower percentages are better*
	Who received an antianxiety or hypnotic medication. *Lower percentages are better.*
	Assessed and given, appropriately, the seasonal influenza vaccine. *Higher percentages are better.*
	Assessed and given, appropriately, the pneumococcal vaccine. *Higher percentages are better.*
	Who received an antipsychotic medication. *Lower percentages are better.*

Source: Medicare.gov Nursing Home Compare website (2016). (Medicare.gov, n.d.-d).

Appendix B: Glossary

30-day rehospitalization: A 30-day rehospitalization occurs when a resident is discharged from an acute hospital stay, is admitted into a skilled nursing facility, and has an unplanned rehospitalization into a hospital within 30 days from the proximal hospital stay.

Nursing facility: A nursing facility provides three types of services—skilled nursing, rehabilitation, or long-term care services—and is often referred to as a nursing home. Skilled nursing and rehabilitation are short-term services, i.e., fewer than 100 days. A Skilled nursing facility, also known as a SNF, offers medical care or related services. Rehabilitation is for individuals who need physical therapy, occupational therapy, or speech therapy due to an injury or surgery. Long-term care provides medical care and assistance with activities of daily living such as dressing or bathing for greater than 101 days. Nearly all nursing facilities provide long-term and short-term care. Certified nursing facilities receive Medicare and Medicaid funding and must meet requirements from the state and from CMS.

Process: Process is the second concept of the Donabedian model to assess healthcare quality. It refers to actions, activities, or interventions performed to provide care or to receive care. Process includes activities from a healthcare professional and from residents.

Resident: A resident is an individual who is admitted into a nursing facility and requires skilled, rehabilitation, or long-term care services. Residents can be admitted into a nursing facility for short-term care or long-term care.

Structure: Structure is used to describe the elements of a setting where care occurs. An example frequently seen in the literature is the number of beds in a facility or the number of resources within a facility to deliver care and achieve a goal. Structure signifies one aspect of assessing health quality, according to Donabedian's Structure Process Outcome model. This model operationalizes quality by evaluating the outcomes of structure and process relationship. In this study, it refers to the nursing home setting and is used to describe organizational characteristics and resources of a nursing facility.

Quality: The term quality in nursing homes refers to measures, standards, or indicators to ensure the delivery of safe care for residents. More specifically, quality is measured with a number of structure, process, or outcome indicators. These indicators are developed by CMS or by the National Quality Forum. Quality outlines initiatives to enhance the value of care, to make resident care safer, and to aim to achieve better health outcomes.

Appendix C: National Coordinating Council for Medication Errors Reporting and Prevention Index

