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The Relationship between Discharge Clinical Characteristics and Readmission in Patients Hospitalized with Heart Failure

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The relationship between discharge clinical characteristics and readmission in patients hospitalized with heart failure

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Heart failure is a clinical syndrome that incurs a high prevalence, mortality, morbidity and economic burden in our society. Patients with heart failure may experience hospitalization due to an acute exacerbation of their condition. Recurrent hospitalizations soon after discharge are an unfortunate occurrence in this patient population. This study explores the clinical characteristics of respiratory status, volume status and functional status at hospital discharge and the correlations of these characteristics to 60-day heart failure readmissions.

The study is a descriptive, correlational, quantitative study utilizing a retrospective review of 134 medical records of individuals discharged with a primary diagnosis of heart failure from January 2006 through December 2007. Records were reviewed for socio-demographic characteristics, health histories, clinical assessment findings, diagnostic information, and nursing sensitive indicators. The determination of nursing sensitive indicators is based upon literature review and theoretical considerations regarding the key factors related to readmission. Significant predictors of 60-day heart failure readmissions were dyspnea ($\beta = .579$), crackles ($\beta = 1.688$) and assistance with activities of daily living ($\beta = 2.328$), independent of age and gender. By using hierarchical logistical regression a model was derived which demonstrated the ability to correctly classify 77.4% of the cohort; 78.2% of those who did have a readmission

(sensitivity of the prediction) and 76.7% of the subjects where the predicted event, readmission, did not occur (specificity of the prediction).

Hospitalizations for heart failure are markers of clinical instability. Future events after hospitalization are common in this patient population and this study provides a novel understanding of clinical characteristics at the time of discharge that are associated with future outcomes, specifically 60-day heart failure readmissions. This study adds to our understanding of the contribution nursing sensitive indicators make to the risk of readmission in patients admitted to the acute care setting with a primary discharge diagnosis of heart failure. A consideration of these characteristics provides an additional perspective to guide clinical decision making and the evaluation of discharge readiness. Along with determining readiness for discharge, an appreciation of clinical discharge factors provides a representation of clinical stability which has implications for post-hospitalization care and monitoring.

This dissertation by Kelley M. Anderson fulfills the dissertation requirement for the doctoral degree in philosophy approved by Nalini N. Jairath, RN, PhD, as Director and by Mary A. Paterson, RN, PhD, and Teresa Walsh, RN, PhD as Readers.

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DEDICATION

This dissertation is dedicated to my family, my husband, Michael R. Anderson, my daughter, Ellyse M. Anderson, my father, Robert F. McKeta, my mother Hideko McKeta, and my sisters Pamela M. McKeta and Mia M. French.

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CHAPTER I

The Problem

Heart failure is a chronic, clinical syndrome that is associated with significant mortality, morbidity and health care costs. Frequently patients with heart failure experience hospitalizations due to an acute exacerbation of the disorder. Re-hospitalizations after discharge from an acute exacerbation of heart failure are common in this patient population. There is limited research on clinical characteristics at the time of discharge and the correlations of these characteristics to readmissions. The purpose of this study is to explore the relationship of respiratory, volume and functional status in heart failure patients at the time of discharge and the association of these indicators with 60-day re-hospitalizations.

This chapter describes the incidence and prevalence of heart failure, including the burdens of heart failure, detailing mortality and morbidity. A notable morbidity associated with heart failure is hospitalizations and predictors from prior studies are reviewed. There are few predictors based on discharge characteristics and characteristics at the end of hospitalization may be critical for determining post-discharge outcomes, including re-hospitalizations. Prior studies have explained that clinical judgment in the evaluation of hospitalized heart failure patients at discharge is challenging. Key factors of the comprehensive guidelines from the Heart Failure of Society of America (HFSA) are explained in regards to inpatient treatment guidelines and discharge criteria (2006). The HFSA guidelines provide a framework for the derivation of the main factors under study

in this research, encompassing respiratory, volume and functional status. The hypotheses, theoretical framework and significance of the study are clarified.

Incidence and Prevalence

Heart failure is associated with considerable incidence and prevalence. The American Heart Association Statistics Committee (AHA, 2007) estimates 5,200,000 individuals in the United States currently have the diagnosis of heart failure. Further, the prevalence and incidence of heart failure is projected to increase over the next decade (The American College of Cardiology and American Heart Association [ACC/AHA], 2005). On the basis of a 44-year long longitudinal investigation, the National Heart, Lung and Blood Institute, in association with the Framingham Heart Study, detail that the incidence of heart failure approaches 10 per 1000 individuals greater than 65 years of age (AHA, 2007). Heart failure is common in the elderly and represents the most frequent Medicare hospital discharge diagnosis (ACC/AHA, 2005).

Data from the Framingham Heart Study provides us with a unique understanding of the possibility of developing heart failure and the pervasiveness of heart failure in our society. Lloyd-Jones et al. (2002) analyzed 8229 individuals enrolled in the Framingham cohort from 1971 to 1996 to evaluate the lifetime risk of experiencing heart failure. The idea of lifetime risk allows an evaluation of an individual's likelihood of developing heart failure during the remainder of his or her life. The lifetime risk for the development of heart failure is one in five, or 20%, for men and women over the age of 40 years.

The Burden of Heart Failure

Mortality

Heart failure is characterized by a high mortality. The National Heart, Lung and Blood Institute conducted a longitudinal study and estimates 80% of men and 70% of women with heart failure under the age of 65 will die within 8 years (AHA, 2007). Overall, the one year mortality rate is estimated at 20% (AHA, 2007). In the period from 1994 to 2004 the overall U. S. death rate declined by 2%, but deaths attributable to heart failure increased by 28% (AHA, 2007).

