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Examining Congestive Heart Failure Hospital Readmissions from Skilled Nursing Facilities

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This is to certify that the doctoral dissertation by

Katherine Mary Day

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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Abstract

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Abstract

In the United States, congestive heart failure (CHF) is a cardiac condition with increasing hospitalization and rehospitalization burden to patients, families, and the healthcare system. This chronic condition is expected to affect more than 8 million people by 2030; however, not much is known about the relationship between risk factors and hospital readmissions once CHF patients are discharged to a skilled nursing facility (SNF). Applying a systems theory—unbounded systems thinking, coupled with a systems-thinking approach—the purpose of this quantitative, retrospective cohort study was to examine CHF hospital readmissions from SNFs within a 90-day period using a secondary data set of gender, age, race, SNF geographic location, length of SNF stay, and home health use risk factors. A binary logistic regression analysis revealed that out of 238 episodes, 99 patients were readmitted; however, no statistically significant relationship between the risk factors and readmission was found. Findings suggest that CHF readmissions from the SNF are not attributed to only quantifiable risk factors. Based on these findings, further research can support social change through multifaceted quantitative and qualitative systemic analyses to identify and inform how healthcare organizations can better assist the elderly population with CHF and improve future post-acute community-based health education and prevention programs.

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Dedication

I dedicate this dissertation to my husband, James, who has supported and encouraged me throughout my academic journey. To Nicholas, who has known me to be a student since he was a little boy. You will graduate from high school soon, always follow your dreams and never give up.

Acknowledgments

I wish to thank my committee members who guided me throughout the dissertation process and challenged me to be a better researcher and scholar. My chairperson, Dr. Howell Sasser, kept my spirits up throughout the writing process and all the revisions. Thank you, Dr. Carlson, for your persistence and guidance to keep me on track with the tedious but necessary manuscript requirements. Thank you, Dr. Agha, for serving on my committee.

I would like to thank my parents, Russell and Jacqueline, who instilled in me the motivation to be a lifelong learner. I would also like to thank my mother- and father- in-law, Karlene and John, who frequently inquired about my progress and if I was getting enough rest.

Special acknowledgements are due to the vice president of quality and the chief medical officer at the community partner organization. Lastly, I am grateful to the continuing care leadership team and research staff at the community partner organization for their continued support throughout the research process. A final thank you to everyone else I did not mention, but who contributed in some fashion to the successful completion of this dissertation.

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Chapter 1: Introduction to the Study

The Affordable Care Act in 2010 shifted how health care organizations and health care professionals approach conditions such as congestive heart failure (CHF), including rethinking care delivery and payment models (Tingley, Dolansky, & Walsh, 2015). CHF is a cardiac condition with increasing hospitalization and rehospitalization burden to patients, families, and the health care system (Carpenter, Short, Williams, Yandell, & Bowers, 2015; Ramani, Uber, & Mehra, 2010). Previous studies have shown the complex nature of CHF and have identified this condition as a major contributor to hospital readmissions and burden of care (Nazir & Smucker, 2015). CHF currently affects at least 6 million people nationwide and is a primary cause of hospitalization and rehospitalization. In addition to these statistics, there is a predicted estimate that up to 8 million Americans will be diagnosed with CHF by 2030 (American Heart Association, 2017).

In this study, I examined the risk factors associated with hospital readmissions of CHF patients receiving skilled nursing care within in a bundled, value-based program. The goal of this research was to determine whether readmission from the skilled nursing facility (SNF) was influenced by a set of risk factors, which included gender, age, race, SNF location by region, SNF length of stay (LOS), and whether home health care was used. Thus, I examined factors that put patients who reside in SNFs at risk of hospital readmission as well as what can improve the care for this population along the care continuum (see Nazir & Smucker, 2015; Tingley et al., 2015).

This research may provide information to initiate positive social change by supporting better outcomes for CHF patients being cared for during a SNF stay. Results from this study may encourage infrastructure changes within health care and community-based organizations by informing what risk factors influence hospital readmissions and which resources can then be allocated based on risk. Additionally, integrated delivery systems are currently emerging and replacing private practice models. Based on the Affordable Care Act, the hospital readmission reduction program was initially focused on reducing readmissions from acute care hospitals (Ottenbacher et al., 2014), but there is movement away from an emphasis on acute care toward post-acute and ambulatory care. Reimbursement will be value-based and bundled rather than a procedure-driven fee-for-service. A systems approach will be necessary to deliver population health toward disease prevention. Saving the government money can contribute to increased revenue for health care organizations, allowing the reallocation of funds toward increased access and quality outcomes for this population.

This chapter includes a brief review of the literature, providing a background and perspective on CHF readmissions from the SNF level of care and identifying the challenges in addressing the risk factors of this population. This chapter also includes an explanation of the problem of readmissions for CHF patients from SNFs and potential risk factors. Additionally, the chapter includes the purpose and research questions, the nature of the study, operational definitions, and a discussion of the two theoretical frameworks guiding this study: unbounded systems thinking incorporating a systems-thinking approach. After offering a brief overview of the study's methods, the chapter

includes the scope and delimitations related to generalizability, inclusion, and exclusion criteria. Finally, the limitations of the study are presented with steps to control for adverse effects on this study.

Background of the Study

In the United States, approximately 20% of the 1 million annual hospital discharges for CHF result in transfer to a SNF. These patients are generally elderly and are living with additional conditions or comorbidities than those who are discharged home (Orr, Boxer, Dolansky, Allen, & Foreman, 2016). There are a little over 6 million Americans with CHF, and among this population the hospitalization rate is approximately 18 per 1,000 patients over the age of 64 (Mirkin, Enomoto, Caputo, & Hollenbeak, 2017). This condition results in high hospital readmission rates with over 700,000 hospital admissions each year, and prevalence is expected to increase 25% by 2030 (Aggarwal & Gupta, 2014; Carpenter et al., 2015; Mirkin et al., 2017).

The Centers for Medicare and Medicaid Services (CMS) has challenged the health care industry with improving CHF outcomes. This may be accomplished by identifying and reducing the risk factors for rehospitalization and improving how CHF patients transition from one of level of care to the next such as from hospital to SNF, hospital to home, or SNF to home (Britton et al., 2017; Gunadi et al., 2015; Hwang, Liao, & Huang, 2014). Treating CHF requires an interdisciplinary care team throughout the continuum of care (see Figure 1). The continuum of care represents not only an array of health care services but also the period that a patient may be monitored to provide coordinated care.

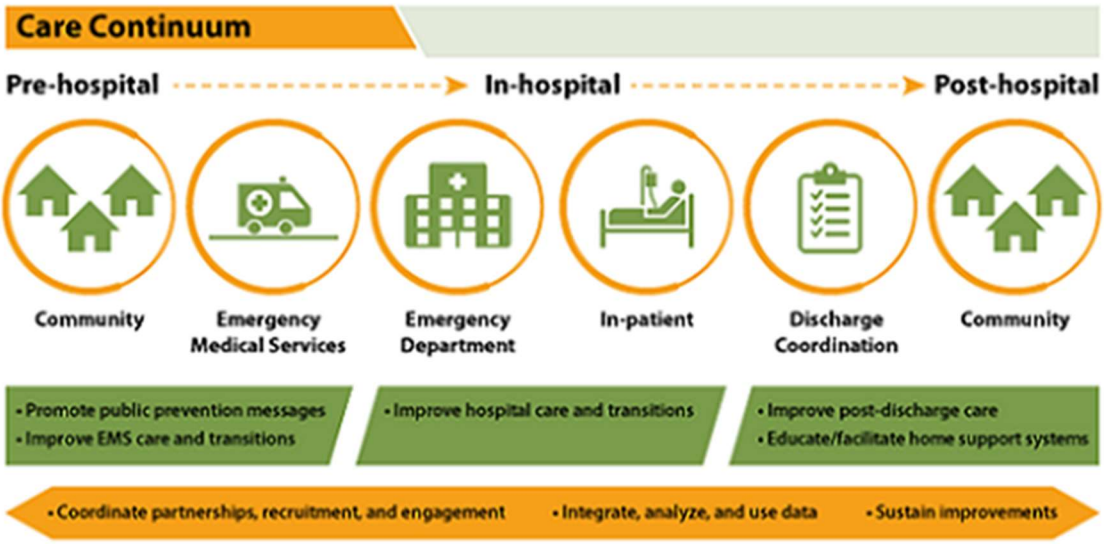

Figure 1. Care continuum infographic. Adopted from the Centers for Disease Control and Prevention, n.d. (https://www.cdc.gov/dhdsp/programs/about_pcnasp.htm)

CMS has identified skilled nursing care as one of the components within the care continuum available for CHF patients once discharged from the hospital (CMS, 2017b). There are also opportunities to improve care by developing health care industry partnerships along the care continuum displayed in Figure 1 (Mechanic, 2014). From a cost standpoint, SNFs account for approximately half of Medicare's overall post-hospital spending (Mechanic, 2014). The care continuum consists of an array of services but is also where inconsistent practice patterns and a fragmented care delivery system results in varied outcomes (Mechanic & Tompkins, 2012; Orr et al., 2016; Phillips & Abrams, 2017).

Though SNFs provide care to CHF patients unable to go home once discharged from the hospital, this level of care can make the difference between rehospitalization or timely transition home with home care. However, there is minimal research regarding

CHF readmissions from SNFs. Because CHF currently affects at least 6 million people nationwide and is a primary cause of hospitalization and rehospitalization (American Heart Association, 2017), this research was necessary to address risk factors associated with hospital readmission for CHF patients admitted to a SNF.

Problem Statement

The repercussions of rehospitalization for health care organizations and post-acute partners have elevated SNF CHF management as a major policy priority (Orr et al., 2016). As evidenced by the Bundled Payments for Care Improvement (BPCI) initiative, CMS is moving toward value-based care models and away from the costlier, siloed fee-for-service model to achieve the Triple Aim concept (see Figure 2), which consists of improving population health by improving patient experience and reducing costs (CMS, 2017a; Institute for Healthcare Improvement, 2018; Mukherji & Fockler, 2014; Phillips & Abrams, 2017).

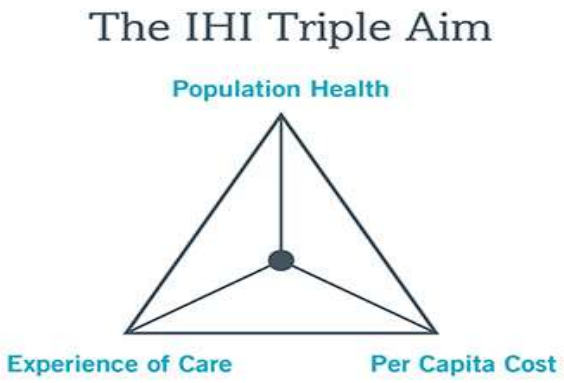

Figure 2. Institute for Healthcare Improvement Triple Aim concept design. Adapted from the Institute for Healthcare Improvement, 2012 (http://www.ihi.org/Engage/Initiatives/TripleAim/Pages/default.aspx)

Since its launch in early 2013, BPCI-related outcomes have been studied to evaluate whether such a value-based program should become the norm for a clinically defined episode of care and how such care should be delivered (Getts & Strauss, 2017; Mukherji & Fockler, 2014). CMS Innovation conducts and sponsors demonstration projects or pilot programs to test various care and payment models (CMS, 2018). The duration of typical demonstration projects may be conducted between 3 and 5 years. The BPCI demonstration project that this research was based on began on April 1, 2015, and was terminated September 30, 2018. CMS conducts evaluations during and after demonstration projects to determine the impact such programs have on recipients and any changes that may alter service delivery (CMS, 2018).

Previous demonstration programs have been focused on the acute or hospital level of care (Gheorghiade, Vaduganathan, Fonarow, & Bonow, 2013). Cost reduction efforts consisted of reducing the duration or LOS, diverting medical procedures or tests that could be completed as outpatient procedures or outside of the hospital stay. Hospitals have been reducing the LOS metric since the early 1990s when Medicare began putting payment reforms into place to reduce costs and improve care efficiency (Burke et al., 2016; Mechanic & Tompkins, 2012). Patients deemed too sick to be discharged directly home, even with home health care, have been discharged from the hospital to a SNF. However, it has not been well studied how SNF care, within a bundled value-based payment program, might impact the readmission risk for the elderly experiencing CHF and how hospital readmissions might vary by gender, age, race, geographic location, LOS, and home health intervention (CMS, 2017a; Mirkin et al., 2017).

Purpose of the Study

Early identification of the risk factors for hospital readmission due to CHF progression will allow those who work most closely with the CHF population to provide appropriate education, care coordination, and arrange for timely home health and primary care follow-up for patients and caregivers to better manage the condition. Although education and care coordination are part of the standards of care, these activities are not always completed and the extent of which such activities are carried out vary among SNF sites. Under fee-for-service reimbursement, Medicare allows SNFs to bill up to 100 days for patient care depending on the severity of the illness and rehabilitation needs. However, Medicare spending on post-acute SNF care within the first 30 days after a patient is discharged has grown between 4.5 to 8.5% between 1994 and 2009 and is unsustainable (Mechanic, 2014). It is also questionable whether keeping an elderly CHF patient in a SNF for a full 100 days is appropriate or medically necessary. Considering the ongoing pilot testing of 30-, 60-, or 90-day time windows and the average length of a SNF stay today for a CHF patient hovering around 20 to 30 days, it is the ongoing variations in readmissions and use of SNF care that require further research to understand the source of these variations. Therefore, the purpose of this study was to examine the risk factors associated with hospital readmissions for CHF patients receiving skilled nursing care in a bundled program and to identify characteristics associated with readmission. Hospital readmission, within 90 days, was the primary outcome of interest (dependent variable) and risk factors (independent variables) included gender, age, race, SNF geographic location defined by region, SNF LOS, and home health care use (HHC).

Research Question(s) and Hypotheses

Research Question 1: How are congestive heart failure skilled nursing facility patients, readmitted within 90 days, different from nonreadmitted congestive heart failure patients in terms of risk factors such as gender, age, race, skilled nursing facility geographic location, length of skilled nursing facility stay, and home health use participating in a bundled, value-based program?

$H_0$1: There is no statistically significant difference between readmitted and nonreadmitted congestive heart failure skilled nursing facility patients, in terms of risk factors, participating in a bundled program.

H_a1: There is a statistically significant difference between readmitted and nonreadmitted congestive heart failure skilled nursing facility patients, in terms of risk factors, participating in a bundled program.

Research Question 2: Among bundled program congestive heart failure patients, to what extent do patient characteristics (gender, age, race) and skilled nursing facility characteristics (skilled nursing facility geographic location, length of skilled nursing facility stay, home health care use) predict 90-day hospital readmissions?

$H_0$2: Among bundled program congestive heart failure patients, patient characteristics and skilled nursing facility characteristics do not significantly predict 90-day hospital readmissions.

H_a2: Among bundled program congestive heart failure patients, patient characteristics and skilled nursing facility characteristics significantly predict 90-day hospital readmissions.

Theoretical Foundation

The U.S. health care system provides care to patients with CHF; however, performance remains inconsistent and largely siloed among the various levels of care. This research was based on two foundational concepts: unbounded systems thinking and a systems-thinking approach (Mitroff & Linstone, 1993; Senge, 2006). In 1990, Peter Senge discussed how learning organizations can apply systems thinking as a holistic approach to achieving performance goals (Elder, 2006). He applied systems thinking as a conceptual framework to describe how individual people within an organization, functioning as a whole, have the potential to continuously learn and adapt to changing environments (Senge, 2006). Senge promoted systems thinking as the fifth discipline following four discipline levels of encompassing personal mastery, mental models, building a shared vision, and team learning.

In 1993, Mitroff and Linstone developed and presented unbounded systems thinking, depicted through a multiple perspectives model, which suggests that any phenomenon, organization, or system (like a health system) can be approached from a number of perspectives (Canyon, 2013; Mitroff & Linstone, 1993; Werhane, 2003). Unbounded systems thinking is the product of Mitroff and Linstone's fifth type of inquiry system and represents a complex mode of inquiry that builds from four simpler types of inquiry (Canyon, 2013; Mitroff & Linstone, 1993). The first and simplest is that the inquiry is consensual or an agreement mode. Second, analysis uses an agreed upon numerical formula. The third type of inquiry system, or way of knowing, represents multiple realities where using many models and observational analyses produces a more

unbiased reality because many more inputs are considered (Canyon, 2013). Fourth, the dialectic inquiry system assumes that truth will emerge due to contrasting views because of input from opposites (Canyon, 2013). Rather than a siloed, uniperspective approach, a multiple perspectives model allows health services professionals, who contribute to the health of populations in the private and public sectors, to manage an array of health challenges such as CHF (Bresnick, 2017; Canyon, 2013). This study included six risk factors requiring a systems approach to understand how such risk factors may impact readmissions and address these factors when caring for the CHF population, which made unbounded systems thinking and a systems-thinking approach appropriate as the theoretical foundation.