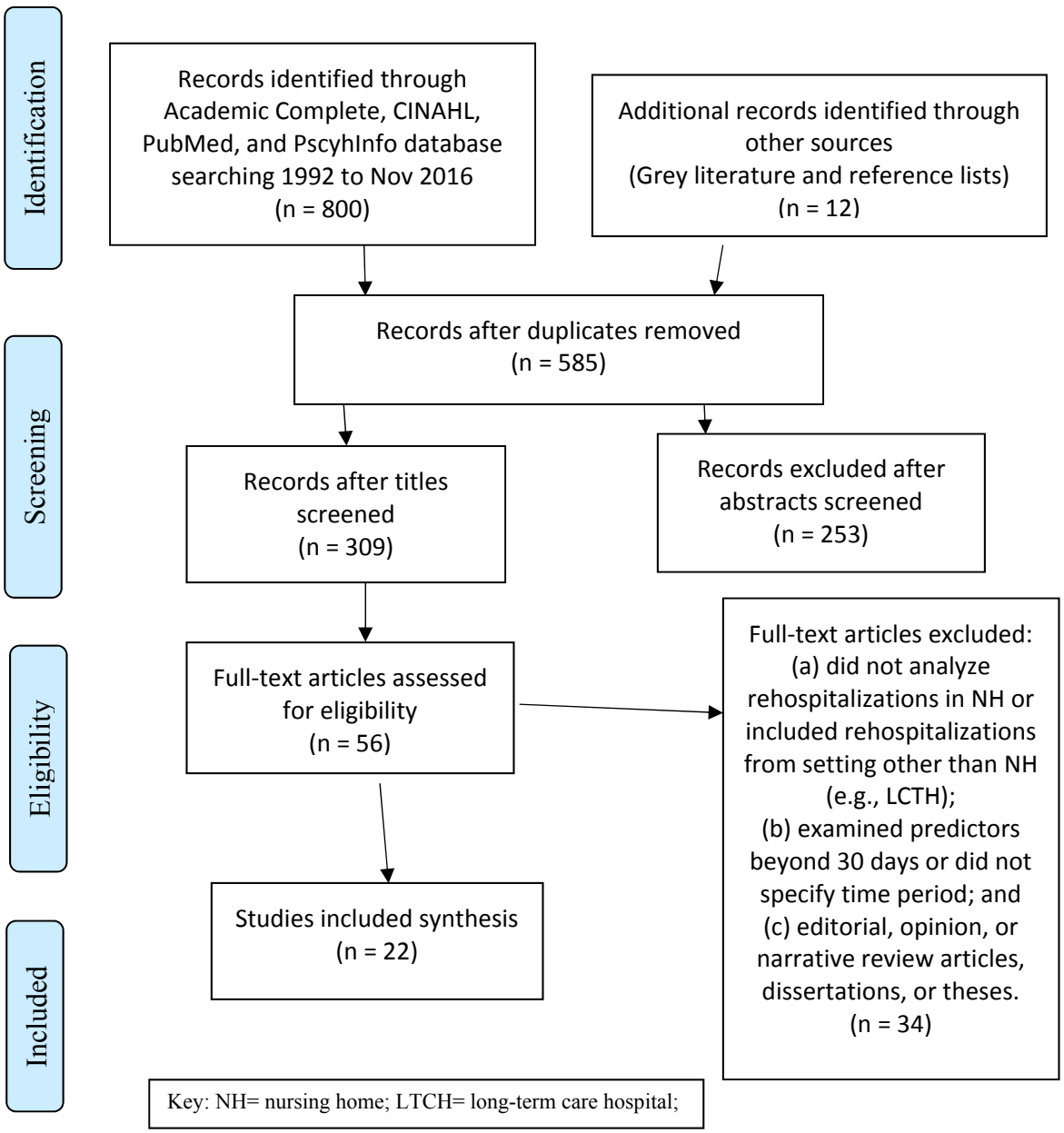
Level	Description	Event
A	Circumstances or events occurred that had the capacity to cause error.	Harm does not reach patient or resident.
B	Error occurred but did not reach the patient or resident.	
C	Error occurred that reached the patient or resident but did not cause patient or resident harm.	
D	Error occurred that reached the patient or resident and required monitoring to preclude harm or confirm that it caused no harm.	
E	Error occurred that may have contributed to or resulted in temporary harm and required intervention.	Harm reaches patient or resident
F	Error occurred that may have contributed to or resulted in harm and required an initial or prolonged facility stay.	
G	Error occurred that contributed to or resulted in permanent patient or resident harm.	
H	Error occurred that required intervention to sustain the patient or resident's life.	
I	Error occurred that may have contributed to or resulted in patient or resident death.	

Source: Office of Inspector General Report (2014). *Adverse events in skilled nursing facilities: National incidence among Medicare beneficiaries*, p. 10. Retrieved from oig.hhs.gov/oei/reports/oei-06-11-00370.pdf

Appendix D: PRISMA 2009 Flow Diagram

PRISMA Flow of Information Diagram:

Resident Factors Associated with 30-day Rehospitalizations



Source*:* Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Journal of Clinical Epidemiology*, *62*(10), 1006-1012. doi:10.1016/j.jclinepi.2009.06.005

Appendix E: Reviewed Studies: Resident Factors and 30-day Rehospitalizations from Nursing Facility