Financial

The financial burden for the care and treatment of individuals with heart failure is substantial. In the United States, the direct and indirect costs for heart failure care for 2007 was estimated at $33.2 billion (AHA, 2007). More Medicare dollars are spent on the diagnosis and treatment of heart failure than on any other diagnosis (ACC/AHA, 2005). In 2001, a heart failure hospitalization of a Medicare fee-for-service beneficiary was averaged at $5,928 per discharge (Medicare Quality Monitoring System [MQMS], 2008).

Hospitalizations

In addition to the high rates of mortality and the economic impact of heart failure, the morbidity of living with this chronic condition is significant. The morbidity of heart failure is associated with hospitalizations for inpatient acute care therapy. The number of

hospital discharges for heart failure increased 175% between 1979 and 2004 with a rise from 399,000 to 1,099,000 discharges annually (AHA, 2007).

A report from the Medicare Quality Monitoring System (MQMS, 2008) 1992-2001, describes the heart failure hospitalization rate from 1992-2001 ranged from 20.6-21.8 per 1000 beneficiaries. The Healthy People 2010 document, describes goals for heart failure admission rates. The actual Medicare fee-for-service beneficiaries 2001 discharge rate for heart failure per 1000 individuals compared to the Healthy People 2010 Goals reveals a striking difference. In individuals between the ages of 65-74 the Medicare rate was 27 per 1000, with a goal of 6.5; age 75-84 the Medicare rate was 55, with a goal of 13.5 and at age 85+ the rate was 132 per 1000 individuals with a Healthy People 2010 goal of 26.5. In addition to a higher rate of hospitalizations than the Healthy People 2010 goals, 30-day and one-year readmissions increased during this time period. The report indicates that the 30-day readmission rate increased by 6% and the 30-day and one year readmission rate for individuals readmitted for heart failure was 9% and 38%, respectively. The 30-day and one year readmission rate for all cause readmissions after an initial hospitalization for heart failure was 25% and 74%, respectively.

Hospitalizations and recurrent hospitalizations are problematic in patients with heart failure. Hamner and Ellison (2005) evaluated 557 heart failure patients for six months after hospitalization and reported a 40% readmission rate. Similarly, Logeart et al. (2004) reported readmission or death rates of 40% in 114 patients, with these events occurring within six months of discharge. Krumholz et al. (2002) noted a 44% rate of

readmission within six months of discharge in the 88 patients in their study and Chin and Goldman (1997) described a 32% incidence of death or hospital readmission within 60 days of discharge in a study of 257 patients.

Consistently, the reported rates of readmission are high and there is an indication that these readmissions occur soon after discharge. “Research demonstrates that older adults with heart failure have the highest hospital readmission rates, ranging from 29% to 47% of all hospitalized adult patient groups, primarily in the first few weeks after discharge” (Sethares & Elliott, 2004). Hoskins and Duffy (2005) conducted a study involving the home health care of 42 heart failure patients. In those individuals who were readmitted to the hospital, the readmissions occurred early in the home period, reporting close to a 50% incidence within the first two weeks and 86% within the first 30 days of discharge (Hoskins & Duffy, 2005).

Predictors of Hospitalizations

Researchers have explored factors from the outpatient setting that predict heart failure hospitalizations. Opasich et al. (2001) prospectively evaluated 2,701 outpatients enrolled in the registry of the Italian Network on Congestive Heart Failure (IN-CHF). This study demonstrates that previous hospitalization, duration of symptoms, ischemic etiology, atrial fibrillation, higher NYHA class, higher heart rate and lower systolic blood pressure were independently, and statistically significantly, associated with heart failure destabilization (Opasich et al., 2001). Fifty-seven percent of the patients with worsening heart failure required hospitalization.

Hamner and Ellison (2005) performed a retrospective review of 557 patients to compare variables associated with readmission in six months (40%) with individuals who did not experience readmission (60%). The variables independently associated with readmission were lack of cardiology consultation during admission, living with family, admission from the emergency department, Medicare and pulmonary hypertension (Hamner & Ellison, 2005).

Krumholz et al. (2000) evaluated Medicare records of 2,176 individuals (1,129 in a derivation cohort and 1,047 in a validation cohort) on patient and clinical factors. Thirty-two factors were entered into the model and four factors were significantly related to readmission, these characteristics included hospitalization in the previous year, prior heart failure, diabetes and elevated creatinine at discharge.

Kasper et al. (2002) conducted a randomized trial of 200 patients to determine the efficacy of multidisciplinary care in patients with heart failure. The endpoints in this study were death or heart failure hospital admission during the six-month study period. In the analysis of data two predictors were independently associated with the primary end points, there predictors were diabetes and ischemic origin for heart failure (Kasper et al., 2002).

Many causes of hospitalization are related to altered adherence to therapeutic treatment regimens, which may be related to lack of knowledge, inability or personal choice. Hospitalizations and heart failure decompensation have been attributed to patients failing to adhere to prescribed therapy and salt indiscretion (Evangelista et al., 2003). As

described, there are several known predictors of re-hospitalizations in several studies; some of the factors are similar, while others differ. Although these predictors of hospitalizations have been explored through previous studies, readmissions for heart failure continue and our understanding of this phenomena in incomplete. Prior studies have focused upon outpatient characteristics and factors during hospitalization as determinants for readmissions, fewer studies have explored the discharge period and the impact of this period of time with subsequent heart failure readmissions.