BPCI was an alternative payment model that combined fixed payments from CMS instead of paying for each service separately as in a fee-for-service model (CMS, 2017a). These value-driven programs encourage health systems to consider a coordinated, systems thinking approach when providing health services (McDonald et al., 2007). The use of structured, evidence-supported systems-engineering approaches used in other industries can also be applied to multiple levels of the health care organization (Kaplan et al., 2013). Adaptation of these combined approaches, coupled with supportive care coordination, can improve care quality provided to the CHF population. The modern version of unbounded systems thinking describes how building bridges can improve outcomes if health care professionals can meet the medical and social needs of patients to prevent rehospitalizations, poor care experiences, and outcomes (Mitroff &

Linstone, 1993; Senge, 2006). Thus, systems thinking provided the framework to this study (Mitroff & Linstone, 1993; Naylor, 2015; Senge, 2006).

Today, health care systems are encouraged to embrace a systems-thinking approach to evolve into an organization able to care for various types of patients experiencing health challenges such as CHF. As patients are discharged from the hospital to the SNF or health facility into the surrounding communities, health care organizations are challenged to creatively provide services beyond the facility. Adopting a holistic approach to understanding the risks associated with CHF patients being readmitted to the hospital after discharge should include multidisciplinary perspectives (McCovery & Matusitz, 2014; Peters, 2014).

Nature of the Study

The approach of this study was based on a positivist perspective, realist ontology, and an epistemological stance of objectivism. Therefore, the nature of this study was a quantitative methodology and a retrospective cohort research design (Burkholder, Cox, & Crawford, 2016). A binary logistic regression analysis was used to examine the nature of the links between the independent variables of age, race, gender, SNF geographic location (region), SNF LOS, HHC use, and the binary dependent variable, readmission (see Mirkin et al., 2017; Warner, 2013). The analysis provided a comprehensive examination of associations between risk factors that may be predictors of hospital readmission while allowing for the identification of any existing patterns through the variables on interpretation of the results.

Data were extracted from proprietary care navigator logs and an electronic medical record database, which were de-identified with oversite by the community partner executive sponsor then converted to an Excel spreadsheet for SPSS v25 input and analysis. Demonstration or pilot programs in health care today use metrics to measure outcomes and analyze patterns (statistics) to evaluate programs (CMS, 2018; Risjord, 2010). Care navigator tracking logs were patient tracking Excel spreadsheets containing program-specific data elements used during participation in BPCI to track clinical outcomes for patient populations diagnosed with various conditions including CHF (University of Washington, 2018). Logs allow for tracking without the high cost commitment of electronic medical record enhancements or purchase and provided BPCI data elements such as CHF diagnosis, SNF location, SNF LOS, HHC use, and whether a CHF SNF resident experienced a readmission. The electronic medical record is the electronic version of a patient's paper chart and provides demographic information, past medical and surgical, preventive, laboratory and radiographic, and drug information about a patient (Practice Fusion, 2017). Most electronic medical records also contain billing and insurance information and other accounting tools (Medical Dictionary, 2018).

Definitions

Bundle payments for care improvement (BPCI), Model 3: One of four models of care linking Medicare payments for multiple services beneficiaries receive during an episode of care. These episodes begin at the start of post-acute care within a SNF, inpatient rehabilitation facility, long-term care hospital, or a home health agency. Model

3 involved a retrospective bundled payment arrangement where actual expenditures were reconciled against a target price for an episode of care such as 90 days (CMS, 2017a).

Centers for Medicare and Medicaid (CMS): The federal agency, formerly the Health Care Financing Administration, which administers Medicare, Medicaid, and Child Health Insurance programs (Luke, 2016, p. 140).

Continuum of care: The range of services required by chronically ill, impaired, or elderly people. Services may include preventive measures, acute medical treatments, rehabilitative and supportive care, and social service (Medical Dictionary, 2018).

Demonstration project: Also referred to as Medicare demonstration project. The CMS Innovation conducts and sponsors numerous innovative demonstration projects and model tests to measure the effect of potential program changes. Demonstrations and model tests study the impact of new methods of service delivery, coverage of new types of service, and new payment approaches on beneficiaries, providers, health plans, states, and the Medicare Trust Funds. Evaluation projects validate the research and demonstration/model findings to monitor the effectiveness of Medicare, Medicaid, and the Children's Health Insurance Program (CMS, 2018).

Diagnosis-related group: A statistical method of classifying inpatient stays into groups that assist in allocating insurance compensation (Diagnosis-related group, n.d.). In this study the CHF diagnosis-related group codes specific to the bundle program are represented as 291, 292, and 293.

Gender: For this study gender was categorized as either male or female (Whittaker, Soine, & Errico, 2015).

Home health care: Refers to health care services provided in the home that can be either medical or rehabilitative in nature. Most often provided after a hospital or SNF stay to assist one in achieving either prior level of functioning or adjusting to a new level of function to live as independently as possible. Care is provided by licensed nurses and therapists (Luke, 2016, p. 121).

Interdisciplinary team: A group of health care professionals from diverse fields who work in a coordinated fashion toward a common goal for the patient. For example, this could represent a team of professionals such as a registered nurse, clinical care coordinator, director of nursing, attending physician, and administrator from the SNF who collaborate on the same case or episode (Nancarrow et al., 2013).

Length of stay (LOS): Term used to describe the duration of a single episode of hospitalization, skilled nursing home or rehabilitation facility. For this study, inpatient days refer to time in a SNF and were calculated by subtracting day of admission from day of discharge from the SNF (Medical Dictionary, 2018).

Medicare: Defined as the single-payer, federal insurance program governed by the U.S. government for Americans over the age of 65 (CMS, 2018; Luke, 2016, p. 142). For the purposes of this study, patients are covered under Medicare Part A (Hospital Insurance). Part A helps cover inpatient care in hospitals, including critical access hospitals, and skilled nursing facilities (not custodial or long-term care). Patients are also enrolled in Medicare Part B (medical insurance). Part B helps cover doctors' services and outpatient care. It also covers some other medical services that Part A does not

cover, such as some of the services of physical and occupational therapists, and some home health care (CMS, 2018).

Patient care navigator: Patient care navigators assist beneficiaries by overseeing and coordinating care. They help patients to understand the positives of being in a bundle program such as lowering their care costs and improving their care experiences. The navigator then guides patients through what incentives an episode of care will entail (CMS, 2017b).

Readmission: The return of a patient to inpatient hospital care shortly after discharge. Typically, the time frame considered is within 30 days of discharge (Medical Dictionary, 2018). For this study, the timeframe is within 90 days of discharge. This represents the period identified by the BPCI pilot program.

Region: Defined by the U.S. Census Bureau as groupings of states and the District of Columbia by subdividing the United States for the presentation of census data (U.S. Census Bureau, 2015). For this study, geographic location of SNFs is represented by three regions: Northeast, Midwest, and Great Lakes (U.S. Census Bureau, 2015; Wilson & Brown, 2012).

Skilled nursing facility (SNF): Commonly known as nursing homes or convalescent homes providing two levels of care, custodial or long-term care and short-term rehabilitation care. SNFs are distinct relative to other post-acute care options in that they provide a specified level of skilled nursing and/or rehabilitation services (Orr et al., 2016). In this study, patients diagnosed with CHF who were hospitalized were discharged to the SNF for cardiac rehabilitation. The goal of the SNF is to provide care

services to get a person healthy and strong enough to be discharged from the SNF to home (Luke, 2016).

Triple aim of health care: Depicts a healthier population, improved medical care, and reductions in costs and inefficiencies in delivering care (Luke, 2016).

Value-based care program: Defined as a program that is reimbursed by Medicare based on the quality or value of care, rather than volume, provided to Medicare recipients. Main types of value-based care are represented by accountable care organizations, bundle or episode-based care, and the patient-centered medical home (Philips, 2018). I examined CHF readmissions associated within a bundled or episode-based care model.

Assumptions

This study was based on the following assumptions:

1. All data elements obtained from the care navigator logs and electronic medical record were clinically accurate. The assumption of accuracy included diagnosis, date of SNF admission and discharge, date of hospital readmission, and home health referral.
2. CHF diagnoses provided for each beneficiary in the bundle program were clinically verified and up-to-date from both log data and the electronic medical record. Only readmissions with CHF-related primary or secondary diagnoses (diagnosis-related group 291, 292, or 293) were included. The first hospital readmission or index rehospitalization following SNF discharge was examined for this study.

Scope and Delimitations

The scope of this study included community partner SNF patients only, covered by Medicare Part A and enrolled in Medicare Part B, where CHF was the admitting diagnosis to the SNF qualifying the patient to be in BPCI (CMS, 2017a). SNF patients may have comorbidities, but CHF was the anchoring diagnosis. Readmission, as related to the index or first hospital readmission from the SNF, was analyzed but not subsequent readmissions. A delimitation of this study was that I examined a small subset of CHF SNF patients from a limited data set. It may have not captured all ethnic minorities and vulnerable groups, affecting external validity and making the study design less replicable and results less generalizable. Additionally, all SNFs were in urban areas.

Limitations

Variety in program implementation, policies, and procedures between the various SNFs included in this study may have been the result of the beginning of care redesign efforts. Value-based, alternative payment models such as BPCI are relatively new. One of the limitations of this study is that the outcomes cannot be used to describe other SNFs' progress in reducing hospital readmissions, especially those with varying patient acuity levels, populations, and comorbidities. The sample included only Medicare A participants diagnosed with CHF who experienced or had not experienced a hospital readmission. Because this study included the first or index rehospitalization of a CHF SNF patient, readmissions may have been directly related to CHF, were cardiac related, or noncardiovascular.

Another limitation was that data collected for this study were solely from the SNFs of the community partner. The community partner is a division of a not-for-profit national health care organization operating over 50 nursing home facilities in multiple states. Twelve initial SNFs were selected by the organization to participate in BPCI. However, not all 12 locations were assigned by the organization to be responsible for metrics associated with the CHF diagnosis. Only locations elected to be at risk for the outcomes of their patients with CHF were available for analysis in this study. A total of nine SNFs, in urban areas, were included in this study assigned to a representative region to account for and offset the differences in SNF facility size and BPCI CHF SNF patient volumes (U.S. Census Bureau, 2015). The Great Lakes Region included SNFs from Michigan. This region was represented by five SNFs, two in West Michigan and three in Southeast Michigan. Two SNFs from Indiana comprised the Midwest Region. One SNF from Connecticut and one from Maryland represented the Northeast Region. Using a regional approach to represent SNF geographic location also provided a more reasonable distribution for geographic location while allowing sufficient granularity to interpret results. The reliance on the care navigator log and electronic medical record for accurate data collection may have led to a limitation because of human or technological input error that influenced results. However, both sources allowed for corroboration of the data to cross-check most data elements and minimize documentation errors being transferred to the study sample.

Significance of the Study

Determining the risk factors for hospital readmissions due to CHF can improve the chance that the right interventions will be provided at the right time for the most vulnerable populations, thereby reducing health care costs as health care moves toward bundled value-based programs for this population. Saved money can be allocated to the appropriate recipients requiring the most care to maintain an optimal quality of life (CMS, 2017a). This study also highlights how various factors might be correlated with quality outcomes related to CHF, which may inform how health care organizations can better assist elderly populations with CHF perhaps expanding to similar senior populations with other chronic diseases. Using a sample of SNFs represented by geographic regions may contribute data that informs how the community partner organization should conduct interventions toward eliminating health disparities within the communities for which they provide services (see Brownson, Fielding, & Maylahn, 2009).

Significance to Social Change

The community partner for this study can contribute to positive social change because of its organizational commitment to People-Centered 2020 care and population health. Participating in BPCI has allowed the community partner and its ministries to apply learnings from this program toward the betterment of the CHF elderly population who are cared for within this community partner's facilities. Public health can be improved by the community partner collaborating with other organizations and governmental agencies. Triple aim enterprises, as depicted in Figure 3, are created by

integrating services applying a systems approach. They have the potential to drive quality initiatives toward better health for patients and the communities served through community partnerships (Institute for Healthcare Improvement, 2018). Health care systems and associated subsystems are not closed, static systems and should continue to examine how care is delivered to avoid unnecessary hospital readmissions of the elderly CHF populations in surrounding communities (Institute for Healthcare Improvement, 2012; Werhane, 2003). System-wide policies, processes, outcome metrics, and procedures may be established to better align with positive health outcomes for the CHF population similar to the participants examined in this study.

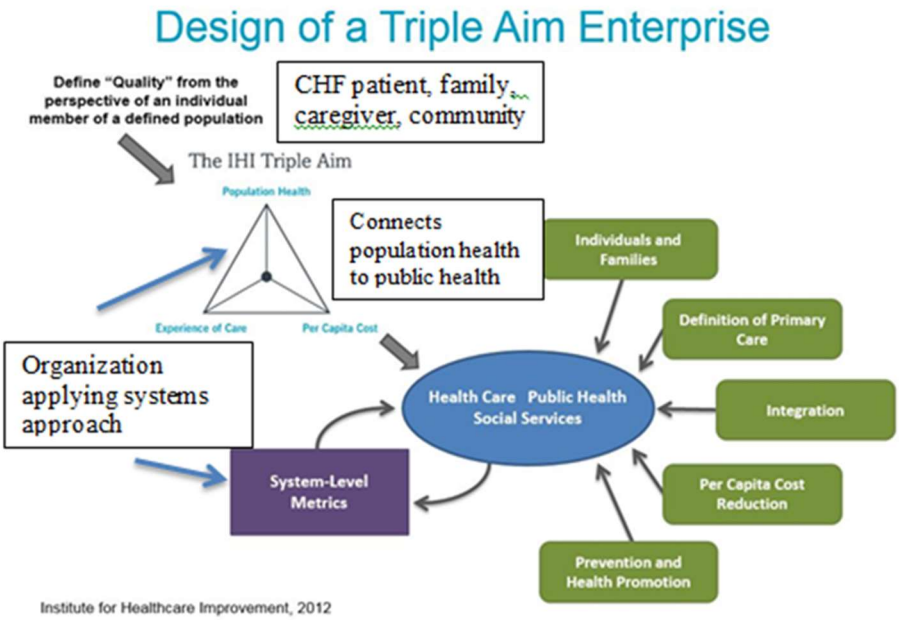

Figure 3. Applying a systems approach integrating the triple aim. Adapted from the Institute of Healthcare Improvement, 2012 (http://www.ihi.org/Engage/Initiatives/TripleAim/PublishingImages/IHI_DesignofTripleAimEnterprise.JPG)

Summary

BPCI participation has fostered comprehensive, patient-centered care for the CHF patient population while decreasing high cost service use. A lack in current literature is knowledge about hospital readmissions for CHF patients discharged to a SNF. Understanding the care required for CHF patients requires data to interpret patterns over time (Salmond & Echevarria, 2017). The next chapter presents a thorough explanation of how a systems approach, using a multiple perspectives model, provided a framework for this study and informs how health care organizations may use a systems approach drawing on multiple perspectives to care for the CHF population.

Chapter 2: Literature Review

Introduction

The purpose of this quantitative, retrospective study was to examine the risk factors associated with hospital readmissions for CHF patients receiving skilled nursing care in a bundled program. This includes patient characteristics such as race, gender, and age and SNF characteristics such as geographic location, SNF LOS, and whether partnering with home health services influence hospital readmissions. This chapter provides the background and rationale for why this study was important in understanding whether participating in a value-based bundle program influences hospital readmissions for CHF patients cared for at the SNF level. The variables of bundle program participation and hospital readmissions for CHF were chosen because of their relationship to the research questions and the lack of literature pertaining to SNF care.

Research has shown that Medicare patients with CHF disproportionately use health care services when compared to the general population (Mechanic, 2014). Discharge from the hospital to a SNF is common among CHF patients, and SNFs play a pivotal role in providing skilled care that can prevent unnecessary rehospitalization. Bundled-payment programs, born out of Medicare reform, provide health care organizations an opportunity to save money and improve the quality of care for Medicare patients with CHF. In response to the movement away from fee-for-service toward value-based payment models, health care organizations are seeking ways of identifying predictors of hospital readmissions, and studies have attempted to identify factors associated with CHF readmissions. Studies have involved mostly quantitative designs

and various regression-related statistical techniques; however, few studies have indicated consistent predictors of readmission, and fewer have involved 90-day readmissions from the SNF using a systems approach (Mechanic, 2014; Whittaker et al., 2015).

This chapter includes a description of the literature review search strategy. The chapter also provides a general background and overview of the systems approach as it is applied to the health care environment. The chapter continues with a description and application of combined systems approach and unbounded systems thinking as the theoretical foundation for this study, adopting key constructs of both theories to create a more relevant theoretical framework. This review provides insight into how subacute care fits into an integrated delivery system along the continuum of care process for CHF patients. In addition, this chapter reveals what is known and what remains a research gap to develop a baseline of knowledge, which supports the purpose of this study and its results. This chapter concludes with an overview of the literature that was examined.