First author Year	Design (*N*)	Data source and Time	Significant rehospitalization rate / Correlates	Other Findings
Bogaisky et al., 2015	Retrospective cohort study (625)	Hospital charts 2009-2010	CKD, pressure ulcers, CHF, dementia	Hospitalization for CHF and pneumonia significantly higher risk
Callahan et al., 2012	Prospective cohort (752)	EMR, Medicare claims, MDS, 2001-2008		25.3% rehospitalization rate in persons with dementia
Dombrowski et al., 2012	Retrospective review (100)	Medical charts May-October 2009	Comorbidities, anemia, malignant tumors, GI condition in hospitalization, ↑ help with eating & walking, ↓ hemoglobin and albumin levels	62% rehospitalization rate related to same condition preceding NF stay
Hain et al., 2012	Retrospective study (6,809)	Medicare FFS 2007-2008	> 5 day in hospital, older age	Infection reason for rehospitalization rate in 34%
Ouslander et al., 2011	Retrospective (10,778)	Electronic hospital data 2007-2008		63% rehospitalizations for infections or cardiovascular disorders
Ouslander et al., 2016	Retrospective root cause analysis (4,658)	INTERACT tool survey	Polypharmacy, dementia, cancer, surgical complications, falls, functional decline, respiratory infection, SOB, abnormal UA or radiograph test	Staff rated higher proportions of transfers as potentially avoidable

First author Year	Design (*N*)	Data source and Time	Significant rehospitalization rate / Correlates	Other Findings
Li et al., 2011	Retrospective cohort (960,644)	Minimum dataset 2008		rehospitalization rate higher for Black patients
Li et al., 2015	Retrospective cohort (1,300,000)	Minimum dataset 2012		Black residents higher risk of avoidable hospitalization
Lima et al., 2012	Cross-sectional (202)	MDS, Medicare claims, OSCAR, survey 2006-2007		Higher rehospitalization rate with CHF, poly-pharmacy, no DNR order
Marcantonio et al., 2005	Observational cohort (504)	Medical records, National Death Index	Delirium	Delirium twice as likely to be rehospitalized
Ogunneye et al., 2015	Retrospective cohort study (489)	EMR 2008-2011		Higher rehospitalization rate in females, obesity, HTN
Rahman et al. 2015	Retrospective cohort study (890,922)	Medicare enrollment and claims, MDS 2008-2009		Dual eligible equally likely to experience 30-day rehospitalization as Medicare only

EMR = electronic medical record; CHF = congestive heart failure; CKD =chronic kidney disease; HF = heart failure; HTN = hypertension; NF = nursing facility; GI = gastrointestinal; FFS = fee-for-service; UA = urinalysis; MDS = Minimum Data Set; OSCAR = Online Survey Certification and Reporting; SOB = shortness of breath; DNR = do not resuscitate.

Appendix F: Reviewed Studies: Facility Factors and 30-day Rehospitalization from Nursing Facility

First author Year	Design (*N*)	Data source & Time period	Findings
Grabowski et al., 2010	Regression specification (3.3M)	MDS, Medicare SNF, hospital claims, OSCAR 2000-2005	High Medicare share (> 15%) more like to have 30-day rehospitalization rate, resident w/DNR less likely to be rehospitalized
Li et al., 2011	Retrospective cohort (960,644)	Minimum Data Set 2008	NF with higher concentrations of Blacks had higher rehospitalization rate
Li et al., 2012	Retrospective cohort (>1.1M)	MDS, OSCAR January to September 2008	Higher rehospitalization rate in low-volume facilities (<45 annual admissions)
Lima et al., 2012	Cross-sectional (202)	OSCAR, MDS, Medicare claims, MSO survey	30-d rehospitalization less likely in facilities with formal physician appointment process; more likely when proportion of residents cared for per attending physician > 20% (ref. < 10%)
Neuman et al., 2014	Retrospective cohort (1.5M)	Medicare Provider Analysis and Review files, OSCAR, MDS, Nursing Home Compare, September 2009-August 2010	Available performance measures not consistently associated with differences in adjusted rehospitalization rate. Higher unadjusted rehospitalization rate for one-star rating in staffing and inspections
Ogunneye et al., 2015	Retrospective cohort (603)	EMR, Nursing Home Compare November 2008-October 2011	Rehospitalization rate higher for lower-quality NF, capability to administer IV furosemide associated with lower RR, higher RR in lower-quality SNF
Ouslander et al., 2016	Retrospective root cause analysis (4,658)	INTERACT tool data	Hospitalization avoided if condition managed in SNF with available resources