Discharge Predictors

A recent study focused on the evaluation of factors at the time of discharge to predict re-hospitalizations in patients with heart failure (Howie-Esquivel & Dracup, 2007). These researchers evaluated 72 participants within 48 hours of discharge to determine whether demographic, clinical or psychological variables predicted an increased risk of hospitalization. Female gender, ethnicity, pulmonary disease and symptom stability were correlated with an increased risk of rehospitalization within 90 days of discharge.

Moser, Doering and Chung (2005) described potentially modifiable risk factors of 202 heart failure patients after discharge from hospitalization. Patients were assessed in their home setting 3-7 days after discharge. There was evidence of functional impairment, altered symptoms, psychological risk factors, altered quality of life and poor adherence among the individuals studied. These authors suggest that judgments regarding clinical

stability and ability to assume care post-discharge may not be accurate for many patients and is related to re-hospitalizations (Moser, Doering, & Chung, 2005).

The prior research provides us with guidance regarding predictors for hospitalizations. However, no compelling, consistent or dependable indicators for re-hospitalization are prominent. There is a consensus regarding the difficulty of providing proper assessments in heart failure patients at the point of discharge and the implications of discharge evaluations.

Discharge Evaluation

A component of care not well defined in individuals admitted with an exacerbation of heart failure is the evaluation of patients at the end of hospitalization with criteria for discharge. There are a variety of management options in the care of heart failure patients who are admitted in the acute care setting due to decompensation of their condition. After interventions are provided and stability is obtained, the overarching goal is to discharge individuals in a timely manner. Decisions regarding clinical stability and discharge timing, however, is dependent on clinical judgment. In clinical practice, knowledge of when to discharge a patient after hospitalization for acute decompensation is challenging.

Logeart et al. (2004) underscored the importance of the discharge evaluation in regards to how patients will do after they return home. In this study, discharge was decided by two cardiologists based on clinical examination, biological tests, electrocardiograms, chest radiographs and when the patients had no signs of

decompensation, stable blood pressure, stable renal function and optimal angiotensin-converting enzyme inhibitors and diuretic dosages (Logeart et al., 2004). The patients were judged to be stable at discharge although 15% were readmitted or died in the first month and more than 40% after six months. “In practice it is difficult to evaluate, using clinical criteria, the stability of such weakened and sometimes bedridden patients after several days of aggressive treatment…many CHF patients are discharged without sufficient circulatory stabilization, despite the clinician’s impression to the contrary” (Logeart et al., 2004, p.639).

In the 2006 Comprehensive Heart Failure Practice Guidelines, The Heart Failure Society of America provided recommendations regarding treatment goals and discharge criteria for patients admitted for acute decompensated heart failure. The guidelines are based upon previously published research, with the research classified in three levels: A, B and C. Level A evidence is defined as randomized, controlled, clinical trials; Level B evidence is defined as cohort and case-control studies. The recommendations regarding treatment goals and discharge criteria are Level C guidelines, which are defined as expert opinion. “The need to formulate recommendations based on level C evidence is driven primarily by a paucity of scientific evidence in many areas critical to a comprehensive guideline” (HFSA, 2006, p. e5). Thus, further research in this area is necessary to provide empirically valid practice recommendations, because there is currently a lack of evidence-based criteria to assist with these decisions. Although these components of the guidelines are helpful, there is a lack of guidance on what these recommendations

translate to in a clinical manner. Unfortunately, the guidelines do not provide us with clear, clinically applicable interventions or assessment findings to assist in the determination of discharge appropriateness. There is also uncertainty in regards to the ability of the guidelines to translate into positive outcomes post-hospitalization, including the reduction of hospitalizations for heart failure after discharge.

This study focuses upon several aspects of the guidelines. In the guidelines, there are several treatment goals for patients who are admitted with heart failure decompensation. The first treatment goal is to improve symptoms (respiratory status), especially congestion and low-output symptoms (HFSA, 2006). A second treatment goal is to optimize volume status (volume status). Discharge criteria are also described, including recommendations relevant to all patients with the diagnosis of heart failure. Two of the discharge criteria that are recommended for all heart failure patients include that exacerbating factors are addressed (respiratory status) and a near optimal volume status achieved (volume status). For patient with advanced heart failure or recurrent admissions for heart failure, discharge criteria include ambulation before discharge to assess functional capacity after therapy (functional status).

Respiratory Status

In the HFSA guidelines regarding the care of patients hospitalized for heart failure, the first treatment goal is to improve symptoms. Researchers have evaluated the characteristics of heart failure patients who present to the emergency department. Dyspnea was determined to be a classic symptom upon presentation in the emergency

department (Welsh et al., 2002). Dyspnea is defined as the unpleasant sensation of difficult or labored breathing (Doran, 2003). Dyspnea is a "term used to characterize a subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity" (Meek et al., 1999).

Parshall et al. (2001) conducted a study to explore heart failure patients who presented to the emergency department and to evaluate dyspnea duration, distress and intensity. A total of 57 patients were interviewed retrospectively (Parshall et al., 2001). Dyspnea was the most frequent and distressing symptom and resulted in the primary reason for the emergency department visits in 70% of patients. Of those who presented to the emergency department, 88% of patients were admitted and experienced a median length of stay of three days. Dyspnea duration prior to presentation to the emergency department was unrelated to admission. Two-thirds of patients had marked worsening of dyspnea intensity and distress in the prior three days before the emergency department visit. The remaining patients had uniformly severe dyspnea for a week prior to admission.