Literature Search Strategy

The Walden University Library was the primary resource to conduct the literature search. The CINHAL and MEDLINE Simultaneous Search database provided the most comprehensive resources providing health care related information. Other databases accessed were EBSCO host Academic Search Complete, ProQuest Central, and Science Direct. Key search terms included *congestive heart failure, hospital readmissions, skilled nursing care, subacute nursing care, risk factors and heart failure, bundled payment, value-based programs, population health, public health, systems theory, systems approach, population health, heart failure outcomes, sociodemographic risk factors,*

socioecological model, and *statistical analysis* in addition to combinations of these terms using Boolean operators to target relevant articles. Preference was given to peer-reviewed articles published between 2013 and 2018; however, also included is earlier foundational research from 1953, 1993, 1996, 2003, and 2006 for insight into early systems theoretical framework and readmissions. Bibliographies were screened within the research articles to identify additional sources, key words, and relevant concepts. A literature matrix excel spreadsheet was used to document, categorize, and synthesize research articles.

Theoretical Foundation

At the core of systems theory is the system pertaining to how things are connected to each other as parts of a whole (McCovery & Matusitz, 2014; Peters, 2014). The word system is derived from the Greek word *sunistanai*, meaning "to cause to stand together" (Peters, 2014). A system is a whole entity, made up of elements or people that interact, communicate, and act together in some way toward a common purpose (Peters, 2014). Systems thinking evolved from inquiry to practice in the 20th century with origins in various disciplines such as biology, anthropology, psychology, mathematics, computer science, and management (Peters, 2014). Because of the varied origins, systems theory is associated with many scientists like Ludwig von Bertalanffy, who developed general system theory; Hegel, a German philosopher who applied a religious approach to interconnectedness; and Peter Senge, who incorporated systems thinking to the learning organization to reduce fragmentation (McCovery & Matusitz, 2014; Peters, 2014).

Present day health care challenges require a wider, systematic philosophical approach (McCovery & Matusitz, 2014). There have been positive trends in health care including a decline in mortality and increased life expectancy, but this creates additional health-related issues (McCovery & Matusitz, 2014). People are now surviving longer, living with chronic conditions, and entering their senior years with potentially more complex conditions including CHF (Spears, Fetter, Rodgers, & Kay, 2015). The rapidly changing health care landscape requires more effective ways of addressing the combination of complex conditions like CHF, new payment programs, and a growing volume of patients requiring care such as the baby boomer generation. Health care delivery is changing based on early outcome measures for chronic conditions such as CHF; however, the structure of the current health care system will need to continue to evolve to allow for coordination across disciplines spanning both inpatient and outpatient settings while fostering institutional integrity (Spears et al., 2015; Werhane, 2003).

The theoretical framework for this study depicts a convergence of population health, public health, and community health, which are integral to providing long-term care for vulnerable patients in value-based health care (Bresnick, 2017). The setting in which health care professionals intervene is complex because health systems are constantly evolving in response to national health care policies, local sociopolitical environments, and the internal dynamics within health care institutions both private and public (Prashanth et al., 2014). But a systems approach benefits both providers and the recipients of care because people are at the core of healthy systems (Prashanth et al., 2014). Advances in health care have resulted in people living longer with chronic

conditions. This results in clinical outcomes that may be fragmented and variable, which makes it difficult to measure and predict clinical, business-related, and population health-related outcomes (Kaplan et al., 2013; Levenson, 1996).

It is important for organizations to adopt a systems-thinking approach because systems thinking promotes a learning organization whereby colleagues are encouraged to think unconventionally and create innovative ways to adapt to changing internal and external environments (Elder, 2006; Senge, 2006). Unbounded systems thinking augments systems thinking by promoting the use and integration of technical (scientific), organizational (societal), and personal perspectives to implement a new program (Hall, Guo, Davis, & Cegielski, 2005). Similar to how unbounded systems thinking has been extended to create and implement a university admissions process (Hall et al., 2005), I considered unbounded systems thinking to implement BPCI as a new way of addressing the problem of hospital readmissions.

There is a lack of consensus around what theories or frameworks best represent health systems' attempt at implementing population health programs while addressing the risk factors associated with reducing rehospitalization of patients diagnosed with CHF (van Olmen, Marchal, Van Damme, Kegels, & Hill, 2012). Thus, this study contributes to the literature by using two theoretical frameworks as a roadmap in addressing hospital readmissions from a SNF for a health system participating in BPCI (see CMS, 2017a; van Olmen et al., 2012). This study also contributes to the argument that frameworks developed by health systems are products of their time, emerging from specific complex diagnostic populations and public health challenges to meet outcome requirements of

governmental demonstration projects such as BPCI. Frameworks should be purposive, draw from multiple perspectives, and be shaped by the needs of their patients, communities, and multiple stakeholders (Canyon, 2013; van Olmen et al., 2012).

Research has been conducted that addresses the need for organizations to support multiple perspectives during information acquisition, assessment, and diffusion (DeVore, Allen, & Eapen, 2015; Hall et al., 2005). However, less research has been conducted guided by a theoretical framework based on a system design that provides organizational insight into appropriate care design implementation. Despite continuing efforts to close the gaps in care toward reducing hospital readmissions due to CHF, there is a lack of information on the SNF as an integral level of care along the health care continuum (Davore et al., 2015; Hall et al., 2005; Nazir, Dennis, & Unroe, 2015). Hospitals are discharging patients, including CHF patients, earlier than in the past, generally just under 5 days from the date of admission (Novartis, 2018). SNFs are complex adaptive organizations that are challenged with providing effective treatment for complex conditions such as CHF. Discharge to a SNF is common for hospitalized CHF patients. SNFs are now challenged by CMS, accountable care organizations, and private insurers to reduce the LOS of CHF patients, resulting in shorter timeframes at the subacute level of care (Allen et al., 2011).

There is an established body of evidence on the acute level of care, evidence-supported clinical guidelines, importance of multidisciplinary teams during hospitalization, transitioning from hospital to home, patient self-care, and medication compliance (Pressler, 2011; Nazir et al., 2015). However, there is limited information

available on risk factors, interventions, care coordination, and quality improvement efforts among patients with CHF who are discharged from the hospital to the SNF (Driscoll et al., 2016; Nazir et al., 2015).

Congestive Heart Failure

CHF is a progressive, chronic, condition costly to both patients and the health care system (Carpenter et al., 2015). To understand CHF, it is beneficial to begin by understanding how a healthy heart functions (American Heart Association, 2017). A healthy adult heart is approximately the size of an adult fist and functions similar to a pump (American Heart Association, 2017; National Institutes of Health, 2014). Blood is pumped through the chambers in one direction taking deoxygenated blood from various parts of the body, delivering it to the lungs to be oxygenated and then sends blood back out to the body and back to the heart again in approximately one minute at rest (American Heart Association, 2017).

CHF represents heart failure whereby the heart no longer is efficiently pumping blood and oxygen, through vessels, to other parts of the human body (American Heart Association, 2017). Though the term *failure* may suggest that the heart has stopped functioning, it represents a syndrome whereby the heart can no longer pump blood efficiently enough to meet the body's needs (Casey, 2013). CHF is the inability of the heart to maintain adequate circulation of blood and oxygen to meet the metabolic needs of body tissues and organs resulting in abnormal retention of water and sodium (American Heart Association, 2017; Medical Dictionary, 2018). There are a little over 6 million Americans with CHF, and among this population the hospitalization rate is

approximately 18 per 1000 patients over the age of 64 (Mirkin et al., 2017). Much of this condition is precipitated by coronary artery disease and uncontrolled hypertension (Feltner et al., 2014). CHF is a major public health problem and remains a leading cause of hospital readmissions and increased health care costs in the United States (Feltner et al., 2014). This condition affects people of all ages ranging from children to young adults, the middle-aged, and the elderly (Emory, 2018).

Upwards of 1.4 million out of the 6 million already diagnosed with CHF are under age 60 (Emory, 2018). Incidence increases with age and, along with sustained high hospital readmission rates, there are over 700,000 hospital admissions each year. As recently as 2 years ago prevalence was expected to increase 25% by 2030 (Aggarwal & Gupta, 2014; Carpenter et al., 2015; Feltner et al., 2014; Mirkin et al., 2017). This number has now risen to 46% by 2030 based on recent predictions from the American Heart Association (2017) for several reasons. Medical technology and focused cardiac clinical interventions contribute to more people surviving heart attacks, but these patients resume life with the risk of developing CHF. Obesity and diabetes are additional contributors to the rising incidence of CHF in addition to the rising elderly population (American Heart Association, 2017). However, reasons why CHF patients return to the hospital after an initial hospitalization, also referred to as being readmitted, vary within current literature.

Value-Based Programs

The CMS Innovation Center, a creation of the Affordable Care Act, initiated new payment models to transform the way health care is delivered in the United States (Getts

& Strauss, 2017). Some of the more notable models are accountable care organizations, BPCI, and comprehensive joint replacement programs. The goals of these programs are to reduce risk to the payer, CMS, and shift risk to the hospitals, SNFs, primary care physicians, and specialists while improving the quality of care to specific at-risk patient populations experiencing certain conditions (Getts & Strauss, 2017).

Value-based programs provide participating providers incentives to adopt new, more proactive approaches to care coordination (Getts & Strauss, 2017). Value-based programs, such as bundled payment programs, are claims-based initiatives and promote standardization when caring for populations of patients experiencing a particular disease or condition. Rewarding health organizations to find the right or best alternative to hospital readmissions focusing on a single or uniperspective such as acute care or the hospital limits how care is delivered to vulnerable patients (Hall, Levant, & DeFrances, 2012).

Systems thinking is essential to understand, evaluate, and change health care delivery and payment in the United States (Werhane, 2003). Until there is comprehension of systemic interrelationships within and across systems or subsystems, subacute care for CHF at the SNF level cannot be evaluated to begin making changes that are significant to avoid unnecessary hospital readmissions in a value-based world (Werhane, 2003). Using Senge's systems thinking as an overarching background with Mitroff and Linstone's unbounded systems thinking model, subacute care at the SNF level may be better understood and recognized as equally valuable as service delivery methods evolve (Canyon, 2013; Levenson, 1996; Pressler, 2011).

Hospital Readmissions

The topic of hospital readmissions was first documented in medical journals in 1953 when Moya Woodside, a psychiatric social worker in England, examined the outcomes of psychiatric patients in London during post-WWII (Woodside, 1953). A hospital readmission occurs when a patient who has been admitted, treated, and discharged from the hospital is admitted again either to the same or other acute care hospital within a specified period (CMS, 2017a). The time frames most analyzed for research purposes generally focus on 30-, 60-, 90-day, or 1-year readmissions (Aggarwal, 2014; Anderson, 2014; CMS, 2018). The original admission is referred to as the index admission and readmission is being admitted again for the same or other clinical cause (CMS, 2017a). CMS (2017a) further defines a hospital readmission as one in which a patient is admitted to an acute care hospital within 30 days of discharge from the same or another acute care hospital. Hospital readmissions may be analyzed based on specific diagnosis-related groups such as CHF or for any cause also known as all-cause (O'Connor et al., 2016). Publicly available data through Medicare.gov (2018) indicates the national average all-cause readmission rate for a short stay (< 100 days) SNF patient is 22.4%. This quality metric, available to compare SNF performance, includes both 30- and 90-day readmission rates. Regionally, community partner SNFs representing the Northeast averaged an all-cause readmission rate of 22.5%, the Midwest averaged 24.2%, and the Great Lakes SNFs averaged 20.8% compared to the 22.4% national average (Medicare.gov, 2018).

Congestive Heart Failure Readmissions

CHF is responsible for 11 million annual physician visits and accounts for more hospitalizations than all cancers combined (Emory, 2018). Approximately 1 million patients annually, with CHF as the primary diagnosis, experience an initial or index hospitalization and these same patients then remain at high risk for readmissions within 30 days after discharge from the acute level of care (Spears et al., 2015). Feltner et al. (2014) explained that even though survival after CHF diagnosis has improved over time, mortality and readmissions remain high. More than 30 percent of CHF patients die within 1 year of hospitalization and readmissions can range between 30 to 40 percent varying among SNFs (Feltner et al., 2014; Mechanic, 2014). It is not uncommon to see 90-day readmissions for CHF be as high as 50% post discharge from the SNF. This is most likely because patients are being discharged quicker and sicker from both the hospital and then again from the SNF (Qian, Russell, Valiyeva, & Miller, 2011). If close monitoring of any changes in condition are not acted upon, either from the hospital or the SNF, the patient will most likely experience a readmission.

Preventable or avoidable readmissions for CHF are debatable terms lacking a single definition but utilized by payers to control reimbursement (Feltner et al., 2014). The Medicare Payment Advisory Committee has estimated that close to 20% of all Medicare discharges from the hospital result in readmission within 30 days of which CHF is the leading cause (Jencks, Williams, & Coleman, 2009; McIlvennan, Eapen, & Allen, 2015; Sud et al., 2017). Out of this number approximately 12% of the readmissions are considered potentially avoidable (McIlvennan et al., 2015). Avoidable

readmissions have been identified as those readmissions that are clinically related to the prior hospitalization that may have been avoided for such reasons as better clinical management of the CHF patient, more coordinated discharge planning or transitional care, and establishing a safety net to identify disease-specific clinical warning signs earlier (Feltner et al., 2014). Both CMS and private insurers monitor hospital readmissions associated with CHF because of the cost burden (Mirkin et al., 2017). As much as $10 billion per year is spent on caring for CHF patients and readmissions have been identified as the main contributor to this cost (Mirkin et al., 2017). Per patient this equates to an average cost of approximately $13,679 for each readmission (Mirkin et al., 2017).

Past research describes readmissions for CHF from the acute care setting within 30 days post discharge and it has been a long-standing quality metric of CMS (Akande, 2017; Castillo, Edriss, Selvan, & Nugent, 2017; Kurtz et al., 2016). There has been less focus, however, following readmission rates for CHF patients 90 days post discharge from the inpatient hospital stay which includes those patients discharged to a SNF (Feltner et al., 2014; Spears et al., 2015). CMS, through value-based demonstration projects such as BPCI, is now analyzing hospital readmissions up to 90 days because of proposed changes to reimbursement and quality metrics in post-acute care (Galloway et al., 2016). Research into readmissions occurring at the 60- and 90-day timeframes is currently in process and, as in this study, results of analyses considering the lengthier timeframes are expected to be published. Therefore, there is a call for further research into how health care leaders and providers are addressing the risks for CHF readmissions

beyond the hospital stay and up to 2 months post discharge (Britton et al., 2017). Targeting preventable readmissions is an important goal in reducing overall monetary health care costs to society, payers, and individuals, while potentially reducing patient and caregiver burden (Feltner et al., 2014).

Congestive Heart Failure Readmission Risk Factors

Efforts to learn more about the risk factors, discharge status, and related outcomes of the CHF population are needed because hospital readmissions are not only costly but also a burden for patients, families, and society (Allen et al., 2011; Bogaisky & Dezieck, 2015). Previous studies have demonstrated adverse outcomes for CHF patients discharged to SNFs (Pressler, 2011). Research indicates that early identification of risk factors for hospital readmissions from the SNF can provide valuable care recommendations and improved outcomes for CHF patients (CMS, 2017b). Outcome data have been monitored regarding its impact on hospital readmissions for its CHF patient population. The length of follow-up in most studies was approximately 30 days with fewer recent studies addressing 60 and 90 days (Akande, 2017; Anderson, 2014; Kurtz et al., 2016). Perhaps it is because this metric is still in its infancy. As outcomes for CHF patients admitted to a SNF participating in BPCI continue to be evaluated, it is anticipated that the existing gap of knowledge around risk factors will decrease (Nichols, Vose, & Nunley, 2017). Locating literature addressing the 90-day readmission metric from the SNF level of care was limited but Kurtz et al. (2016) and Unroe, Greiner, Colón-Emeric, Peterson, and Curtis (2012) addressed this metric directly.

Kurtz et al. (2016) conducted a study to analyze both 30- and 90- day readmissions after total knee arthroplasty. Although this study focused on total knee arthroplasty and not CHF, its relevancy lies in the focus of hospital and clinical factors influencing 90-day readmissions. Kurtz et al. (2016) recognized that both 30- and 90-day readmission rates are relevant benchmarks used by hospitals and CMS to assess quality of care and costs. Thirty-day readmissions were part of this study because under the provisions of the Affordable Care Act, excess 30-day readmissions for particular orthopedic, respiratory, and cardiac diagnoses will result in financial penalties. The bundled payment system was the main reason Kurtz et al. (2016) included the 90-day readmission variable using claims data. This could be because CMS is still conducting pilot studies with bundle payment programs and SNF-level data is still being processed. Unroe et al. (2012) considered hospital readmissions and mortality within 90 days as the main outcome measure in their retrospective cohort study of 164,672 Medicare beneficiaries discharged to SNFs after hospitalization for heart failure in 2006–2007. The results showed that nearly half of the patients discharged to a SNF were readmitted to a hospital within 90 days after discharge, and 30% died within 90 days. The review of recent, relevant studies considering the factors gender, age, race, SNF location, SNF LOS, and home health use, in terms of risk for hospital readmission associated with this study, are detailed in the following paragraphs.