First author Year	Design (*N*)	Data source & Time period	Findings
Rahman et al., 2013	Retrospective cohort (2.8M)	Medicare enrollment, Medicare A, MDS, OSCAR, 2004-2006	The greater the concentration of discharges a hospital sends to a single SNF, the lower rehospitalization rate
Rahman et al., 2016 2016	Retrospective cohort (946,822)	Medicare standard analytic file, Medicare FFS claims, Medicare enrollment, OSCAR, 2007 AHA Survey 2009-2011	Patients treated in SNFs with higher rehospitalization rate have slightly higher predicted likelihood of rehospitalization
Stearns et al., 2016	Retrospective cohort (648,320)	Medicare SNF claims, MDS, OSCAR, ARF	Higher rehospitalization rate in freestanding SNF compare to hospital-based SNF
Thomas et al., 2013	Retrospective cohort (681)	Internal LTCFocUS.org file (MDS, OSCAR, ARF), Resident history file, Florida nursing home staffing reports 2002-2009	Licensed nurse retention rate is significantly associated with rehospitalization rate, a 10% increase in licensed nurse retention had a 0.2% lower rehospitalization rate
Thomas et al., 2014	Retrospective cohort (1.3M)	Medicare claims and enrollment, MDS, OSCAR, hospital compare, AHA data 2006-2008	Residents admitted into higher nurse staffing and lower deficiency scores NF had lower rehospitalization rate.

MSO = medical staff organization; ARF = areas resource file; AHA = American Hospital Association; MDS = Minimum Data Set; OSCAR = Online Survey Certification and Reporting; LTCFocUS = Long-term Care: Facts on Care in the U.S.; SNF = skilled nursing facility; NF = nursing facility

Appendix G: Research proposal to the nursing home corporation

The nursing home corporation
Research Review Summary

Please complete all information, attach additional materials as requested/needed, and send four copies to:
Director Clinical Analysis
Outcomes Management Department
The nursing home corporation
Date: _9/14/2016_____ contact person (if any): _
Name of project: Resident and Facility Factors Associated with Rehospitalization from Long Term Care Principal Investigator: Mark Parshall, PhD, RN, FAAN
Institution/Company: University of New Mexico, College of Nursing_
Co-Investigator(s): Angelina Flores-Montoya, MSN, RN, RWJF Nursing & Health Policy Fellow: University of New Mexico, College of Nursing/ Health Sciences Center

In the following space, please provide a brief summary of the proposed research. Summarize the project's aims, design and methods, timeline, and the uses to which the data will be put. Describe how the research will further knowledge and practice in gerontology, geriatrics, and/or health services. A separate abstract may be substituted.

Rehospitalizations from a long-term care (LTC) facility are often necessary, but multiple transfers across health settings increases the risk of adverse outcomes for LTC residents. Rehospitalizations are costly to Medicare ($14.3 billion in 2011)[1] with policy implications impacting nursing homes such as the risk for penalties and poor quality measure reports. In 2011, nearly 25% of residents who stayed at least one day in a nursing home experienced a hospitalization[1]. Given the prevalence, expense, and adverse outcomes associated with rehospitalization, a better understanding of risk factors for potentially preventable hospitalization is needed.

The purpose of this study is to determine which resident and facility characteristics are the strongest predictors of rehospitalizations. Investigators will perform statistical analysis of deidentified health and minimum data set records for residents who were admitted to the nursing home corporation LTC facility following an acute hospitalization in the year 2015. The primary endpoint will be rehospitalization within 30 days of initial LTC admission.

The study would be conducted to fulfill degree requirements for a PhD degree in nursing for Ms. Flores-Montoya (the PhD candidate and co-investigator). Receipt of deidentified data from the nursing home corporation HealthCare will be contingent on approval of the dissertation proposal by the candidate's doctoral committed (chaired by

[1] Department of Health and Human Services, Office of Inspector General. (2013). *Medicare nursing home resident hospitalization rates merit additional monitoring* (OEI-06-11-00040). Retrieved from https://oig.hhs.gov/oei/reports/oei-06-11-00040.pdf

Dr. Parshall) and Human Research Review Committee of the UNM Health Sciences Center, with final approval by the nursing home corporation. The timeline for completion of the dissertation would be 12 to months from receipt of the data.