The majority of patients with heart failure who are admitted to acute care facilities initially present to the emergency department for care, once a patient presents to the emergency department, hospitalization is common. The Acute Decompensated Heart Failure Registry (ADHERE) described that 77% (n=65,180) of patients who were admitted for acute episodes of heart failure initially presented to the emergency department (Fonarow, 2003). The majority of patients who require hospitalization for heart failure have an alteration in their respiratory status. In this registry, the majority of

patients (89%) presented with the symptom of dyspnea and 36% experienced dyspnea with rest on admission. Fatigue was present in 33% of patients; however, dyspnea is clearly the primary factor for seeking care by patients and for hospital admission by health care providers. In the ADHERE registry, the clinical outcome of symptom status was evaluated at the time of discharge (Fonarow, 2003). At discharge 50% of patients were considered asymptomatic, 38% were deemed improved but still symptomatic and less than 1% was considered worse or did not change. An additional 11% of the patients did not have the symptom status reported. The reason for the high rate of non-report was not addressed. Nevertheless, it is apparent that many patients continued to have symptoms at the time of discharge and these symptoms are respiratory in nature. Currently, it is unknown how these persistent respiratory symptoms impact future re-hospitalizations.

The evaluation of symptoms at the time of discharge is suggested as an important criterion for determining discharge readiness for individuals admitted with heart failure. Stevenson (2004) describes criteria for hospital discharge in the management of patients admitted with acute decompensated heart failure. These criteria include that patients “should be free of dyspnea… while at rest, washing, and walking…” (Mann, 2004; Stevenson, 2004). A component of this study is to determine the relationship of clinical symptoms, which are generally manifestations of respiratory status at the time of discharge and the correlation of these factors to post-discharge 60-day re-hospitalizations.

Volume Status

In the HFSA (2006) comprehensive guidelines, recommendations are made regarding volume status in the treatment of patients hospitalized for heart failure and the discharge criteria. Treatment guidelines include the recommendation to optimize volume status. One of the guidelines for discharge criteria, for all patients hospitalized for heart failure, is to achieve near optimal volume status.

Fluid overload and signs of congestion are hallmark clinical features in heart failure decompensation. Clinicians have attempted to quantify congestion through a variety of scales and tools. Lucas et al. (2000) evaluated 146 patients four to six weeks after hospital discharge for heart failure exacerbation. During this outpatient visit, patients were evaluated for congestion with the use of five criteria. The Criteria for Congestion encompasses indicators of volume overload: orthopnea, jugular venous distention, a gain of greater than or equal to two pounds in the previous week, edema and the need to increase diuretic dosing at a visit (Lucas et al., 2000). If an indicator is present, the patient receives a value of one and if the indicator is not present, the value is zero. The scores are summed with a score of zero equal to no congestion, score of one to two equal to mild congestion and a score of three to five equal to major congestion. Freedom from congestion was associated with an 87% two-year survival, compared with 67% in those with mild congestion and 41% in patients with major congestion.

Patients who are admitted for heart failure decompensation are often prescribed diuretics and are monitored for fluid status through measurements of input and output

records and daily weights. As the patient is prepared for discharge, the evaluation of volume status is an essential component in determining if the patient has achieved a euvolemic state. The evaluation of volume status is an important clinical indicator to determine discharge readiness and timing, however, this is challenging. The guidelines from the Heart Failure Society of America highlight this difficulty. “Clinical experience suggests it may be difficult to identify persistent congestion. In contrast, even modest relief of congestion may be associated with substantial improvement in dyspnea and sense of well being in many patients despite ongoing volume overload, which may result in premature discharge” (HFSA, 2006). An additional component of this study is to determine the relationship of the clinical indicators of volume status at the time of discharge and the correlation of these factors to post-discharge 60-day re-hospitalizations.

Functional Status

An additional discharge recommendation from the HFSA (2006) guidelines is to ambulate the patient before discharge to assess functional capacity after therapy. Functional capacity or functional status has become a valuable patient outcome because it describes characteristics regarding the patient’s day to day functioning and has a relationship with quality of life (Doran, 2003). Functional status is generally viewed as a multidimensional concept that includes physical, psychological, cognitive and social components. However, in the specific guidelines of the HFSA, functional capacity is defined in terms of ambulation. Ambulation can be assessed with a variety of methods; but specific criteria for ambulation prior to discharge are not addressed.

Patients who present with an exacerbation of heart failure are typically dyspneic and fatigued on presentation. Prior to seeking care, patients will often limit their physical activity in order to compensate for their worsening clinical status. When an admission to the acute care facility is deemed appropriate, the patient is often significantly symptomatic. Due to the patient's status and the nature of acute care facilities, the patient's activity level may be limited during the inpatient stay.

In previous studies that provide treatment recommendations, the suggestion is that activity should be restricted (Ashton et al., 1994). These recommendations suggest that during the acute phase of care, patients should decrease their activity levels. As patients rest and recover during their hospitalization, they do not perform activities equivalent to what may be required in the home setting. In assessing heart failure patients for discharge readiness, the evaluation of clinical status is often determined after several days of activity restrictions and a sedentary state.

Clinical judgment is used to determine discharge timing; however clinical improvement may precede a euvolemic state and may be falsely determined after several days of sedentary activities. Assessing an individual's functional capacity at discharge may be imperative for the accurate evaluation of discharge timing. Currently, there is a lack of research with regard to the evaluation of functional capacity at the time of discharge and the impact this factor may have on the re-hospitalization of individuals with heart failure.