Gender. Results of studies considering CHF readmission have been mixed with regards to gender. Mirkin et al. (2017) conducted a retrospective cohort analysis of all hospital admissions for patients diagnosed with CHF during 2011 using a statewide

discharge data set from Pennsylvania. With readmission as the dependent variable, they found that out of 155,146 CHF patients, 35,294 (22.8%) were readmitted within 30 days and of those male gender was one of several significant risk factors ($p < 0.001$). Discharge destination of SNF resulted in a significant finding (AOR 1.29, $p < 0.001$) and included male gender as being more likely to be readmitted. However, in another study, Dolansky et al. (2012) found that patients selected for SNF admission after being hospitalized for CHF are more likely to be females with age greater than 80 years. Agrawal et al. (2016) included gender as a demographic variable to analyze 30-day readmissions of patients who experienced acute myocardial infarction. Although discharge destination was not clarified, the analysis of 2,371,867 hospitalizations queried from the Nationwide Inpatient Sample represented 20% of all U.S. hospital data for years 2009 through 2013 and found that the female gender was associated with higher readmission rates compared to their male counterparts. Similar to the findings of Galloway et al. (2016), where hospital readmissions were studied up to 90 days, gender was not a significant factor for patients with CHF where the majority of patients in the study were female (60.1%). Results of studies considering gender as a predictive factor of hospital readmission risk from the SNF continue to be varied.

Age group. Medicare covers individuals age 65 years and older or younger if diagnosed with a disability (U.S. Department of Health and Human Services, 2014). Consistently, increasing age or advanced age is described in research studies as being associated with either primary or secondary diagnosis of CHF (Akande, 2017). Age is implicated in avoidable readmissions and the specific parameter is age 65 years and older

because this age group represents the majority of Medicare fee-for-service patients hospitalized with CHF (Allen et al., 2011). Allen et al. (2011) found advanced age (81 years, $p < 0.001$) to be one of several patient factors associated with rehospitalization from the SNF. Although age alone was not found to be a potential risk factor ($n = 128$), Akande (2017) found that patients with decreased functional status within the 76 to 85 years age category were more likely to be readmitted within 30 days of hospital discharge. Therefore, functional status ($p < 0.0077$) was significantly associated with readmissions as age increased. This could be because the older the CHF patient, the more likely the need for activities of daily living (ADL) assistance and this may be a contributing factor toward hospital readmission (Akande, 2017).

Kurtz et al. (2016) attempted to determine which hospital and patient clinical factors influence 30- and 90-day hospital readmissions after total knee arthroplasty. Although CHF was not the diagnosis studied, categories within the age variable that showed the highest percentage of 30- and 90-day readmissions was the 70-74 age category where 30-day = 26.3% and 90-day = 26.0%. When total knee arthroplasty patients were admitted to a SNF 30-day = 39.7% and 90-day = 42.1%. The study by Mirkin et al. (2017) analyzed 155,146 CHF patients to better understand the risk factors for 30-day hospital readmission. Results indicated that the age category of 76-85 years was more associated with 30-day readmissions from the SNF than the 86+ age category. Berry et al. (2018) studied age trends with regards to all-cause unplanned hospital readmissions across four age ranges but did not focus solely on CHF or the Medicare population. The results of this study showed the odds of readmission for patients aged 65

years and older decreased to 0.78 (0.77 to 0.79) and remained constant with advancing age through 90+ years ranging from 0.67 (0.66 to 0.67) to 0.78 (0.76 to 0.79). Berry et al. (2018) suggested further investigation is warranted to explain the decrease in odds of hospital readmissions for patients aged 64 (0.91) to 65 (0.78) years. It is possible the recent heightened attention and efforts to reduce readmissions for Medicare patients might already be contributing to readmission reductions.

Ottenbacher et al. (2014) included age as one of the socio-demographic predictor variables and defined age, upon rehabilitation admission, within the following categories: less than or equal to 74 years, between 75 and 84, and greater than 85 years. Ottenbacher et al. (2014) referred to age in the results section describing the mean age as 78 (*SD* = 7.3) with no further discussion. From the Dolansky et al. (2012) study, as age increased so did the likelihood that being over 80 was associated with a 5 to 7 times increase in using a SNF for all cardiac events compared to the 65-69 age category. A reasonable expectation might be that, out of a study population of patients aged 65 years and older, being over 80 could be associated with increased hospital readmissions from the SNF (Dolansky et al., 2012).

Race. Mirkin et al. (2017) included race as an additional demographic variable to analyze CHF readmissions and found that black race was a significant risk factor associated with 30-day readmissions. Ottenbacher et al. (2014) highlighted race in their examination of 30-day readmissions from post-acute rehabilitation facilities, within CMS data files, from 2006 to 2011. Specifically, data from the Medicare Provider Analysis and Review, Inpatient Rehabilitation Facility-Patient Assessment Instrument, the Beneficiary

Summary file, and Inpatient Rehabilitation Facility-Rate Settings revealed that rates were highest for non-Hispanic blacks (13.8%; 95% CI, 13.5%, 14.1%). Conversely, Allen et al. (2011) found white race ($p < 0.001$) to be a significant factor associated with hospital readmissions when discharged from hospital to SNF.

Geographic location. Reports highlight the associations of geography with CHF in terms of service utilization, outcomes, number of primary care physicians per population, regional income level and Medicare payment (Cook & Lauer, 2011). Regional factors for both hospitals and SNFs have been analyzed and categorized as urban or rural, by state, region, or median income-to-zip code (Aggarwal & Gupta, 2014; Ottenbacher et al., 2014). Ottenbacher et al. (2014) studied hospital readmission rates across the United States at the state level comparing rural and urban area SNFs. Adjusting for demographics and rehabilitation impairment, readmissions were similar for SNFs categorized as either rural or urban facilities. However, the Ottenbacher et al. (2014) study found patient geographic location varied in terms of lower rates for mid-Northern and Northwestern states ranging from 9.2% (Idaho and Oregon) and higher rates such as 13.6%, in southern and some mid-western states (Michigan).

The nationwide Aggarwal and Gupta (2014) study (n = 2,536,439) considered whether CHF patient residence categorized as either metropolitan or nonmetropolitan and median income for zip codes categorized into four quartiles were associated with 30-day hospital readmissions. The results indicated the first quartile (lowest median incomes) had the highest readmission rate, 10.07%, while the fourth quartile (highest median incomes) had the lowest rate, 8.57%. Elderly female patients, aged 65+, from high

median income and metropolitan areas, with Medicare coverage where CHF was a secondary diagnosis rather than primary diagnosis experienced higher readmissions (12.58%). Aggarwal and Gupta (2014) concluded that strategies to reduce CHF hospital readmissions should include individualized care plans that consider the clinical and contextual factors for more comprehensive care. Implications from the Ottenbacher et al. (2014) study indicate that variation in Medicare spending across geographic locations was attributed to post-acute care which includes SNF care. Addressing readmission rates from hospitals only will not provide a complete a picture. It is important to consider how SNF readmissions impact overall readmissions (Ottenbacher et al., 2014).

The Kurtz et al. (2016) study found patients living in the Western U.S. regions had the lowest readmission rates (4.3%, 30 days; 7.3%, 90 days). The other census regions categorized as Midwest, Northeast, and South regions had 30-day readmission rates between 5.0% and 5.4%, and 90-day readmission rates between 8.5% and 8.9%. Compared to the West region the other geographic census regions were 9% to 12% higher at 30 days and 6% to 11% higher at 90 days. Kurtz et al. (2016) could not determine the reasons for this regional variance compared to the West region.

Zhang and Watanabe-Galloway (2008) suggested that CHF is a condition for which hospital readmissions are avoidable and depend on appropriate post-acute care. Considering that rehospitalization rates for CHF may reflect regional geographic variations in patient care, Zhang and Watanabe-Galloway (2008) analyzed National Hospital Discharge Survey data to examine 10-year trends of CHF hospitalizations and U.S. regional variation. The geographic areas included in the study mirrored the four

U.S. Bureau of the Census regions; Northeast, Midwest, South, and West. The hospitalization rate for CHF patients, aged 65+, from 1995 to 2004 was 214.3 per 10,000 population, varied from year to year, and showed no clear secular trend. CHF hospitalization rates for this elderly group were higher for the Midwest and Northeast regions during all 10 study years. There was a higher concentration of elderly adults in both the Midwest and Northeast regions and this may have contributed to higher hospitalizations in these regions.

Burke et al. (2016) considered a nationally-representative sample of SNF patient rehospitalizations (n = 3,246) and highlighted how regional spending differed for post-acute care across the United States. Patient outcomes varied regionally and, even after adjusting for patient characteristics, 30-day readmissions ranged from 0 to 50% and discharge rates from the SNF ranged from 0 to 84% among various SNF providers. This suggested that care processes differ regionally as well. Criteria for SNF use also appears to vary in different regions of the United States. (Burke et al., 2016). According to Wilson and Brown (2012), public health policy-makers are forgoing national level statistics and are focusing more on regional and local level data to capture contextual factors that provide a more comprehensive analysis of place-based programs and policies. Too wide a geographic focus, such as national data, may result in much of the information being lost and too narrow a focus, such as county or city, may compromise privacy (U.S. Department of Health and Human Services, 2010). The challenge for researchers and policy-makers is to effectively segment the data into geographic areas

and find the right level of granularity in order to answer particular research questions, compare trends, and draw conclusions to inform further study (Duscheid, 2011).

Skilled nursing facility length of stay. The LOS metric has been examined in research studies as a predictor variable of rehospitalization (Whittaker et al., 2015). This metric may reflect the length of time a patient remains in the hospital before being discharged to a lower level of care. LOS can also represent the time between a patient's date of admission to a SNF and date of discharge from the SNF to the next level of care. Few studies have examined SNF LOS prior to hospital readmission. Allen et al. (2011) conducted an observational analysis of Medicare beneficiaries (≥ 65 years of age) participating in the Get With The Guidelines-Heart Failure (GWTG-HF) program. Among the cohort of 15,459 CHF patients, sampled from registry claims data with a median age of 80, the median hospital LOS was five days. Additional patient factors discovered through the Allen et al. (2011) multivariable analysis (n = 5,396) included advanced age (81 years, $p < 0.001$), female gender ($p = 0.007$), and white race ($p < 0.001$). Overall conclusions from the Allen et al. (2011) study indicated that hospital discharges to a SNF occur in approximately 1 in 5 CHF patients. Allen et al. (2011) concluded that the CHF patient population faces a higher risk of death or rehospitalization and the results of their study highlighted the need to further analyze outcomes and care processes within the SNF setting.

Anderson (2014) explored the clinical and diagnostic characteristics of CHF patients from a large hospital system in the mid-Atlantic region of the United States that were readmitted versus not readmitted within 60 days of hospital discharge. The

descriptive, correlational, retrospective review of 134 CHF individuals, aged 50 years or older, resulted in a hospital LOS mean 5.8 $\pm$ 3.2 days that was not correlated with rehospitalization (p = .083).

Both hospital and SNF LOS have been linked to patients with a more complicated clinical picture including CHF and non-CHF patients (Dolansky et al., 2012; Kurtz et al., 2016; Mirkin et al., 2017; Ottenbacher et al., 2014). Although longer SNF LOS may be associated with medically complex patients this variable alone produces inconsistent results when considering how SNF LOS impacts hospital readmissions and whether the rehospitalizations are associated with the initial CHF diagnosis or noncardiovascular characteristics (Manemann et al., 2017). Overall, the mean hospital LOS for CHF-related hospitalizations ranges between 7 and 8 days while SNF LOS averages between 8 and 20 days depending on CHF severity, comorbidities, cognitive impairments, and frailty levels (Kilgore, Patel, Kielhorn, Maya & Sharma, 2017; Resnick, 2015).

Home health care. Home-based care represents all of the services provided in the home to support CHF patients once they are discharged from either the acute care hospital or SNF (Dolansky et al., 2012; Landers et al., 2016). Services range from custodial care, nursing and therapy care, visiting physicians, hospice, and palliative care. Home health care (HHC) refers to the skilled care associated with Medicare provided in the home rather than the SNF. The discharge destination for a CHF patient is determined by the functional status of the patient, availability and commitment of caregivers, and the type of services required (Dolansky et al., 2012). Patients hospitalized with CHF are generally discharged to a SNF due to the complexity of the condition. However, as

hospital LOS continues to decrease the use of HHC services continues to rise. CHF patients that are clinically stable, maintain a certain level of functional ability, and are deemed to have support in the home setting may be discharged home with HHC services (Riggs, Madigan, & Fortinsky, 2011). Readmission rates for CHF patients discharged to home with HHC were found to be lower than those CHF patients discharged to a SNF, 24% versus 27%, respectively (Allen et al., 2011; Nazir & Smucker, 2015). Although not a significant finding (p = .35) there was a difference in 30-day all-cause readmissions between patients discharged from the hospital without HHC who were readmitted versus not readmitted, 20% versus 15%, respectively (Whittaker et al., 2015). A more recent international study, conducted in Israel, revealed that CHF patients (n = 196) who received HHC after discharging from the hospital experienced a 46.3% reduction in rehospitalization compared to six months prior (Punchik et al., 2017).

A workshop conducted in 2014 by the Institute for Medicine and National Research Council with health care leaders and health policy stakeholders developed a framework around what home health care could look like for future post-hospital participants within the continuum of care (Landers et al., 2016). A study by Landers et al. (2016), although skewed toward the insights of government and payers, revealed that bundled payment arrangements will continue but will encompass only a small fraction of Medicare expenditures.

At this time no single payment model is emerging and CMS continues to test various value-based programs through pilot studies. This is expected to be the case for the next 3 to 5 years (Landers et al., 2016). Home health care provides a safety net for

CHF patients discharged from the hospital or SNF to home especially when the upstream provider is attempting to limit the LOS days at the higher level of care. However, when comparing costs, Medicare spends nearly $28,000, on average, for SNF care compared to the $16,755 average cost for home health services (Landers et al., 2016). From a cost perspective, home health services are more economical. From a systems perspective, home health services will be a strategic partner in caring for CHF patients discharged home. Home health agencies will be considered strategic stakeholders and the agencies able to care for complex patients, such as CHF patients, and produce positive outcomes at lower costs will be chosen to join preferred post-acute provider networks (Landers et al., 2016; Phillips & Abrams, 2017). Dolansky et al. (2012) predicted heightened use of HHC within post-acute care for cardiac-related conditions to identify risks for rehospitalization, but their study did not specifically include CHF as a primary cardiac event. The impact on hospital readmissions for CHF patients discharged home with home health services remains unclear.

Review of Research Methods

A variety of literature has been reviewed related to the methodologies investigating hospital readmissions for patients with CHF. Qualitative research addresses outcomes generally at the individual level especially when evaluating the impact of a health promotion program or implementing a prevention program and utilizes interviews or surveys (Nazir et al., 2015). McHugh et al. (2017) utilized a mixed-methods approach when researching how establishing SNF-level preferred provider networks assist hospital administrators to reduce 30-day hospital readmissions from the SNF. Due to the early

stage of BPCI research studies and the fact that outcomes continue to be evaluated even at the time of this writing, it is expected that more methods may be forthcoming. The predominant methodology has been quantitative methods with the dependent variable involving, but not limited to, hospital readmission or rehospitalization.

The quantitative research method most cited to analyze CHF readmissions is logistic regression conducted retrospectively utilizing either CMS claims data, specific databases, electronic medical record chart reviews or records or a combination of these data sources. Anderson (2014) measured 60-day readmissions in patients hospitalized with CHF using a descriptive, correlational, quantitative design. The study sample was derived from the retrospective review of all patients discharged with a primary diagnosis of CHF at two study institutions for two consecutive years. Data collection occurred from January until August 2009. Anderson (2014) utilized the Initiation Management Pre-Discharge Assessment of Carvedilol Heart Failure registry as the source for the collection of cohort data based on a larger study.

In terms of sample size, Anderson (2014) referred to previous studies, not a specific power analysis calculation or program, to justify collecting 134 individual data episodes with a primary diagnosis of CHF to provide 80% power to detect a difference between those CHF patients who experienced 60-day CHF readmission and those who did not, with a small to moderate effect size. Logistic regression analysis was used to predict the probability that a CHF patient discharged with specific risk factors would be readmitted for CHF within 60 days. Anderson (2014) documented limitations that may have contributed to the final outcomes of the study such as adequacy and accuracy of the

data that is documented in medical records, inclusion/exclusion criteria, and small sample size limiting generalizability to larger CHF populations.