The aim is to identify resident-and-facility-level risk factors for potentially preventable rehospitalizations. Results of the study will be shared with the nursing home corporation HealthCare when the dissertation is completed. Results will be published in peer-reviewed journals and presented at geriatric, nursing, and health policy conferences, but resident and facilities will not be identifiable. The study has the potential to prevent avoidable rehospitalizations by improving nursing home care practices, thereby reducing harm for nursing home residents and lowering costs associated with rehospitalizations.

1. *Which the nursing home corporation HealthCare programs and services will this study involve?*

   The nursing home corporation facilities that are Medicare/Medicaid certified to provide Long Term Care and Skilled Nursing Facility services in the United States.

2. *Will the nursing home corporation **customers** be research subjects? If so, indicate (a) number to be involved, (b) means of sampling/selection, and (c) inclusion/exclusion criteria.*

   Deidentified administrative and health records data of the nursing home corporation customers (nursing home residents) will be analyzed. Use of deidentified existing records make it likely that requirements for informed consent may be waived.

   A) This study will include health records data for all the nursing home corporation residents in the year 2015 who meet inclusion criteria (see below).

   B) We hope to analyze health records data from all residents who met the inclusion criteria during calendar year 2015 together with administrative facility-level data (e.g. staffing, time of day of rehospitalization, etc.)

   C) *Inclusion criteria:* 1) admitted into a certified the nursing home corporation long term care or skilled nursing facility following an acute hospital stay. *Exclusion criteria*: 1) individuals with multiple episodes of LTC or SNF admissions in the same year

3. *Will the nursing home corporation **staff** be research subjects? If so, indicate (a) number to be involved, (b) means of sampling/selection, and (c) inclusion/exclusion criteria.*

   No, the nursing home corporation staff will not be research subjects.

4. *Will the nursing home corporation **staff** be involved in the research other than as subjects (e.g., providing ratings of customers; delivering special services for the study; receiving training)? If so, indicate (a) how they will be involved, (b) the amount of staff time needed, and (c) any planned means of compensating for staff time diverted from regular duties for the purposes of this research.*

Yes, the nursing home corporation staff will be involved in the study.

A) The nursing home corporation IT staff will provide access to deidentified resident data and facility-level data. No training specific to this research is necessary for staff.

B) Time needed is determined by availability of requested data and the ability to compile and format data.

C) No planned means of compensating for staff time.

5. *What measures will the study use? List specific methods and measures (e.g., self-report instruments, existing records), with whom they will be used, and how the information will be collected. Attach copies of instruments if they are available.*

The study will use existing data from A) electronic health records, B) Minimum Data Set measures, and C) facility characteristics. Only existing data on residents who meet inclusion criteria will be used in the study. This study will not require clinical or administrative staff to be involved in recruitment or collection of new data.

A) Health records measures include, but are not limited to: 1) reason for discharge to hospital, 2) date/time of discharge, 3) discharging nurse LPN/RN, 4) resident medication list, 5) vital signs at discharge, 6) provider credentials who ordered discharge (MD/NP/PA), 7) 24 hours provider orders prior to hospital discharge (i.e. labs, x-rays, intravenous therapy, oxygen, etc.)

B) Minimum Data Set example measures: 1) admission date, 2) active diagnoses, 3) resident demographics (i.e. age, gender, race/ethnicity, marital status) 4) functional status/activities of daily living, 5) form of payment (Medicare, Medicaid, Private Insurance), 5) pain management, 6) special treatments, procedures, and programs in last 14 days while a resident, 7) influenza vaccine, 8) pneumococcal vaccine

C) Facility measures include: 1) provider number, 2) number of beds, 3) state, 4) zip code

6. *Describe procedures for explaining the project to participants, obtaining informed consent, and maintaining confidentiality.* ***Attach (a) copies of all consent statements and related materials, and (b) documentation of institutional review board approval from relevant institution(s).***

A) This is a secondary analysis of existing deidentified records. It is likely that requirements for informed consent will be waived.