Nursing Sensitive Indicators

The evaluation of respiratory, volume and functional status are clinical conditions that nurses and nurse practitioners are educated and qualified to evaluate. Nursing-sensitive indicators reflect the structure, process and outcomes of nursing care….Patient outcomes that are determined to be nursing sensitive are those that improve if there is a greater quantity or quality of nursing care…" (American Nurses Association [ANA], 2008). If a link can be made between these nurse-sensitive indicators and re-hospitalizations, clinicians can use these factors to guide clinical decision making at discharge. Clinical decision-making at this point in time may include the duration of hospitalization and considerations for home health services, referrals, long-term care facilities, hospice care and the intensity of post-hospitalization outpatient follow-up. When research provides direction in post-hospitalization management, an overall improvement in care is possible, as well as, enhancements in outcomes and potentially a reduction in re-hospitalizations.

Statement of the Problem

Many patients with heart failure experience hospitalizations due to an acute exacerbation of the disorder. Re-hospitalizations after discharge from an acute exacerbation of heart failure are frequently experienced in this patient population. There is limited research on clinical characteristics, such as respiratory status, volume status and functional status at the time of discharge and the correlations of these characteristics to 60-day heart failure readmissions.

Research Hypotheses

It is hypothesized that in patients hospitalized and discharged with a discharge diagnosis of heart failure:

H_1: Reduced respiratory status at discharge is related to 60-day heart failure readmission

H_2: Increased volume status at discharge is related to 60-day heart failure readmission

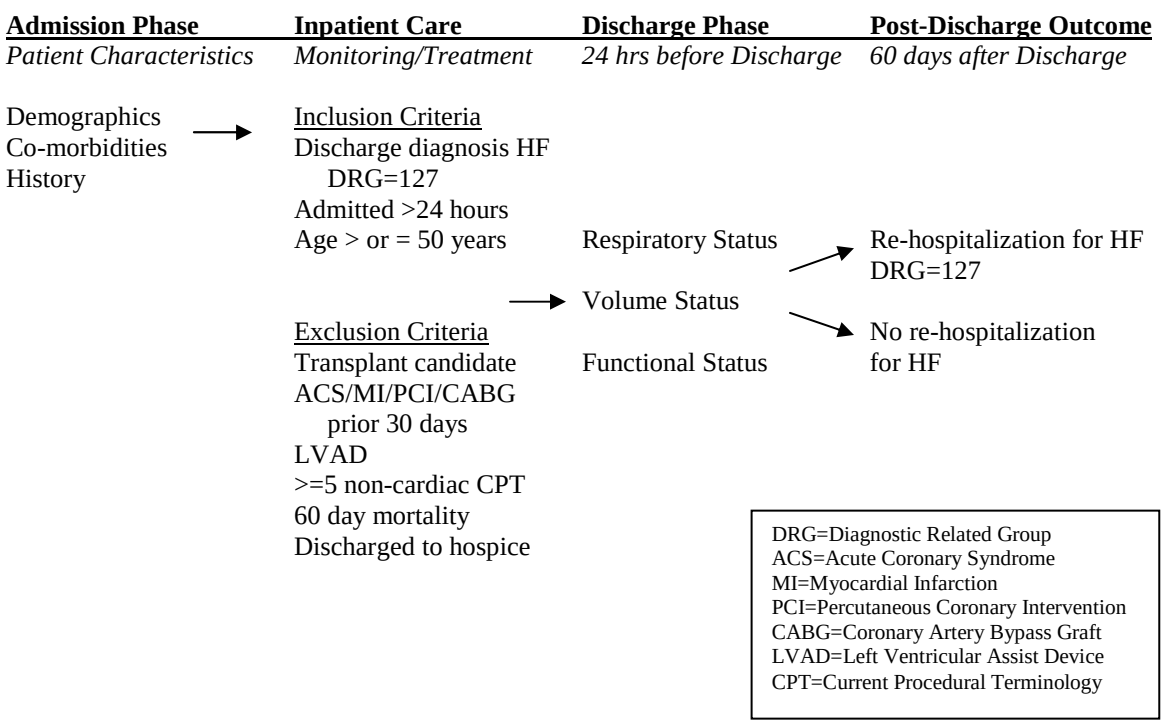
H_3: Reduced functional status at discharge is related to 60-day heart failure readmission

Conceptual Framework

A conceptual framework is proposed to identify nurse-sensitive indicators that predict 60-day re-hospitalizations in patients with heart failure. The model proposes that when heart failure patients receive acute care treatment for an exacerbation of their heart failure, the patient receives appropriate monitoring and treatment of their illness. At the end of the hospitalization, as the patient exhibits indications of clinical improvement, then the patient is evaluated for discharge. In this model, respiratory, volume and functional status are suggested to ascertain if a relationship exists between these indicators and 60-day re-hospitalizations in patients with heart failure. The model suggests that patients who experience certain characteristics related to respiratory, volume and functional status will or will not have a re-hospitalization for heart failure.

Figure 1

Conceptual Framework of Nurse Sensitive Indicators of Heart Failure Re-Hospitalization



Definition of Terms

Heart Failure

Theoretical: Heart failure is a "syndrome caused by cardiac dysfunction, generally resulting from myocardial muscle dysfunction or loss and characterized by LV [left ventricular] dilation or hypertrophy" (HFSA, 2006).

Operational: A patient with heart failure will be defined as a patient discharged from the acute care setting with a primary diagnosis of heart failure, Diagnostic Related Group (DRG) = 127.

Discharge Period

Theoretical: Discharge period is operationally defined.

Operational: Discharge was the period of time from discharge and the immediate 24 hours proceeding the discharge time.

Nurse Sensitive Indicators

Theoretical: "Nursing-sensitive indicators reflect the structure, process and outcomes of nursing care…" (ANA, 2008).