Akande (2017) conducted a retrospective chart review ($N = 128$; $p < 0.10$) to examine the patterns and factors associated with 30-day hospital readmissions in SNF patients with heart failure. A power analysis indicated that a sample size of 109 patients was sufficient to achieve .80 power with an alpha of .05 to detect statistically significant results. Akande (2017) oversampled patients to allow for exploratory statistical analysis resulting in 19 additional patients being added to the initial sample of 109 participants. Multiple regression analysis was conducted with eight independent variables that included age, heart failure diagnosis, patients discharged to a SNF, clinical factors and lab results, and the existence of comorbidities. The dependent variables were clinical events of 30-day readmission or emergency department admissions. Analysis included descriptive statistics and univariate analysis using chi-square or Fischer's exact test for categorical variables and the Mann-Whitney test for continuous data that compared patients readmitted within 30 days to those who had not been readmitted for the same time frame. Akande (2017) acknowledged that electronic medical record analysis was limited to being retrospective from a suburban teaching hospital in the Northeast region of the United States limiting generalizability. Outcomes of this study highlighted the importance of including more diverse patient samples to prevent biased findings. Building a more complex multivariate model might have uncovered what predictors influenced hospital readmissions. Akande (2017) admitted there was still no consensus as to which variables predicted CHF readmissions.

Kurtz et al. (2016) utilized the Medicare national hospital claims database to identify 952,593 elderly patients defined as 65 years or older with a primary diagnosis of total hip arthroplasty from 3,848 hospitals between 2010 and 2013. Using a 1-year look-back period to capture factors important for their study, readmission was defined as the appearance of a new hospital claim record for the patient within 30 or 90 days of the patient's discharge date. Those patients who returned to the hospital for rehabilitation only or who were treated for an unrelated condition or complication not associated with the primary total knee arthroplasty hospitalization were not included. A multilevel logistic regression analysis with a clustered data structure was used that defined individual-level factors such as age, gender, comorbidity, and group-level (hospital) factors such as bed size, type of hospital, geographic location (rural/urban) in the same model. The logistic regression approach was utilized to analyze a binary outcome such as readmitted or not readmitted. The "cluster" application referred to grouping the patients based on the hospital that provided treatment. In addition to other factors, Kurtz et al. (2016) included age, gender, race, census region, Medicare buy-in status, and additional comorbidities. Results were considered significant at the $p < .05$ level. The researchers did acknowledge that the study sample size was considerably larger than most other total knee arthroplasty readmission studies and, as a result, most factors, even with only modest association with the outcome, were found to be highly significant. The strength of this study was its generalizability in that it captured outcomes for approximately a million patients. The Kurtz et al. (2016) study paralleled this study in

that it considered the impact of BPCI and how factors may or may not be directly linked with hospital readmission.

Bundled Payment

BPCI was a claims-based, alternative payment model where Model 3 represented retrospective payments to post-acute providers based on patient outcomes over a specified timeframe. Timeframes ranged from 30, 60, or 90 days and were referred to as an episode of care (CMS, 2017a; Getts & Strauss, 2017). SNFs providing subacute care agreed on a set payment fee for the entire care episode. This set fee included costs incurred or saved around avoidable hospital readmissions that occurred throughout the episode (Getts & Strauss, 2017). Early analysis of BPCI outcomes for CHF patients has shown a favorable impact on 30- and 60-day readmission rates, readmission rates during SNF stay, and SNF LOS (Anderson, 2014; Sud et al., 2017). Anderson (2014) reported that index or initial hospitalizations for CHF are markers depicting clinical instability and hospital readmissions are common within this patient population. CHF was a diagnosis included in BPCI because of the clinical challenges and costs associated with this condition.

Although participating SNFs were initially paid via a fee-for-service method, there was a look-back period for all claims occurring during the episode. If expenses exceeded the agreed upon bundle amount then providers paid back the money to Medicare at year end. Money saved, in terms of total cost savings, were shared between SNFs and Medicare (Getts & Strauss, 2017). BPCI was intended to force transitional care interventions through collaboration between case management and other providers,

at the acute, subacute, and home health levels of care to determine an optimal discharge plan and be accountable for both costs and patient outcomes (Feltner et al., 2014; Getts & Strauss, 2017).

Interdisciplinary Team Approach

Interdisciplinary care teams have the potential to significantly influence patient outcomes and enhance team collaboration (Ciemins, Brant, Kersten, Mullette, & Dickerson, 2016). This requires a paradigm shift including mental models supporting and strengthening comprehensive health services and empowering communities toward advocating for the integration of targeted disease programs (Senge, 2006; van Olmen et al., 2012). The interdisciplinary care team approach, that has roots in complexity science, has been established in the literature as a best practice when caring for complex patients with CHF and providing palliative care (Ciemins et al., 2016). Health care transformation efforts, however, create challenging SNF environments for the interdisciplinary care team such as bundled payment requirements, CMS reductions in reimbursement, demand for new technologies through meaningful use, and the increasingly complex aging population (Ciemins et al., 2016). The Ciemins et al. (2016) study confirmed the importance of an interdisciplinary care team approach to address patients experiencing a complex condition such as CHF and organizations as complex systems to provide coordinated care. Fathi et al. (2016) add to prior research around the interdisciplinary care team by emphasizing how care coordination for complex patients can be elevated when the interdisciplinary care team has access to timely patient data at

the time that care is provided. Transitional care has been linked to reducing readmission risk (Nelson & Pulley, 2015).

Transitional Care

Transitions between care settings are vulnerable stages for patients experiencing multiple conditions including CHF (Nelson & Pulley, 2015). During this time patients move from one care setting to another (Albert et al., 2015). Transitional care refers to a collection of interventions aimed at ensuring safe, smooth, and efficient shifts or transitions requiring optimal communication and coordination of services (Albert et al., 2015; Nelson & Pulley, 2015). Interventions designed to prevent hospital readmissions among patients with CHF are referred to as transitional care interventions or transitional care and are multifactorial (Britton et al., 2017; Feltner et al., 2014).

Authors have defined transitional care to include a range of services supporting continuity of care along a care continuum to avoid hospital readmission and poor outcomes while providing safe and timely transfer of patients from one level of care to another or one setting to another for at-risk populations (Britton et al., 2017; Feltner et al., 2014; Naylor, 2015). Britton et al. (2017) found that increasing patient complexity, the ability for hospitals and SNFs to identify subsequent appropriate care settings, increasing financial responsibility, and effective communication to be the main themes associated with provider perceptions on care transitions between hospital and SNF.

Barriers to successful transitions exist because there is no consensus as to when the transition period ends (Feltner et al., 2014; Hirschman, Shaid, McCauley, Pauly, & Naylor, 2015). There are no clear set of instructions or directions around the components

of transitional care interventions that overlap with other forms of care such as population health, community health care, public health interventions, discharge planning, care management, and chronic disease management (Feltner et al., 2014; Nelson & Pulley, 2015). For example, numerous studies suggest that including multiple perspectives strengthens data analysis and fosters cross continuum collaboration (Britton et al., 2017). However, this research has generally excluded one stakeholder or solely focused on another, such as excluding physician involvement, or focusing primarily on emergency department utilization. Also, even though hospital, SNF, and ambulatory providers share many concerns around care transition, the concerns are described through the lens of their respective levels of care or facility type (Britton et al., 2017; Hilligoss & Cohen, 2013; Rattray et al., 2017). An area of concern is that handoffs or, handovers, are not well defined.

Handovers represent an important aspect of communication representing vulnerable informational exchange points crucial to coordination of care (Jusela, Struble, Gallagher, Redman, & Ziemba, 2017). A handover contains essential information such as patient demographics, disease and medication information, plan of care, patient education, and social or environmental barriers to care (Britton et al., 2017; Jusela et al., 2017).

Care Coordination

The continuum of care concept was introduced into health care literature in 1984 as a way to provide care to patients over their lifetime that included clinical, mental, and social services (Evashwick & Aaronson, 2006; Salmond & Echevarria, 2017). Case

management, utilizing a care coordinated approach, has been recognized as an important component in providing proactive, holistic patient care that results in achieving the triple aim-better quality, improved services and reduced cost (Klein, 2017; Salmond & Echevarria, 2017). Care navigators play an instrumental role in transforming care by collaborating with both upstream and downstream providers and the interdisciplinary care team. Care navigators provide transitional care assistance, coordinate continuing care beyond the SNF stay, and utilize a health coaching approach to educate and advocate. They support complex CHF patients that may have multiple chronic illnesses and assist such patients to identify and access support systems that are available from both a health care and social care perspective (Salmond & Echevarria, 2017). Navigators provide patients with appropriate resources to obtain their health goals. Care navigators add value to the resident experience resulting in qualitative and quantifiable impacts. In addition, care navigators contribute to reducing preventable emergency room visits, increasing patient confidence through self-managing care, and lowering the cost of care. Recent key quantifiable impacts are reductions in average LOS, readmission rate during SNF stay, and 90-day readmission rate.

Summary

This chapter described the literature search process and presented a review of the literature on systems approach applied to unbounded systems thinking. Adopting the key constructs of both theories created a more relevant theoretical framework with which to review how skilled or SNF care fills the void that exists to develop a truly integrated delivery system of care for CHF patients within a bundled program. The research

questions and objectives for this study have been developed from exploring the gap in the literature examining a 90-day timeframe for CHF hospital readmissions from the SNF.

To date, research studies have varied in sample sizes, data sources, geographic location, and timeframes post discharge from the acute care hospital when analyzing factors related to rehospitalization. The most common outcome measure was 30-day all-cause hospital readmission (Berry et al., 2018; Burke et al., 2016; Kang, McHugh, Chittams, & Bowles, 2017; Ottenbacher et al., 2014). Two available studies conducted to measure 90-day CHF readmissions lacked clear consensus of the risk factors that play a major role in patient readmission (Jenks et al., 2009; Uthamalingam, Gurm, Daley, Flynn, & Capodilupo, 2011). Gheorghiade et al. (2013) questioned whether the 30-day rehospitalization rate is an ideal metric and recommended it not be the only quality metric. There is inconsistency in the results of the effect that age, gender, race, and hospital LOS have on readmission. The differences in results around age as a predictor appears to be due to the age ranges included in the sample and whether age was analyzed as either a categorical or continuous variable. Hospital readmissions by race, whether all-cause or CHF-related were predominantly higher among the Black population relative to other races. Overall, researchers found value in examining demographic factors in predicting the risk of rehospitalization (Jencks et al., 2009). Hospital LOS was most cited as a risk factor over SNF LOS and as hospital LOS increased so did the risk of hospital readmission in most studies (O'Connor et al., 2016).

As displayed in this chapter, when researchers sought to examine the risk factors for a binary dependent variable such as hospital readmission, a strength of logistic

regression included the ability to incorporate multiple predictor variables into the model. Logistic regression analysis was conducted in several studies included in the literature when the research goal was to predict hospital readmission. The increased reliance on SNFs to provide skilled care for CHF patients unable to be discharged home makes logistic regression a valuable statistical tool to determine whether individual predictor variables may contribute to readmission. SNFs are part of the post-acute provider network and play a major role in contributing to cost savings and improved outcomes within value-based programs.

Since the establishment of BPCI is relatively new, literature around outcomes for elderly CHF patients participating in this program at the SNF level of care is relatively scarce. SNF outcome data is slowly becoming available but is still lacking regarding if there are any risk factors that stand out as key contributors to 90-day hospital readmissions from the SNF within a bundle program. Continued research is needed to determine which risk factors best predict readmission for CHF over a longer period than previously studied (Mirkin et al., 2017). Therefore, to obtain a better understanding of risk factors, a retrospective cohort analysis design of SNF-level data may assist in identifying factors that predict CHF hospital readmissions. Additionally, CHF, as a diagnosis, continues to be piloted in bundled programs for the most vulnerable patients living with CHF. Because CHF is a challenging condition to treat a systems approach will be necessary to determine and address what risk factors have the greatest impact on CHF readmissions.

Chapter 3 discusses the research methodology, including research design, data collection, and analysis of this study. The sources of the data and the research sample are identified in addition to data handling, data analysis approach, and measures undertaken to protect the secondary data set associated with this study. The setting and sample are detailed and both internal and external threats to validity are identified.

Chapter 3: Research Method

Introduction

The purpose of this quantitative, retrospective study was to examine the risk factors associated with hospital readmissions for CHF patients receiving skilled nursing care in a bundled program. This research included characteristics potentially associated with readmission. Using a retrospective cohort design provided a comprehensive examination of possible associations between risk factors as independent variables (gender, age, race, SNF geographic location defined by region, SNF LOS, and HHC use) that may be predictors of hospital readmission. Interpretation of the results also allowed for the identification of any existing patterns.

This chapter includes an overview of the research design and rationale to address the research questions concerning readmission for CHF bundled participants within a 90-day window. A discussion of population selection and sampling procedures is followed by an explanation of the population represented and how the sample was obtained. The data analysis plan is outlined including a description of how each research question was addressed using the variables and quantitative analysis with IBM SPSS Statistics v25 available through Walden University. Threats to internal, external, and construct validity will also be shown based on the variables and how they may have influenced the study. Lastly, there is a discussion of any ethical issues and the methods used to preserve sample integrity.

Research Design and Rationale

Study Variables

Through a retrospective cohort research design, I used relevant data previously collected from a CMS BPCI implementation plan protocol that produced a limited data set. As outlined in Table 1, I analyzed patient-level independent (predictor) variables: gender, age, and race (see Burke et al., 2016; Kurtz et al., 2016). Process or facility-level factors included SNF LOS as a continuous variable, measured as the total length of time, in days, from admission to the SNF to the day of discharge from the SNF (see Mirkin et al., 2017). Discharge destination was included in the model to analyze CHF SNF patients discharged home with or without home health care (see Kurtz et al., 2016; Mirkin et al., 2017). HHC was categorized as *yes* or *no*. The facility-level factor of SNF geographic location, regionally categorized, allowed for analysis of any trends based on SNF location and surrounding communities (Islam, O'Connell, & Lakhan, 2013; U.S. Census Bureau, 2015). For example, if regional SNF location was statistically significant, then further investigation into local socioeconomic data and surrounding area median income levels could be explored in a future study. Based on results, further research into any regional differences between SNFs may be warranted, allowing details to remain internal to the community partner organization. The dependent variable was the 90-day readmission to any acute care hospital. This categorical variable represented whether a readmission occurred within the 90-day episode and was coded as *yes* or *no*.

Table 1

Dataset Variables

Variables	Coding Description	Type
Independent variables (Predictors)	Patient Level	
Gender	Female = 0 Reference Group Male = 1	Categorical
Age	65-69 = 1 70-74 = 2 75-79 = 3 80-84 = 4 85+ = 5 Reference Category	Categorical
Alternative age categories	65-79 = 1 80-89 = 2 90+ = 3 Reference Category	Categorical
Race	Black = 1 Hispanic = 2 Asian = 3 Other/Unknown = 4 White = 5 Reference Category	Categorical
	SNF Level	
SNF LOS	Number of days in SNF	Continuous
Discharge destination	Home w/HHC = 0 Reference Category Home w/out HHC = 1	Categorical
SNF geographic location	Regions: Great Lakes (W.Mich, SEMI) 5 SNFs = Reference Category = 1 Midwest (Indiana) 2 SNFs = 2 Northeast (Connecticut, Maryland) 2 SNFs = 3	Categorical
Dependent variable		
90-day readmission	Readmitted? No = 0 Yes = 1	Binary Categorical

Note: W. Mich= Western Michigan; SEMI = Southeast Michigan

Nine SNFs represented the post-acute network of the community partner as episode initiators participating in the BPCI program. The geographical areas represented in this study were SNFs from the Great Lakes, Midwest, and Northeast regions in the United States and all were in urban areas. Five SNFs were in Michigan, with three in Southeastern Michigan and two in Western Michigan. One SNF was in West Hartford, Connecticut; another SNF was in Burtonsville, Maryland; and the two SNFs in Indiana were in South Bend. All SNFs included in this study were in metropolitan, urban areas close to nearby hospitals. Although five SNFs represented the Great Lakes region, the facilities differed in terms of size and CHF patient volumes. Two of the five SNFs had very low overall volumes compared to the higher volume SNFs. This resulted in regional volumes being relatively equal. The retrospective analysis timeframe for this study closely mirrored the time when the community partner began participating in BPCI Model 3, beginning April 1, 2015, through June 30, 2018, allowing for 90-day follow through ending September 30, 2018.