B) IRB approval by University of New Mexico Health Sciences Center Human Research Review Committee.

7. *Are there other ethical issues, risks, or discomforts associated with research participation? If so, enumerate them and describe methods for dealing with them.*

   Risks: No discomforts are associated with research participation. Risks to confidentiality will be minimized by using a deidentified data set supplied by the nursing home corporation HealthCare. Data will be maintained in an encrypted data security management platform maintained by the University of New Mexico Health Sciences Center or on an encrypted, password protected computer.

8. *Are there direct benefits that accrue to research participants? If so, please describe.*

   No direct benefits to research participants.

9. *What, if any, costs will the nursing home corporation incur as a result of participating in this project?*

   There may be costs associated with the time needed to create and approve the deidentified data set compiled from existing clinical and administrative data.

10. *What benefits will accrue to the company as a result of participating in this research?*

    The nursing home corporation will gain detailed information regarding rehospitalizations from facilities the company owns or manages. The support of the nursing home corporation HealthCare will be acknowledged in the dissertation and in any presentations or publications resulting from the research.

11. *Will the study help the nursing home corporation improve its care delivery systems and practices? If so, how?*

    Yes, this study will provide the nursing home corporation with explicit information in the practices of their facilities related to the rehospitalizations. Results of the study will have the potential to inform the nursing home corporation of clinical or administrative risk factors for rehospitalizations which may be of use in identifying residents at higher risk of rehospitalization early enough in the LTC stay to reduce rehospitalization rates and avoid resident harm. Decreasing rehospitalizations improves quality measure rating scores and may contribute to improving processes and support for QAPI work.

12. *How and when will research findings be shared with the nursing home corporation?*

    The research findings will be shared with the nursing home corporation upon completion of the doctoral dissertation, target date December 2017. The nursing home corporation is invited to attend the doctoral defense presentation and will have access to the dissertation and any publications that result from the study.

Appendix H: De-identified data requested

MDS section	MDS Data	EMR Data
	(On admission, Entry/discharge reporting, & Type of discharge)	(On admission, during first 30 days, and discharge)
A0100	Facility Provider #	Facility
A0900	Age	Medical diagnoses
A0800	Gender	Medication List: dose, frequency
A1000	Race/Ethnicity	Vital signs
A1200	Marital status	Do Not Resuscitate order
A1700	Type of entry (admission/Reentry)	Diet Order
A1800	Entered from (acute, psych, hospital)	Physical Activity Order
A1600	Entry date	Lab orders in 30 days
A1900	Admission date	Laboratory test results (30 days)
A2000	Discharge date	Admission orders
A2100	Discharge status	Radiology test results (30 days)
A0600, A0700	Insurance type (Medicare, Private, Medicaid)	Admission Time
C0700	short-term memory	Pain assessment
C0800	long-term memory	Physical assessment admission
C1000	cognitive skills for daily decision making	Physical assessment 3 days
C1300	Signs & symptoms of delirium	Physical assessment 7 days
C1600	Acute onset of mental status change	Physical assessment 14 days
E0100	Potential indicators of psychosis	Physical assessment 30 days
E0200	Behavioral symptom	Hospice or palliative care order
E0800	Rejection of Care	Flu vaccine date
E0900	Wandering	Pneumococcal vaccine date
G0110	ADL assistance	Admission note (MD,NP, PA)
G0400	Functional limitation ROM	Admission note nursing
H0300	Urinary continence	Discharge note (MD, NP, PA)
H0400	Bowel continence	Discharge note (nursing)
I	Active diagnosis in last 7 days	Care Plan

J0100	Pain management	Discharge orders
J0300-J0600	Pain assessment	
J1100	Shortness of Breath	
J1400	Prognosis	
J1700	Fall history on admission	
K0100	Swallowing disorder	
K0200	Height and weight	
M0100	Determination of pressure ulcer risk	
M0150	Risk of pressure ulcer	
M0300A	# of stage 1 pressure ulcer	
M0300B	# of stage 2 pressure ulcer	
M0300C	# of stage 3 pressure ulcer	
M0300D	# of stage 4 pressure ulcer	
N0410	Medication received	
O	Special treatments, procedures, programs while a resident	
O0250	Influenza vaccine	
O0300	Pneumococcal vaccine	
O0500	Restorative nursing program	
O0700	Physician orders	
Q0100	Participation in assessment	
Q0300	Resident overall expectation	
Q0400	Discharge plan	