Operational: For the purposes of this study, nurse-sensitive indicators were defined as respiratory, volume and functional status.

Index Hospitalization

Theoretical: Index hospitalization is defined operationally.

Operational: An index stay was defined as the first hospitalization, with a discharge diagnosis for heart failure, DRG = 127, occurring in the study period.

Re-Hospitalization

Theorectical: Re-hospitalization is defined operationally.

Operational: Re-hospitalization was defined as an admission into an acute care hospital with a primary discharge diagnosis of heart failure, DRG = 127 within 60-days of discharge from the index hospitalization with a primary discharge diagnosis of heart failure, DRG = 127.

Respiratory Status

Theoretical: "A description of specific details which are deemed to have an impact on the patient's breathing." (Scotland, 2008)

Operational: Respiratory status was defined as respiratory rate, breath sounds, cough, oxygen saturation**,** dyspnea, orthopnea, and chest radiographic findings of pleural effusions or congestion within 24 hours of discharge.

Volume Status

Theoretical: "Volume status refers to the volume of blood in the patient's circulatory system. This is related to the patient's state of hydration…"

Operational: Volume status was defined as weight changes, volume changes recorded in intake and output records, heart sounds (S3), jugular venous distention, hepatojugular reflex, lower extremity edema and ascites within 24 hours prior to discharge.

Functional Status

Theoretical: " Functional status is a summary of the individual's ability to perform activities of daily living and instrumental activities of daily living based on appropriate functional assessment." (Scotland, 2008).

Operational: Functional status was evaluated through the documentation of the patient's functional ability, activities of daily living, toileting, bathing, ambulation and mobility within 24 hours prior to discharge.

Significance of the Study

Nurse-sensitive clinical characteristics of heart failure patients at the time of discharge were appraised. For those patients who experienced readmission, an evaluation was conducted to determine the relationship of respiratory, volume and functional status to hospital readmissions. The significance of this study has relevance for practice, research and theory development. The results may help to guide discharge criteria development and to assist in discharge decision-making and clinical guidance of care. Guidelines for discharge decision-making may improve discharge timing or improve considerations for outpatient care and monitoring. The overall goal is to improve patient outcomes by reducing readmissions, avoiding exacerbations of illness and maintaining health based on scientific and empirical data. Subsequent research can build upon the findings from this study and to determine if the recommendations are supported through empirical findings. Lastly, this study aids in our understanding of the phenomena of readmissions in the heart failure patient, a conceptualization is proposed.

Summary

Heart failure is a clinical syndrome that incurs a high prevalence, mortality, morbidity and economic burden in our society. Heart failure has a tremendous impact on individuals who experience the disorder as well as the health care community. Heart failure patients have frequent adverse outcomes after hospitalizations for exacerbations of illness, including re-hospitalizations, often shortly after discharge. Multiple prior investigations encompass the myriad of complexities in this patient population, and our

understanding of the intricacy of caring for patients with heart failure is developing and improving. The basis of the current study is founded upon this prior research, with the key study factors derived from comprehensive heart failure guidelines. The impetus of the study is established from the clinical challenges and empirical evidence attesting to the difficult of caring for individuals with heart failure. These challenges provide numerous opportunities for nurses and nurse practitioners to improve care based upon future research endeavors.

CHAPTER II

Review of the Literature

Heart failure is a chronic clinical syndrome that is prevalent in our society, according to the American Heart Association's statistics for 2007; over five million Americans are currently diagnosed with heart failure. Due to the aging of our population and the successes in the treatment of cardiovascular diseases, the occurrence of heart failure is anticipated to rise and is currently the only major cardiovascular disorder with an increasing incidence. Heart failure is common in the elderly and represents the most frequent Medicare hospital discharge diagnosis. This complex clinical syndrome is associated with high mortality, frequent hospitalizations and substantial health care utilization.

The rate of hospitalizations and readmissions shortly after hospitalization continues to be problematic. An unexplored area of research is an evaluation of patient factors at the time of discharge that are associated with early, 60 day readmissions. Nurse-sensitive indicators at the time of discharge may prove to be important components in our understanding of the complex and multifaceted issues surrounding heart failure outcomes post-hospitalization.

The search strategy employed to support this study encompassed an ongoing process until the research was completed. The heart failure literature is continually evolving and issues of post-hospitalization outcomes have been monitored from 2006 until the present time. The time frame of the search also includes studies prior to 2006 to

support the primary basis for the study, the study methodology and the key study variables. The primary basis of the study is the relevance of the incidence and prevalence of heart failure and the burden of heart failure in our society. The burdens of heart failure include significant mortality and morbidity, principally related to hospitalizations and re-hospitalizations shortly after hospital discharge. There are predictors for hospitalizations from prior studies, generally from admission and outpatient data, with a few of these predictors based on data relevant to discharge characteristics. Discharge characteristics are an underexplored area; however, there is an appreciation that evaluating individuals in the clinical setting at this juncture of time is essential. The Heart Failure Society of America has proposed guidelines related to discharge criteria and these guidelines are based upon expert opinion. The guidelines provide the foundation of research for the main variables in this study, respiratory status, volume status and functional status.

Heart Failure

Heart failure is a "syndrome caused by cardiac dysfunction, generally resulting from myocardial muscle dysfunction or loss and characterized by LV [left ventricle] dilation or hypertrophy" (HFSA, 2006). The syndrome of heart failure is characterized by an alteration of the cardiac ventricles to fill with or eject blood (ACC/AHA, 2005). Heart failure occurs under any circumstance that changes the normal maintenance of cardiac output. Any alteration in preload, afterload, contractility, heart rate and metabolic state can alter ventricular function and predispose an individual to develop heart failure.