Study Design

The research design for this study was a quantitative, nonexperimental, retrospective cohort design. Nonexperimental designs with correlational research have been used to explore factors associated with heart failure readmissions and referral patterns in relation to the elderly SNF population (Akande, 2017; Burke et al., 2016; Lau et al., 2014; Li, Cai, Yin, Glance, & Mukamel, 2012). A retrospective cohort design is appropriate when researchers wish to study groups of individuals who share certain characteristics but may vary regarding a certain variable that cannot be manipulated

(National Cancer Institute, n.d.). The participants are then compared regarding an outcome variable. In this study, hospital readmissions of BPCI SNF patients with CHF were not manipulated due to the retrospective design. However, the knowledge gained through this analysis may be used to reduce future avoidable hospital readmissions among this population. Resources, data availability, cost, and time constraints reinforced the appropriateness of this design because this design allowed for the study to be conducted on a smaller scale compared to prospective studies. This design was also less expensive because less time and resources were devoted to collecting or acquiring data compared to primary data collection (Smith et al., 2010). However, there are limitations to retrospective designs. Two of the main drawbacks to retrospective cohort designs are the risk of selection and misclassification or information bias and the inability to manipulate the independent variables ("Prospective vs. Retrospective Studies," n.d.).

In this study, CHF patients were preexisting, as it was not feasible to randomly assign patients to the BPCI program. A retrospective design was also consistent with the amount and scope of data desired to be collected to answer the research questions. Although CMS hospital claims data had provided sample data for similar studies and was initially considered for this study, the claims data that would have been required for this study involved SNF-level data and obtaining claims data was highly restricted at the time of this analysis.

Methodology

Population

The target population consisted of traditional Medicare fee-for-service patients, 65 and above, discharged directly from an acute care hospital to a BPCI participating SNF who had not died during the 90-day episode (Ottenbacher et al., 2014). Medicare enrollees under age 65 identified with or without an anchor diagnosis of heart failure were excluded from the data set. Medicare Advantage enrollees, disabled beneficiaries, or those diagnosed with end-stage renal disease were not part of the sample. The diagnosis of CHF, as an admitting diagnosis, resulted in a patient qualifying for the BPCI Model 3 bundle program. The population examined was CHF patients, having received bundled services, who were either readmitted to any acute care hospital during the 90-day episode or not readmitted for the duration of 90 days. It was estimated that between 200 and 225 CHF patients would be included for this study. Ultimately, 238 CHF episodes were obtained. The data represented CHF patients having been admitted to one of the nine community partner SNFs participating in the BPCI Model 3 program from April 1, 2015, through June 30, 2018.

Sampling and Sampling Procedures

This study included a secondary analysis of existing private, corporate data. The CHF patient population for this study was extracted from a proprietary patient tracking spreadsheet containing various data elements of bundle program enrollees in addition to demographic data elements contained in the electronic medical record. Together these two data sources contained the variables pertinent to this study and a raw data file was

created by me. Care navigator logs also confirmed that the data included in the electronic medical record was accurate and vice versa. The tracking logs contained current, relevant, patient data, in real time. These logs were working documents reflecting multidisciplinary clinician contributions to the care of bundle program enrollees at each of the participating SNFs. Clinical records are preferable to Medicare claims data and when attempting to predict hospital readmissions, claims-based models can be surrogates for medical record models (O'Connor et al., 2016). The tracking logs were technically not part of the patient medical record and were used mainly for communication with care managers, program consultants, and the interdisciplinary care team to plan care coordination activities and to demonstrate documentation of compliance with CMS BPCI program requirements. Active recruiting of participants was not necessary for this research because CMS already established eligibility criteria that essentially included any SNF patients covered by Medicare A and assigned an anchor diagnosis-related group that the SNF had previously committed to being financially responsible for such as CHF.

After community partner and Walden University Institutional Review Board (IRB) approvals were obtained, navigator log data were manually cross-checked and combined with electronic medical record data on an Excel spreadsheet. A new data set was then created. I de-identified the data and this was confirmed by the community partner executive sponsor. I transferred these de-identified data elements into SPSS v25 for analysis.

Inclusion criteria included sample participants who were Medicare beneficiaries, covered under Part A and enrolled in Part B, age 65 years or older, had an anchor

diagnosis of CHF, and were admitted to one of the nine SNFs participating in the BPCI Model 3 program. Exclusion criteria included Medicare enrollees under age 65 identified with or without an anchor diagnosis of CHF. Data were also excluded for beneficiaries who were disabled or had end stage renal disease. Finally, Medicare Advantage enrollees and participants who expired during the 90-day episode of care were also excluded from the dataset.

The analysis was conducted by performing a binary logistic regression. An a priori analysis indicated that a sample size of 97 would be minimally sufficient to achieve 80% power to detect a medium-to-large effect size (*f*) of 0.15 for a regression model with up to six independent variables at an alpha of .05 (Soper, 2018). Warner (2013) suggested that a minimum *N* should include at least 10 times the number of independent variables in the model. For each pair of categorical variables, including the binary dependent variable, there should be minimal cells with expected frequencies fewer than five. It was anticipated that the total sample would contain more than 200 CHF patients having met inclusion criteria resulting in a larger sample size less those who had died to achieve empirical validity. To determine if a risk factor was significant, the alpha level was set at the standard 0.05, two-tailed. Because the goal of BPCI was to reduce hospital readmissions, it was estimated that the total number of participants in the sample who were readmitted would be less than those not readmitted or a 40% to 60% difference, respectively, due to process and coordination improvements. For associations between risk factors and the outcome variable, it is important to be clear that the study is

hypothesis generating, which requires careful interpretations and may require a larger confirmatory study due to sample size (Hackshaw, 2008).

Data Analysis Plan

Data preparation of the raw data file consisted of three main parts: cleaning or scrubbing, creating appropriate variables, and formatting all variables (Martin, 2018). Pre-analysis entailed preliminary data screening including data cleaning, creating necessary dummy variables, and formatting all the categorical variables (Martin, 2018; Warner, 2013). This process also involved ensuring that the variables selected met the basic assumptions for logistic regression analysis. Decisions were made regarding data duplication, missing data, and outliers. Finding and eliminating incorrect values for specific variables and episodes meeting exclusion criteria were removed (Martin, 2018; Warner, 2013). Once processed, the variables were then categorized and recoded, as displayed in Table 1.

The variables of age, gender, race, SNF LOS, SNF geographic location, and HHC were selected because they had been included in the literature as factors associated with hospital readmission. Logistic regression analysis entails five main data assumptions that were required to be met to ensure valid results:

1. The dependent variable, hospital readmission, should be measured on a dichotomous scale and scores are usually coded 1 and 0. For this study hospital readmission was categorically measured as *yes* (1 = readmitted) or *no* (0 = not readmitted; Warner, 2013).

2. One or more independent variables can be either continuous or categorical. The independent variables for this study were categorical except for SNF LOS which was continuous.
3. The study should have independence of observations and the dependent variable should have mutually exclusive and exhaustive categories (Warner, 2013). The dependent variable, hospital readmission, had exclusive and exhaustive categories of readmitted or not readmitted.
4. The model must be correctly specified in that it should contain only relevant predictors but not include those predictors determined to be irrelevant (Warner, 2013). Only relevant predictors, based on the literature, were included in this study.
5. The binomial distribution is the assumed distribution for the conditional mean of the dichotomous outcome (Warner, 2013). The analysis for this study was conducted based upon binomial distribution.

Additionally, binary logistic regression does not require normally distributed scores on the outcome variable, a linear relationship between scores on the categorical outcome variable and continuous predictor variables, or homogeneous variance of the outcome variable across levels of the predictor. Logistic regression requires less restrictive assumptions and it is for this reason that this analysis was considered more appropriate where the outcome variable represented two groups (Warner, 2013). Statistical power in logistic regression depends on many factors including the degree to which assumptions are violated, size of correlation among the predictor variables, and

strength of association between the predictor variables and the binary outcome variable. Therefore, it is challenging to provide more than general recommendations about the sample size required to reach adequate statistical power in logistic regression (Warner, 2013).

Checking for the assumptions in an ordered fashion was important to determine any violations. If not completed in this sequence there would be an increased risk to the validity of the results. Data were then transferred into SPSS v25 for Windows where variable and value labels were created. Descriptive statistics were conducted on the variables. Frequencies and percentages were presented for the categorical data. Mean and standard deviations were presented for the continuous variable. The following research questions were addressed with binary logistic regression for the independent variables (gender, age, race, SNF location, SNF LOS, and HHC) and dependent variable of 90-day hospital readmission:

Research Question 1: How are congestive heart failure skilled nursing facility patients, readmitted within 90 days, different from nonreadmitted congestive heart failure patients in terms of risk factors such as gender, age, race, skilled nursing facility geographic location, length of skilled nursing facility stay, and home health use participating in a bundled, value-based program?

$H_0$1: There is no statistically significant difference between readmitted and nonreadmitted congestive heart failure skilled nursing facility patients, in terms of risk factors, participating in a bundled program.

H_a1: There is a statistically significant difference between readmitted and nonreadmitted congestive heart failure skilled nursing facility patients, in terms of risk factors, participating in a bundled program.

Research Question 2: Among bundled program congestive heart failure patients, to what extent do patient characteristics (gender, age, race) and skilled nursing facility characteristics (skilled nursing facility geographic location, length of skilled nursing facility stay, home health care use) predict 90-day hospital readmissions?

$H_0 2$: Among bundled program congestive heart failure patients, patient characteristics and skilled nursing facility characteristics do not significantly predict 90-day hospital readmissions.

$H_a 2$: Among bundled program congestive heart failure patients, patient characteristics and skilled nursing facility characteristics significantly predict 90-day hospital readmissions.

Threats to Validity

External validity refers to the degree to which the results can be generalized across individuals, settings, and times. Threats to external validity arise when researchers make inaccurate inferences from the sample to other people, settings, and past and future situations (Creswell, 2009; Rudestam & Newton, 2015). To address potential threats to external validity, no generalizations were made outside of the particular sample selected for this study which included Medicare participants age 65 years and older, with an anchor diagnosis of CHF, and admitted to one of the nine SNFs participating in the BPCI Model 3 program. Interaction effects of selection bias were carefully considered. This

study was a retrospective cohort study and considered 90-day readmissions from program inception of April 1, 2015, through June 30, 2018.

Internal Validity

Internal validity refers to the degree that the dependent variable is caused by the independent variable or whether known factors are contributing to the outcome. Creswell (2009) advised that internal validity threats are experiences, treatments, or procedures that threaten one's ability, as the researcher, to make correct inferences from the data about the sample population being studied. This study incorporated a longitudinal design where maturation may have posed a threat to internal validity. It was possible that an increase in 90-day readmissions may have occurred during flu season while a CHF patient was enrolled in the bundle program and this may have resulted in case scores that were extreme resulting in outliers. This potential scenario contributed to the need to conduct further evaluation of the data, determine the accuracy of the data, and decide to either keep or remove extreme scores (Warner, 2013). No scores were deemed outliers. Additional threats to internal validity included omitted variable bias regarding the CHF diagnosis, missing data, and measurement error due to the clinician making random mistakes when inputting data onto the log or into the electronic medical record. Errors in variable biases were reduced by cross-checking log data elements, where feasible, with electronic medical record data.

Construct Validity

Achieving construct validity occurs when researchers use accurate definitions, instruments, and correct measures of the variables (Creswell, 2009). Evidence of

construct validity was supported by well-defined variables. Construct validity may have been threatened due to differing SNF-level practices within a bundle program. One CHF participants' engagement may have differed from another either within the same SNF or compared to another SNF located elsewhere. The flexibility provided to the SNFs by Medicare to participate in this bundle program may have been advantageous in garnering SNF participation, allocating resources to provide the incentivized services for identified CHF patients, and sustainable engagement, however, this posed a threat to the construct validity of this study. As a SNF's ability to operate in a value-based world progresses and as health care systems increase standardization of processes and policies, a more accurate definition of enrollment, engagement, and participation at both the patient and SNF level will be developed. However, at this time when health care systems and their affiliated SNFs are just getting familiar with alternative, value-based payment models, loose definitions posed notable threats to the construct validity of this research.

Ethical Procedures

Protection of Human Subjects Review was undertaken prior to data collection as IRB approval was obtained from both Walden University (approval number 12-24-18-0557792) and the community partner organization (approval number T-R-18-1810). An application to utilize retrospective data was submitted to the community partner IRB with a description of the research project and the data elements to be included in the study. The community partner IRB of record also acts as a privacy board and 18 HIPAA elements were reviewed by this committee. Permission of the community partner was secured to utilize and analyze the secondary data sources such as tracking logs and

electronic medical record demographic data to execute the study. The community partner vice president for clinical quality served as the executive sponsor.

To mitigate the possibility that patient sensitive information may be compromised an attempt was made to determine which record in the data set might be most vulnerable to identification (U.S. Department of Health and Human Services, 2010). In anticipation of this possibility, modifications were made to certain variables, such as categorizing age, race, and SNF geographic location, to minimize risk, protect market reputation of SNFs, and enhance privacy protections for both patients and SNFs. The goal was to balance disclosure risk with data utilization to answer the research questions. Guidelines and techniques to mitigate data exposure risk provided by the U.S. Department of Health and Human Services (2010) were used. Study oversight and final approval was granted by the community partner local IRB of record.

Another potential ethical issue was that the primary researcher works within the corporate office that oversaw the bundle pilot program including the SNFs under consideration. There was no direct contact with CHF patients before, during, or after this study. CHF patient anonymity was protected because once all data elements were aligned with identified CHF participants, I immediately removed individual identifying information, including patient and physician names. The executive sponsor confirmed this to be true. These data and additional log data not part of this study were removed, leaving only demographic, SNF-level, study-specific data elements required for data analysis. The newly created raw data file remained confidential and was accessed with a password in the same way that internal files are accessed and protected under company

policy. Re-identification of CHF episodes with patient information was not necessary. However, the de-identified data file created for this study will be available according to company policy. Password-protected back up data was stored on the community partner hard drive that consisted of nightly backup. Data stored within the community partner-owned, password-protected computer system will be destroyed in compliance with community partner company policy and according to both community partner and Walden IRB requirements.

Summary

This chapter provided an explanation of the methodological foundation of the study, methods utilized in the preanalyzing phase, and how the data was incorporated into the research design. The sources of the data and the research sample were identified in addition to data handling, data analysis approach, and measures undertaken to protect the secondary data set associated with this study. These steps were necessary to establish data appropriate for binary logistic regression analysis. Chapter 4 presents the results of this study.

Chapter 4: Results

Introduction

The purpose of this study was to examine the risk factors associated with hospital readmissions for CHF patients receiving skilled nursing care in a bundled program and to identify characteristics associated with readmission. Hospital readmission, within 90 days, was the primary outcome of interest (dependent variable) and risk factors (independent variables) included gender, age, race, SNF geographic location defined by region, SNF LOS, and HHC. In the previous chapter, a presentation of the methods, patient data privacy protections, and procedures for data collection and analysis were discussed. This chapter is focused on the research questions and hypotheses, results of the data analysis, and presentation of the findings that answered the research questions.

Research Questions and Hypotheses

Research Question 1: How are congestive heart failure skilled nursing facility patients, readmitted within 90 days, different from nonreadmitted congestive heart failure patients in terms of risk factors such as gender, age, race, skilled nursing facility geographic location, length of skilled nursing facility stay, and home health use participating in a bundled, value-based program?

$H_0$1: There is no statistically significant difference between readmitted and nonreadmitted congestive heart failure skilled nursing facility patients, in terms of risk factors, participating in a bundled program.

H_a1: There is a statistically significant difference between readmitted and nonreadmitted congestive heart failure skilled nursing facility patients, in terms of risk factors, participating in a bundled program.

Research Question 2: Among bundled program congestive heart failure patients, to what extent do patient characteristics (gender, age, race) and skilled nursing facility characteristics (skilled nursing facility geographic location, length of skilled nursing facility stay, home health care use) predict 90-day hospital readmissions?

$H_0 2$: Among bundled program congestive heart failure patients, patient characteristics and skilled nursing facility characteristics do not significantly predict 90-day hospital readmissions.

$H_a 2$: Among bundled program congestive heart failure patients, patient characteristics and skilled nursing facility characteristics significantly predict 90-day hospital readmissions.

Data Collection and Analysis

Retrospective data were collected from care navigator logs and the electronic medical record after receiving IRB approval from both the community partner and Walden University. There were no modifications to data collection methods from the original study design plan. Per inclusion criteria, BPCI Model 3 episodes representing a resident diagnosed with CHF admitted to one of the identified SNFs were extracted from the care navigator logs. The navigator logs provided four variables: SNF LOS, SNF location, HHC use, and whether the patient was readmitted. Electronic medical record face sheets associated with identified CHF patients were then accessed providing three

variables: gender, age, and race. These data were transferred to a Microsoft Excel spreadsheet file and patient names were removed. The de-identified data were then transcribed into an Excel file, coded, scrubbed for outliers or missing data, and then imported into SPSS v25 for data preparation and analysis.