Appendix I: Logistic Regression Model 3: Adjustment for Multicollinearity

Model 3	OR	(95% CI)
Resident Characteristic		
Gender**[a]	0.67	(0.46 - 0.96)
Race/Ethnicity[b]		
Hispanic	0.94	(0.59 - 1.48)
American Indian/Alaska Native**	2.00	(1.07 - 3.71)
Asian, Black, Native Hawaiian, or Pacific Islander	0.7	(0.20 - 2.45)
No race/ethnicity identified**	1.86	(1.10 - 3.16)
Heart/circulation diagnosis[c]	1.09	(0.71 - 1.68)
Gastrointestinal diagnosis[c]	1.35	(0.90 - 2.04)
Cancer[c]	1.58	(0.89 - 2.80)
Shortness of breath*[c]	1.54	(0.96 - 2.46)
Renal failure/insufficiency or ESRD*[c]	1.49	(0.95 - 2.34)
Delirium*[c]	1.57	(0.93 - 2.68)
Dementia**[c]	0.51	(0.26 - 1.00)
Rejects care**	3.30	(1.28 - 8.53)
Supplemental oxygen[d]	1.03	(0.69 - 1.54)
Unhealed pressure ulcer[c]	1.42	(0.83 - 2.43)
ADL mobility***[e]	1.71	(1.27 - 2.30)
Constant***	0.02	(0.01 - 0.04)

CI = confidence interval; ESRD= end stage renal disease; ADL = activities of daily living.
[a] Reference Category = Male
[b] Reference Category = White
[c] Reference Category = No diagnosis/condition
[d] Reference Category = Room air/no supplemental oxygen
[e]Scale 0-4 with higher scores indicating less mobility and greater ADL assistance; Reference category = 0.
* p<0.1, ** p<0.05, *** p<0.01 vs. reference category.

Appendix J: Logistic Regression Model 4: Adjustment for facility differences in rehospitalization rates

Model 4	OR	(95% CI)
Resident Characteristic		
Gender**[a]	0.67	(0.46 - 0.97)
Race/Ethnicity[b]		
Hispanic	0.94	(0.59 - 1.48)
American Indian/Alaska Native**	2.01	(1.08 - 3.76)
Asian, Black, Native Hawaiian, or Pacific Islander	0.7	(0.20 - 2.44)
No race/ethnicity identified**	1.87	(1.09 - 3.19)
Heart/circulation diagnosis[c]	1.07	(0.69 - 1.66)
Gastrointestinal diagnosis[c]	1.35	(0.89 - 2.04)
Cancer[c]	1.56	(0.87 - 2.77)
Shortness of breath*[c]	1.61	(0.98 - 2.65)
Renal failure/insufficiency or ESRD*[c]	1.47	(0.94 - 2.32)
Delirium[c]	1.54	(0.89 - 2.64)
Dementia*[c]	0.51	(0.26 - 1.00)
Rejects care**	3.26	(1.26 - 8.44)
Supplemental oxygen[d]	1.04	(0.70 - 1.55)
Unhealed pressure ulcer[c]	1.42	(0.83 - 2.45)
ADL mobility***[e]	1.70	(1.26 - 2.29)
Constant***	0.02	(0.01 - 0.05)

CI = confidence interval; ESRD= end stage renal disease; ADL = activities of daily living. Regression coefficients for facility fixed effects included in model, but not displayed.

[a] Reference Category = Male

[b] Reference Category = White

[c] Reference Category = No diagnosis/condition

[d] Reference Category = Room air/no supplemental oxygen

[e] Scale 0-4 with higher scores indicating less mobility and greater ADL assistance; Reference category = 0.

* $p<0.1$, ** $p<0.05$, *** $p<0.01$ vs. reference category.

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