The physiologic changes that occur which cause alterations in cardiac function; result in a variety of clinical features and symptoms that are characteristic of individuals with heart failure. The cardinal clinical manifestations of heart failure are dyspnea and fatigue. Other common clinical features include tachycardia, edema, nocturia, fluid retention and congestion. The constellation of clinical characteristics, based upon specific patient symptoms by history and physical examination findings provide the diagnosis of heart failure (ACC/AHA, 2005).

The Framingham Criteria for Congestive Heart Failure (Table 1) details that the diagnosis of heart failure requires the presence of two or more major criteria or one major criterion associated with at least two minor criteria (Medical Criteria, 2009).

Table 1

Framingham Criteria for Congestive Heart Failure

Major Criteria	*Minor Criteria*
Paroxysmal nocturnal dyspnea Neck vein distention Rales Radiographic cardiomegaly Acute pulmonary edema S3 gallop Increased central venous pressure Hepatojugular reflux Weight loss >4.5kg in 5 days in response to treatment	Bilateral ankle edema Nocturnal cough Dyspnea on ordinary exertion Hepatomegaly Pleural effusion Decreased vital capacity by one third from maximum recorded Tachycardia (heart rate >120 beats/min)

Co-Morbidities

Heart failure develops as a consequence to other medical conditions and individuals with heart failure often have a variety of co-morbid conditions. Common etiologies for heart failure include hypertension, coronary artery disease, diabetes, hyperlipidemia, obesity, valvular abnormalities and cardiotoxic medications. The most noteworthy risk factors for the development of heart failure are hypertension and coronary artery disease. An analysis was completed of 8229 individuals enrolled in the Framingham Heart Study from 1971 to 1996 to establish the lifetime risk for developing congestive heart failure (Lloyd-Jones et al., 2002). Through this analysis, the risk of heart failure is strongly associated with hypertension. There were differences in men and women, with antecedent myocardial infarction more important for the development of heart failure in men. Myocardial infarction was not a comparable factor for the development of heart failure in women. Hypertension "accounted for 59% of the population-attributable risk for CHF in women compared with 39% in men (Lloyd-Jones et al., 2002, p. 3070)." Several large databases elucidate the incidence of concomitant conditions frequently associated with heart failure (Table 2).

Table 2
Co-Morbidities Associated with Heart Failure

Co-Morbidities	**IMPACT-HF Registry O'Connor, et al., 2005 n=567**	**Moser, 2005 n=202**	**ADHERE Registry Fonarrow, et al., 2003 n=52,047**	**Krumholz, et al., 2000 n=1129**
Hypertension	64.7%	64%	72%	10%
Ischemic Heart Disease Myocardial Infarction	48.7%	30%	58%	10%
Ventricular Arrhythmias/ Ventricular Tachycardia	11.5%	9%	9%	
eGFR<60ml/min/Chronic Renal Insufficiency/Chronic Renal Failure	23.5%		29%	10%
Permanent Pacemaker/ICD	16.9%		20%	
Atrial Arrhythmia/Atrial Fibrillation/ Atrial Flutter	35.4%		31%	10%
Hyperlipidemia/Dyslipidemia	64.7%		34%	
Diabetes	45.1%	42%	44%	35%
Cerebrovascular Disease Cerebral Vascular Accident/TIA	13.2%	10%	17%	10%
Pulmonary Disease	27.5%	19%	31%	
Peripheral Vascular Disease		17%	18%	

Heart failure can be classified into two broad categories. These categories are heart failure with left ventricular systolic dysfunction and heart failure with preserved left ventricular systolic function, termed diastolic dysfunction. There are certain features for each type including differences in left ventricular structure, remodeling and functional abnormalities (Zile, Baicu, & Bonnema, 2005). Individuals with systolic dysfunction have abnormally reduced left ventricular ejection fractions (LVEF) and enlarged ventricular size. Heart failure with a preserved systolic function is caused by diastolic dysfunction and is defined as abnormal relaxation of the ventricles during diastole. Ventricular filling is slow or incomplete because the myofibrils are unable to rapidly or completely return to their resting lengths. Diastolic heart failure is characterized by concentric remodeling associated with slow relaxation and increased stiffness, but with normal left ventricular diastolic volume (Zile et al., 2005). Individuals may have either type of heart failure and in most individuals systolic and diastolic dysfunction coexists (ACC/AHA, 2005). Currently, there is no evidence to support a difference in post-hospitalization readmissions in patients who have systolic versus diastolic dysfunction.

Smith, Masoudi, Vaccarino, Radford & Krumholz (2003) prospectively followed 413 patients for six months after hospitalization for heart failure to compare clinical outcomes in those individuals with preserved versus depressed left ventricular ejection fraction (LVEF). Preserved left ventricular function was defined as a left ventricular ejection fraction greater than or equal to 40% (Smith, Masoudi, Vaccarino, Radford, & Krumholz, 2003). Those individuals with preserved left ventricular function were older,

more likely to be female and have a history of hypertension. Those with reduced heart function had a longer history of heart failure, were more likely to experience arrhythmias and were more prone to have coronary artery disease. The mortality at six months was 13% in those individuals with preserved heart function, compared with 21% in individuals with depressed LVEF. The risk of readmission was comparable in the preserved and reduced LVEF groups. Forty six percent of patients were readmitted in the six-month follow-up period for any cause with 19% readmitted for heart failure. Functional status at baseline was not significantly different at baseline; however, individuals with preserved LVEF experienced significantly worse functional status at follow-up. Dyspnea was described to be worse in individuals with reduced LVEF, but the absolute burden of heart failure was considered to be comparable in both groups. Currently, there is a preponderance of literature based upon individuals with altered systolic function; however both groups are included in this study.