Sample Characteristics and Demographics

The final study sample consisted of 238 unduplicated CHF patients admitted to one of nine SNFs between April 1, 2015, and June 30, 2018. Descriptive statistics of the sample are presented in Table 2 for the categorical variables and metric (continuous) variable, SNF LOS, respectively. Of the total sample ($N = 238$), there were 154 (64.7%) females and 84 (35.3%) males. The age variable initially consisted of five categories. There were 13 (5.5%) patients in the 65-69 age range, 17 (7.1%) in the 70-74 age category, 21 (8.8%) in the 75-79 category, 42 (17.6%) in the 80-84, and 145 (60.9%) in the 85 and above age category. To reduce the possibility of unreliable standard error used to compute statistical significance, the age category was reduced to three categories: 65-79 range ($n = 52$, 21.8%), 80-89 range ($n = 90$, 37.8%), and 90+ age range ($n = 96$, 40.3%). The alternative age categories were included in the final model.

The race variable initially consisted of five categories. However, there were no Other/Unknown patients in this category, and this category was removed from the sample. Among the remaining race categories, there were 21 (8.8%) Black, six (2.5%) Hispanic, three (1.3%) Asian, and 208 (87.4%) White patients. The dichotomous home health category was split between patients discharged from the SNF with home health 119 (50%) and those that were discharged home without home health 119 (50%).

Among the three SNF regions, there were 118 (49.6%) episodes from the Great Lakes region, 62 (26.1%) from the Midwest, and 58 (24.4%) from the Northeast. The minimum number of days for the continuous variable, SNF LOS, was 1 day, while the maximum was 101 days. The mean was 27 days with a standard deviation of 19.6 days and median of 22 days.

Overall, several sample characteristics for this study mirrored previous studies. For instance, the White race category outnumbered other race categories by more than half (Dolansky et al., 2012). Additionally, nursing homes are historically populated by residents aged 80 years and above (Dolansky et al., 2012; Mirkin et al., 2017; Ottenbacher et al., 2014). More females tend to reside in SNFs versus males (Dolansky et al., 2012; Ottenbacher et al., 2014). Length of SNF stay mean was within range compared to other studies at 27 days (*SD* = 20; Kilgore et al., 2017; Resnick, 2015).

Table 2

Descriptive Statistics

Variables ($N = 238$)	*n*	%	Cumulative percent
Categorical			
Gender			
Female	154	64.7	64.7
Male	84	35.3	100.0
Age			
65–69	13	5.5	5.5
70–74	17	7.1	12.6
75–79	21	8.8	21.4
80–84	42	17.6	39.1
85+	145	60.9	100.0
Alternative Age Categories			
65–79	52	21.8	21.8
80–89	90	37.8	59.6
90+	96	40.3	100.0
Race			
Black	21	8.8	8.8
Hispanic	6	2.5	11.3
Asian	3	1.3	12.6
White	208	87.4	100.0
Home Health (HHC)			
Discharge home with HHC	119	50	50
Discharge home without HHC	119	50	100.0
SNF Region			
Great Lakes	118	49.6	49.6
Midwest	62	26.1	75.6
Northeast	58	24.4	100.0

Continuous				
SNF LOS	Min	Max	*M*	*SD*
	1	101	27.11	19.6

Note. *M* = Mean, *SD* = Standard Deviation

Testing Statistical Assumptions

The assumptions of a binary logistic regression model include the following:

1. The outcome variable is dichotomous usually coded 0 and 1.
2. Scores on the outcome variable must be statistically independent of each other.
3. The model must be correctly specified using only the relevant predictor variables.
4. The categories on the outcome variable are assumed to be exhaustive and mutually exclusive. (Warner, 2013)

The four main data assumptions of logistic regression analysis were met by the design of the study to ensure valid results, and the data were deemed satisfactory and without any irregularities or outliers (Warner, 2013). Because of disagreements around the necessity to screen for multicollinearity in binary logistic regression (Lund, 2017; Warner, 2013), collinearity statistics were also conducted (see Appendix A) even though there are times when researchers may ignore multicollinearity when indicator (dummy) variables are categorical variables with three or more categories (Allison, 2012). Tolerance is the variance of a predictor not explained by the other predictor variables. Variance inflation factor is the ratio of variance in a model with multiple terms, divided by the variance of a model with one term alone and quantifies the severity of multicollinearity (Warner, 2013). SPSS Help documentation suggests to inspect if the variance inflation factor is greater than 3. Table A1 (see Appendix A) shows that all variance inflation factor values were fewer than 3. Therefore, multicollinearity was not an issue with the predictors.

Binary Logistic Regression Analysis Results

There were three objectives of the binary logistic regression analysis based on the hypotheses: (a) to determine the differences between CHF SNF patients readmitted and not readmitted, (b) to determine which independent predictor variables were significant and had an effect on the dependent criterion variable, readmission, and (c) determine whether the binary logistic regression model predicted the binary dependent criterion variable of readmission. Baseline characteristics of the study cohort, frequencies of patient factors and the associations with 90-day readmission, including the first part of the output produced by SPSS v25 are presented in Table 3. Of the 238 patients, 99 (41.6%) experienced a hospital readmission, and 139 (58.4%) did not within 90 days of SNF admission. The base model, also known as the null model, representing the null hypothesis is presented in Table 4. The output for the null model is the regression model developed without any of the independent predictor variables. Predictions in this null model are based on which category occurred most often in the data, the not readmitted category. Given the base rates of the two outcomes, (99/238) 41.6% were readmitted and (139/238) = 58% were not readmitted. Using this model, a prediction could be made that for every 90-day episode a SNF patient with CHF, would not be readmitted. Using this strategy, researchers would be correct 58% of the time.

Table 3

Frequencies and Associations Between Readmission and No Readmission

Variable	*n* = 238	Readmission	No Readmission	*p* value
Total, *n* (%)		99 (41.6)	139 (58.4)	
Age (years), *n* (%)				0.388
65-79	52 (21.8)	25 (25.2)	26 (18.7)	
80-89	90 (37.8)	37 (37.3)	54 (38.8)	
90+	96 (40.3)	37 (38.6)	59 (42.4)	
Race, *n* (%)				0.352
Black	21(8.8)	12 (57.1)	9 (42.9)	
Hispanic	6 (2.5)	1 (16.7)	5 (83.3)	
Asian	3 (1.3)	2 (66.7)	1 (33.3)	
White	208 (87.3)	84 (40.4)	124 (59.6)	
SNF Region, *n* (%)				0.548
Great Lakes	118 (49.6)	48 (40.7)	70 (59.3)	
Midwest	62 (26.1)	24 (38.7)	38 (61.3)	
Northeast	58 (24.4)	27 (46.6)	31 (53.4)	
Home Health, *n* (%)				0.144
D/C home w/ HHC	119 (50)	45 (37.8)	74 (62.2)	
D/C home w/out HHC	119 (50)	54 (45.4)	65 (54.6)	
Gender, *n* (%)				0.995
Female	154 (64.7)	64 (41.6)	90 (58.4)	
Male	84 (35.3)	35 (41.7)	49 (58.3)	
SNF LOS (Days)	27.1 ± 19.6	27.1 ± 20.6	27 ± 19.0	0.802
Median (Days)	22	21	23	

Note. SNF LOS: mean and standard deviation.

Statistically significant if $p < .05$.

Table 4

Base (Null) Model Comparison

Observed Readmission	Predicted Readmission		
	No	Yes	Percentage Correct
No	139	0	100
Yes	99	0	0
Overall Percentage			58.4

Note. Overall accuracy = 58.4%

The variable in the equation (see Appendix A, Table A2) for the constant only model showed that the constant was included in the model. The variables that were not included are listed in Table 5. A direct logistic enters all predictors whether significant or not as presented in Table 6. Using the direct enter method for this regression analysis was driven by the design of this study expected to predict the dichotomous dependent variable of no readmission = 0 or readmission = 1. Therefore, all the predictors in Table 5 were entered on the first step.

Table 5

Variables not Included in Base (Null) Model Regression Output

	Score	df	*p*
Gender	0.000	1	0.987
Age	1.975	2	0.373
65-79	1.934	1	0.164
80-89	0.152	1	0.679
Race	3.427	3	0.330
Black	1.173	1	0.279
Hispanic	1.575	1	0.210
Asian	0.786	1	0.375
SNF LOS	0.000	1	0.996
HHC (Yes)	1.672	1	0.196
Region	0.840	2	0.657
Midwest	0.288	1	0.592
Northeast	0.775	1	0.379
Overall	8.307	10	0.599

Note. Statistically significant if $p < .05$.

The omnibus chi-square test, as shown in Appendix A (Table A3), was not significant $\chi^2(10, N = 238) = 8.520$, $p = 0.578$, indicating that the predictor model was not statistically significantly better than the constant only or null model. The Nagelkerke *R*-squared test indicated the amount of variation in the dependent variable explained by the model (Nagelkerke's $R^2 = 0.047$). Therefore, the full model explained 4.7% of what was observed in the outcome variable and the strength of the association between predictors and outcome was relatively weak (see Warner, 2013). Although not a large pseudo R^2, there was some predictive ability of the full model (Warner, 2013). An additional overall

goodness-of-fit measure, the Hosmer-Lemeshow goodness-of-fit procedure tested model fit to the data. A large chi-square for this test indicates a poor model fit. A nonsignificant result ($p > .05$) indicates there is not a poor model fit. Generally, researchers hope to obtain a small chi-square and a corresponding p value larger than .05 (Warner, 2013). The Hosmer-Lemeshow test (see Appendix A, Table A4) was nonsignificant, $p = .994$. This result indicated the model was not a poor fit to the data. The Hosmer-Lemeshow procedure relies on a test of significance. With smaller sample sizes such as this, $N = 238$, it may not be significant even with a poor fit.

Table 6 presents the full model classification table. This full model included all predictor variables. The classification table demonstrates sensitivity of prediction to correctly classify 19% of the patients where the predicted event, readmission, was observed. This table also shows the specificity of prediction to correctly classify 91% of the CHF patients where no readmissions occurred. Note that by adding all the predictors the overall accuracy or hit rate improved to 60.9% compared to 58.4%. This was not a huge overall improvement. Focusing on error rates from the classification table, a false positive would be predicting that readmission would occur when, in fact, it did not. The full model predicted a readmission 32 times. That prediction was wrong 13 times producing a false positive rate of 13/32 = 41%. A false negative would predict that the readmission would not occur when, in fact, it did occur. This model predicted a nonreadmission 206 times. That prediction was wrong 80 times for a false negative rate of 80/206 = 39%.

Table 6

Full Model Classification

Observed Readmission	Predicted Readmission		
	No	Yes	Percentage Correct
No	126	13	90.6
Yes	80	19	19.2
Overall Percentage			60.9

Note. Overall accuracy = 60.9%.

Table 7 presents the results to answering the research questions about the association of each of the predictors with readmission. The results of the logistic regression analysis show that the variables of age, gender, race, SNF LOS, HHC use, and SNF location were not statistically significant. This result confirmed that these risk factors were not significantly associated with 90-day readmission.

Table 7

Binary Logistic Regression Output

						95% CI for *OR*	
	β	*SE* β	Wald $\chi 2$	*p*	*OR*	Lower	Upper
Gender M	0.002	0.285	0.000	0.995	1.002	0.574	1.750
Age			1.891	0.388			
65-79	0.466	0.363	1.642	0.200	1.593	0.782	3.246
80-89	0.027	0.309	0.008	0.930	1.027	0.561	1.882
Race			3.270	0.352			
Black	0.340	0.472	0.520	0.471	1.405	0.557	3.546
Hispanic	-1.562	1.122	1.940	0.164	0.210	0.023	1.889
Asian	1.155	1.286	0.807	0.369	3.174	0.255	39.460
SNF LOS	0.002	0.007	0.063	0.802	1.002	0.988	1.016
With Home Health	-0.426	0.292	2.135	0.144	0.653	0.369	1.156
Region			1.201	0.548			
Midwest	-0.350	0.358	0.956	0.328	0.704	0.349	1.422
Northeast	0.016	0.362	0.002	0.964	1.016	0.500	2.066
Constant	-0.218	0.372	0.343	0.558	0.804		

Note. β = unstandardized regression weight, *SE* β = variation of the unstandardized regression weight, Wald $\chi 2$ = test statistic for individual predictor variables, *OR* = odds ratio, also measurement of association, CI = confidence interval for odds ratio (*OR*). Statistical significance at $p < .05$.

The final piece of output is the classification plot, Appendix B. The plot provides a useful visual guide of the classification table. The display shows how accurate the full model was by displaying how many times the model predicted a readmission outcome (R) based on the calculated probability when, in fact, the outcome for the CHF patient was no readmission (N). If the model demonstrated predictive ability, it should have

presented observations towards the left and right ends of the graph. The classification plot shows most cases to be in the middle and does not predict very well.

Study Findings Related to Research Questions/Hypotheses

This retrospective quantitative cohort study allowed the researcher to answer two research questions by examining associations between six independent predictor variables and one binary outcome or criterion variable for this particular sample.

Research Question 1: How are congestive heart failure skilled nursing facility patients, readmitted within 90 days, different from nonreadmitted congestive heart failure patients in terms of risk factors such as gender, age, race, skilled nursing facility geographic location, length of skilled nursing facility stay, and home health use participating in a bundled, value-based program?

$H_0$1: There is no statistically significant difference between readmitted and nonreadmitted congestive heart failure skilled nursing facility patients, in terms of risk factors, participating in a bundled program.

H_a1: There is a statistically significant difference between readmitted and nonreadmitted congestive heart failure skilled nursing facility patients, in terms of risk factors, participating in a bundled program.

The full model correctly classified 60.9% of the CHF episodes. The full model was not statistically significant. Because the *p* values were greater than the selected alpha level of 0.05, the null hypothesis was not rejected. Therefore, no statistically significant difference existed, between readmitted and nonreadmitted CHF SNF patients

in terms of the risk factors, participating in a bundled program for this particular population.

Research Question 2: Among bundled program congestive heart failure patients, to what extent do patient characteristics (gender, age, race) and skilled nursing facility characteristics (skilled nursing facility geographic location, length of skilled nursing facility stay, home health care use) predict 90-day hospital readmissions?

$H_0$2: Among bundled program congestive heart failure patients, patient characteristics and skilled nursing facility characteristics do not significantly predict 90-day hospital readmissions.

H_a2: Among bundled program congestive heart failure patients, patient characteristics and skilled nursing facility characteristics significantly predict 90-day hospital readmissions.

The full model correctly classified 60.9% of the CHF episodes. The patient and SNF characteristics were found not to be statistically significant predictors of readmission for this population. Because the *p* value was greater than the selected alpha level of 0.05, the null hypothesis was not rejected. Therefore, among bundled program CHF patients, patient characteristics and SNF characteristics did not predict 90-day hospital readmissions.

Summary

This chapter focused on the results of the data analyzed, by presenting the findings to address the research questions and hypotheses. The purpose of the analysis was to examine the risk factors associated with hospital readmissions for CHF patients

receiving skilled nursing care in a bundled program and to identify any patient or facility characteristics that might be associated with readmission from the SNF. A binary logistic regression analysis was conducted to test the hypotheses. Based on the results, the null hypotheses for both research questions were not rejected. The following chapter will include a discussion based on the interpretation of the findings, study limitations and strengths, public health practice and clinical implications, and recommendations for future research and social change.

Chapter 5: Discussion, Recommendations, Conclusion

Introduction

The purpose of this study was to examine the risk factors associated with hospital readmissions for CHF patients receiving skilled nursing care in a bundled program and to identify characteristics associated with readmission. Hospital readmission, within 90 days, was the primary outcome of interest (dependent variable), and risk factors (independent variables) included gender, age, race, SNF geographic location defined by region, SNF LOS, and HHC use. The ability to determine what risk factors impact hospital readmissions for SNF patients diagnosed with CHF continues to be important because avoidable readmissions are a burden to this patient population, their families, the health care system, and public health (Whittaker et al., 2015). Key findings indicated there was not a statistically significant relationship between the risk factors of this study and hospital readmission from the SNF. This chapter includes an interpretation of the findings identified in Chapter 4, connects the findings back to the literature contained in Chapter 2, includes study limitations, provides recommendations for further research, and concludes with a discussion of implications for professional practice and positive social change.

Interpretation of the Findings

Data related to 90-day readmissions from the SNF within a bundled program remains limited; therefore, no literature has explicitly addressed this relationship. This study was designed to explore the patient, facility, and SNF location related risk factors associated with 90-day readmissions among CHF patients enrolled in a bundled program.

Numerous studies have identified patient and process factors associated with hospital readmissions some focusing on either the all-cause or condition-specific 30-day metric; however, relatively few have included examination of 90-day readmissions and fewer have indicated consistent predictors of rehospitalization of CHF patients from the SNF. The findings from this retrospective analysis of CHF SNF patient care navigator logs and electronic medical record data suggest that identifying factors associated with CHF SNF patients from both the readmitted and nonreadmitted groups are the first step in assisting care providers and health systems in developing plans to reduce hospital readmission. Of the 238 episodes present in this study, 99 (41.6%) were readmitted, and 139 (58.5%) were not readmitted to the hospital from the SNF. Although none of the risk factors were found to be statistically significant, and the strengths of the relationships were weak, trends emerged from the results that are worth noting and may inform future research.

Findings to Literature

The findings of this study suggest that the bundled program was associated with reduction in rehospitalization for CHF SNF patients from performance year 2015 through 2018 with some predictability. The binary logistic regression failed to show significance for all the risk factors in relation to the readmission outcome variable. In the following subsections, findings are broken down by variables comparing results within the framework of existing literature.

Congestive Heart Failure Readmissions

As shown in the literature review, findings from past studies on the relationship between risk factors and CHF readmissions have been inconsistent. CHF readmission

findings, reaching almost 42% in this study, affirmed what Qian et al. (2011) found in that readmissions for CHF can reach upwards of 50%. Several researchers have also noted how CHF readmissions have been increasingly recognized as a complex phenomenon, the cause of which is not limited to physiological or demographic variables (Feltner et al., 2014; Hughes & Witham, 2018; Mechanic, 2014; Mirkin et al., 2017). More recent literature suggests that CHF readmissions from the SNF requires additional investigation into causes relying on a combination of qualitative and quantitative methods to address hospital readmissions and pinpoint individual patient factors (Heckman, McKelvie, & Rockwood, 2018; Ouslander et al., 2016; Retrum et al., 2013). To support this suggestion, Hughes and Witham (2018) found that although CHF diagnosis was the biggest factor for hospital readmission, additional diagnoses such as delirium, dementia, frailty, respiratory disease, and complications of heart failure syndrome may influence readmissions. Clinical, psychosocial, and socioeconomic factors may also play a role in hospital readmissions beyond the CHF index diagnosis. In addition, similar to this study, risk prevention models to predict future readmissions have been found to perform poorly (Hughes & Witham, 2018). Therefore, reducing readmissions in this patient group will remain challenging.

Gender as a risk factor. The relationship between gender and CHF readmissions has been documented in the literature but the results vary. Although gender was not significant in this study, females outnumbered males by almost 50%. Both genders were readmitted by approximately 41%. The literature has shown a trend toward males being more likely to be readmitted within 30 days. For example, Mirkin et al.

(2017) found the male gender to be a significant factor. However, other studies examining gender have indicated nonsignificant results (Galloway et al., 2016; Whittaker et al., 2015). Therefore, as found in this study, gender is an unlikely predictor.

Age group as a risk factor. Previous research has indicated significant and nonsignificant results for age as a risk factor. Mirkin et al. (2017) considered a sample population of 40,383 hospital patients discharged to a SNF and found the overall age category to be significant ($p < 0.001$) with most readmissions occurring within the 76-85 age range. Hughes and Witham (2018) also found the mean age of 82 years to be a significant risk factor in predicting 30- and 180-day hospital readmissions from an inpatient rehabilitation facility based on a sample of 3,984. Dolansky et al. (2012) also found that being over age 80 with CHF increased SNF use, but this population was least likely to enter cardiac outpatient rehabilitation. The increasing age coupled with limited rehab opportunities put this population at greater risk of rehospitalization from the SNF. However, Whittaker et al. (2015) examined age as a categorical variable with eight age levels and found the overall age category to be nonsignificant. The overall age category in this study was also not statistically significant. However, the 80-89 and 90+ age categories were similarly populated in terms of SNF use and number of readmissions.

Age-related changes to the vascular and cardiac structure and function also impact heart failure risk as the disease progresses through a common pathway in this population, though the pathophysiology varies on an individual level among CHF elderly patients (Heckman et al., 2018). Therefore, clinical decision-making requires a more

comprehensive understanding of the overall vulnerability at the patient level with system level support (Heckman et al., 2018).

Race as a risk factor. Results of this study differed from other studies in that race was not a significant predictor of hospital readmissions from the SNF (Allen et al., 2011; Mirkin et al., 2017; Ottenbacher et al., 2014; Whittaker et al., 2015). However, this study mirrored the findings from Thomeer, Mudrazija, and Angel (2014), who found that compared to non-Hispanic White and Black adults, Hispanic nursing home use is relatively low, and they concluded that nursing home use is underused for certain racial and ethnic minorities. This might indicate how preferences for post-acute care varies among racial groups because of differences in cultural and socioeconomic factors. Race as a risk factor for CHF readmissions from the SNF remains varied.

Geographic location as a risk factor. CHF patient readmissions from the SNF were lower in all three regional categories compared to their nonreadmitted counterparts. The Great Lakes region contained the most patient episodes (n = 118) readmitted but also had the highest nonreadmitted CHF patients (n = 70) compared to those who were readmitted (n = 48). The Northeast region showed the most readmissions at 46.6% compared to the Midwest (38.7%) and Great Lakes (40.7%) regions. Zhang and Watanabe-Galloway (2008) had similar findings relating to higher hospitalization rates for this population for Midwest and Northeast regions. The challenge for researchers and policy-makers is to appropriately segment the geographic data to the level of granularity that answers the research questions (Duscheid, 2011). Though SNF region was a

nonsignificant risk factor, this study addressed protecting SNF identification and thus can report trends.

Length of stay as a risk factor. The association of SNF LOS with hospital readmission was nonsignificant. This relationship has been less explored in past literature, as researchers tend to study hospital LOS in relation to the discharge of a hospital patient within 30 days (Burke, 2016; Ottenbacher et al., 2014). According to Whittaker et al. (2015), few studies have found this variable statistically significant. This study supports Anderson's (2014) conclusion that hospital LOS was not statistically associated with hospital readmission. However, both studies relied on small sample sizes ($n = 238$, $p = 0.802$ and $n = 134$, $p = 0.083$, respectively).

Home health care use as a risk factor. The number of SNF CHF patients discharged home with HHC equaled those discharged home without HHC ($n = 119$, 50%). However, those not readmitted ($n = 74$, 62.2%), outnumbered those readmitted ($n = 45$, 37.8%) when patients were discharged home with HHC services. HHC services were linked to higher numbers of patients not being readmitted as in Whittaker et al.'s (2015) study, which was nonsignificant ($p = 0.35$) as it was in this study ($p = 0.42$). CHF patients discharged home from the SNF should receive some form of follow-up services to ensure CHF management continues post discharge. Services may include face-to-face nurse visits or telemonitoring. Timely communication between patient and provider, self-care support, and the ability to detect any changes in condition may prevent a hospital readmission (Heckman et al., 2018; Ong et al., 2016). Post-discharge follow up from the SNF has the potential to improve the effectiveness of care transitions and the

patient's ability to manage the disease process. Such interventions may depend on how they are integrated and adhered to in practice and do not always result in statistically significant outcomes (Agboola et al., 2015; Ong et al., 2016).

Findings Related to Theory

SNFs are downstream providers to acute care hospitals that are generally part of a larger overall health system unless they are standalone facilities. The bundle program was a claims-based payment program to test an alternative payment model as part of the federal health system's care delivery reform toward value-based care (Landers et al., 2016). Bundling continues to represent a small fraction of overall Medicare expenditures and this is expected to continue for the next several years. Payment and care delivery reform will continue shifting financial responsibility, based on outcomes, toward physician groups, hospitals, SNFs, and home health agencies raising the responsibility of each level of care to extend beyond its parameters (Landers et al., 2016).

Peter Senge's systems theory has extended to the health care industry because health care organizations are composed of health care professionals from many disciplines interacting as interdisciplinary team members to provide safe, efficient, cost effective, consistent care (Ratnapalan & Uleryk, 2014). Bundling, accountable care organizations, and Medicare Advantage plans are expected to continue to gain momentum but will require constant evaluation. Although health care organizations should apply a system-level approach to provide support toward multidisciplinary care, the most important aspect of CHF management resides in patient-provider communication and timely, coordinated care transitions at the patient level. Therefore,

systems theory was a suitable theoretical framework to examine the risk factors from a system-level perspective. However, in terms of the research questions from this study, researchers should consider applying systems theory incorporating all levels of the socioeconomic model. Systems theory allows researchers to determine how a change in one component within the system influences changes in other components within the system. Pinpointing the factors that impact SNF-level readmissions requires drawing in patient-level care and life goals in addition to SNF staff input.

In summary, based on the results of the binary logistic regression analysis, both null hypotheses were not rejected indicating there was no statistically significant relationship between the risk factors of age, race, gender, SNF location, SNF LOS, HHC use, and hospital readmission. However, there was value in the findings. There were volume and frequency differences among the predictor variables and between patients readmitted and not readmitted. In this study, these differences did not translate into statistical significance. Results showed there was not sufficient evidence to support the alternative hypotheses that there was a relationship between the at least one of the risk factors and readmissions for this sample.

Limitations of the Study

Apart from its retrospective nature, this study had a number of other limitations. This was a relatively small and focused sample, specific to the bundle program, in relation to the total health system SNF population and this reduces generalizability. The study sites were all urban SNFs which could limit generalizability. Although the results of this study mirrored many others contained within current literature, this study did not

consider all community partner SNFs, additional race categories, other forms of cardiac illness or comorbidities, and these limitations could have had an impact on the external validity making the overall results less reproducible.

The categorical nature of the variables, except for metric variable SNF LOS, reduced granularity and undoubtedly small effects would not have been detected. The age categories were compressed in the final analysis to adjust for the small number of observations in the lower age levels. The distribution of participants within variable categories remained uneven, may have resulted in biased findings, and decreased the ability to estimate effect size (Hackshaw, 2008). The quantitative method limited the ability to reveal details among the SNF staff and SNF patient population.

I relied on a secondary data set raising the question of accuracy. In addition, the information contained within the care logs and SNF electronic medical record may have been inaccurate. This study did not include any measure of CHF disease severity as all three CHF diagnosis levels or diagnosis-related groups were included. Due to the complex nature of CHF, the existence of unmeasured confounding from comorbidities cannot be ruled out. Lastly, in terms of study timeframe, the population studied did not extend beyond September 30, 2018. Doing so may have allowed for more episodes and strengthened the power for the 90-day readmission outcome.

Recommendations

I recommend a few changes for future studies. First, conducting a similar study using a mixed-methods approach may reveal additional information beyond secondary data sources such as tracking logs, electronic medical records, registries, and

administrative claims. The quantitative method utilized for this study did not allow for exploration of SNF staff or CHF SNF patient viewpoints. A mixed-methods study may reveal the nuances around readmissions. Data, research, and theory triangulation may provide additional information allowing generalizations of the sample and the results along with the ability to learn different perspectives from all participants (Turner, Cardinal, & Burton, 2015).

Second, although there were no statistically significant findings from this research study, it provides a foundation from which future research designs could expand public health scientific evidence incorporating population health that includes patient-identified and staff-identified factors related to readmission. Person-centered care requires health systems to be dynamic and flexible in order to make the necessary organizational improvements toward improving care delivery through fiscal and human resource stewardship.

Third, this study focused on specific SNFs within one division of a nationwide organization that participated in a bundled program. It would also be interesting to evaluate the effectiveness of a variety of SNFs participating in an alternative payment model and compare them with SNFs not participating in an alternative payment model. A way to expand this study would be to examine the discharge disposition of SNF patients and determine a SNF's ability to assess and identify high-risk patients. SNF process factors are important as a measure of efficiency. However, if SNF patients are not able to manage their chronic conditions after being discharged from the SNF, the health system will continue to incur additional readmission costs. Lastly, consideration

of all-cause SNF readmissions for an entire cardiac disease category rather than restricting examination to a single cardiac condition, such as CHF, would allow a more in-depth analysis and larger sample size.

Implications

The health care industry landscape continues to shift from volume to value-based care emphasizing the importance of collaboration among all levels within the health care system to identify high-risk patients and deliver appropriate cost-effective care. Alternative payment models will drive these value-based programs. There are implications to both public health practice and positive social change.

Professional Practice

The results of this study, in addition to the results of many others cited throughout this research project, indicate that older CHF SNF patients face higher risk for hospital readmission from the SNF. Perhaps higher levels of comorbidities within this SNF population was the reason. It is also possible that CHF disease severity or the severity of other specific comorbidities in SNF residing patients may affect the ability to estimate the association between specific risk factors and hospital readmission. This hypothesis was not tested through this study.

The advanced age of study participants indicated that there remains a need to determine which predictors of readmission may be significantly associated with readmission among elderly cardiac patients, which matters because geriatric-related syndromes and comorbidities affect the older CHF patient and place this cohort at risk of rehospitalization. The frail elderly CHF patient faces continuing disability, mobility

impairment, and cognitive decline as the condition progresses. The push from CMS to lower SNF LOS results in many older CHF patients and their families having to make decisions about post-discharge services or transitioning to the long-term care area of the nursing home if one cannot be cared for within the home setting. Health care system support to care for the older CHF patient coupled with multidisciplinary input has the potential to allow SNF staff to provide the individualized care required for this population. The goal of public health should be to improve the overall health of this cohort through geriatric skills training among SNF clinical staff. This could then be scaled to the general Medicare, Medicare Advantage, and Medicaid populations. Developing and increasing SNF clinical and social work capabilities to fully integrate and coordinate care will create higher quality care toward improved population health and, ultimately, public health.

Positive Social Change

This study reinforced the fact that addressing the medical, social, and economic concerns of the CHF SNF patient allows SNF staff to address patient preferences and goals of care. This is a population health imperative of this quickly aging cohort because CMS continues the shift from siloed to coordinated, value-based care and the SNF industry is rapidly changing. To study and pinpoint potential risk factors for rehospitalization of CHF SNF patients, health systems must move toward a shared medical record to better document and communicate causes of readmission as policy and reimbursement changes continue to evolve. This technology is a crucial investment for health care systems because the aging CHF SNF cohort experiences multiple transitions

moving through acute, subacute, rehabilitation, home care, hospice, specialist, and primary care levels. Improving outcomes for this population requires greater system-level technical and clinical integration and capacity building across the care continuum.

Conclusion

Consistent with this study, optimal CHF care for the SNF patient requires collaboration with multiple stakeholders. This includes the patients themselves, their families or caregivers, health care providers, other health care professionals, and policy-makers along the continuum of care. There is an urgent need for health care systems to become more integrated to provide coordinated care to wider populations of patients to achieve true health care transformation.

Overall, this study addressed an important gap in the literature, by examining SNF-level CHF patient hospital readmissions, within a bundled program, through a growing but still less explored systems theory lens. One of the greatest health care challenges facing this country and the world is ensuring that the aging CHF population, as well as other elderly people with serious chronic conditions, is treated with respect, dignity, and in a manner that meets their care preferences.

In the United States, the elderly are not a burden on our health care system but how we care for them will determine the financial health of the overall health care system because of the implications for both Medicare and Medicaid costs. Therefore, in closing, health care systems and the individuals within them must continue to innovate and provide the CHF population with the right care at the right time with efficiency and cost effectiveness.

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Appendix A: Collinearity Statistics and Additional Output

Table A1

Collinearity Statistics

Coefficients Model	Tolerance	VIF
Gender	.980	1.021
Age	.938	1.066
Race	.921	1.085
SNFLOS	.953	1.049
HomeHealth	.905	1.106
Region	.843	1.186
Readmission	.976	1.024

Note. VIF = Variance inflation factor.

Table A2

Base (Null) Model Regression Output – Variable in the Equation

	B	*SE*	Wald	*p*	*OR*
Constant	-0.339	0.132	6.659	0.010*	0.712

Note. * $p < .05$.

Table A3

Omnibus Tests of Model Coefficients Full Model

	Chi-square	df	*p*
Step	8.520	10	0.578
Block	8.520	10	0.578
Model	8.520	10	0.578

Note. A significant result, $p < .05$, indicates if the set of predictors improves the full model.

Table A4

Hosmer-Lemeshow Test Full Model

Chi-square	df	*p*
1.442	8	0.994

Note. A nonsignificant result, $p > .05$, indicates not a poor fit.

Appendix B: Classification Plot

```
                Step number: 1

             Observed Groups and Predicted Probabilities

      40 +                                                                                                    +
         I                                   R                                                                I
         I                                   R                                                                I
F        I                                   R                                                                I
R     30 +                                   R                                                                +
E        I                                   R                                                                I
Q        I                                   N                                                                I
U        I                                   N         R                                                      I
E     20 +                                 R N         R                                                      +
N        I                                 R N R       R                                                      I
C        I                                 R N R       N                                                      I
Y        I                                 N N N  R  R N  R                                                   I
      10 +                                 N N N  R  R NR R                                                   +
         I                            R    N N N  R RR NN N R                                                 I
         I                           RR   NNRNNN  N RN NN N NR                          R                     I
         I           N          N   NNN N NNNNNNR NRNN NNNNRNN RR    R                 RR  RR                 I
Predicted ---------+---------+---------+---------+---------+---------+---------+---------+---------+----------|
  Prob:   0        .1        .2        .3        .4        .5        .6        .7        .8        .9         1
  Group:  NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRR

          Predicted Probability is of Membership for Readmitted
          The Cut Value is .50
          Symbols: N - No Readmission
                   R - Readmitted
          Each Symbol Represents 2.5 Cases.
```