Predictors of Mortality and Morbidity

The natural course of heart failure consists of a progressive disorder with increasing disability and limitations that occur over time. There is currently no definitive treatment; however, management is aimed at delaying progression, improving symptoms, increasing functional abilities, promoting quality of life, reducing morbidity and delaying mortality.

Patients with heart failure suffer from significant mortality and morbidity. Morbidity has been classified in many forms in this population to include evaluations of

functional ability, quality of life indices, symptom status assessments and associated psychological challenges, such as depression and anxiety. A common indication of morbidity is hospitalization into an acute care facility for heart failure exacerbation and decompensation. There is an interest in hospital admissions as an outcome measure due to the burden this event places on patients and families, the effects on quality of life and the large amount of financial expenditure to care for these patients in the inpatient setting. Not only are hospital admissions a primary concern, but also re-hospitalizations for heart failure is problematic in this patient population. There are numerous studies and registries that describe the rates of mortality, hospitalizations and re-hospitalizations in this patient population; these are common endpoints and indicators in heart failure studies (Table 3).

Table 3

Mortality and Readmission Rates from Selected Studies

Study	**Duration**	**Mortality**	**Readmission**	**Combined Mortality/ Readmission**
O'Connor et al., 2005 n=567	60 day	8.5%	25.7%	31.4%
Hamner & Ellison, 2005 n=557	6 month		40%	
Felker, et al., 2004 n=949	60 day	9.6%		35.2%
Logeart, et al., 2004 n=105	30 day			15%
Schwarz & Elman, 2003 n=156	3 month		44%	40%
Smith, et al, 2003 n=413	6 month		46%	
Krumholz, et al, 1997 n=17,448	6 month	24%	44%	53%

Between October 1, 1990 and September 30, 1994 heart failure was the most common principal discharge diagnosis among Connecticut Medicare beneficiaries (Krumholz et al., 1997). A study was conducted to evaluate the Connecticut Medicare hospital database for individuals discharged with a diagnosis related group code 127 (congestive heart failure) during this time period. A total of 28,198 records were evaluated and reviewed. The primary outcome for this review included hospital readmissions and death within six months of discharge. The study findings revealed that 44% of individuals were readmitted once in 6 months and 16% were readmitted at least twice. This group of beneficiaries experienced a 24% mortality rate in six months. Overall, 53% of the cohort died or experienced a readmission during the six-month follow-up period. The characteristics significantly associated with readmission or deaths were increased age, male gender, multiple co morbidities, longer length of stay and hospital admission in the six months preceding the index hospitalization. This study was limited by the use of an administrative database, which has inadequate clinical information to determine potential confounders. However, there is consistency in the data regarding the problematic nature of hospitalizations and rehospitalizations in this patient population.

A retrospective chart review of 2176 patients (1129 derivation cohort/1047 validation cohort) was used to evaluate outcomes within six months of discharge in a group of heart failure patients (Krumholz et al., 2000). Outcomes included all-cause readmission, heart failure related readmission and death. Thirty-four factors were evaluated including demographic (age, gender, race); medical history (heart failure,

angina, myocardial infarction, atrial fibrillation, angioplasty, bypass surgery, stroke, chronic obstructive pulmonary disease, diabetes mellitus, and hypertension); admission clinical characteristics (paroxysmal nocturnal dyspnea, orthopnea, chest pain, diastolic/systolic blood pressure, pulse, respiratory rate, and pulmonary edema on chest radiograph); hospital course (left ventricular ejection fraction, major complications, including cardiac arrest, myocardial infarction, stroke, or shock; major procedures, including angioplasty, bypass surgery, or cardiac catheterization); length of stay; discharge laboratory tests (sodium, potassium, blood urea nitrogen, creatinine, and the ratio of blood urea nitrogen to creatinine); and discharge mobility. Discharge mobility was defined as either independent or assisted.

Through this analysis four factors emerged as significant predictors of readmission and death, these included prior hospital admission, prior heart failure diagnosis, diabetes mellitus and an elevated creatinine (Krumholz et al., 2000). The rates for readmission and death for no predictors was 26% and 31%; with one or two risk predictors 48% and 54%; with three or all predictors 59% and 65%, respectively. These predictors assist in the identification of high-risk groups.

The prevalence and association of the role of anemia with heart failure is increasingly notable in more recent studies (Tang et al., 2008). Tang et al. (2008) performed a review of 6,159 consecutive charts to determine the prevalence of anemia in the outpatient setting and to determine if changes of anemia status over time impacted the long-term survival of patients. The presence of persistent anemia was significantly related to the poorest survival when compared no anemia or anemia that was incident or

resolved. In this study, 43% of patients had resolution of their anemia over the study period, which improved longevity.

In the outpatient setting, Opasich et al. (2001) prospectively evaluated factors related to worsening heart failure in 2,701 individuals enrolled in the Italian Network on Congestive Heart Failure Registry (IN-CHF Registry) at 133 cardiology centers. This registry evaluated demographic, history, assessment, symptoms and laboratory data (Opasich et al., 2001). Of this population 8%, or 215 patients, experienced short-term decompensation, this was defined as worsening in New York Heart Association (NYHA) class and an increase in diuretic dosing. Previous hospitalization, long duration of symptoms, ischemic etiology, atrial fibrillation, NYHA functional class III or IV, higher heart rate and low systolic blood pressure were independently and significantly associated with heart failure destabilization. In 40% of participants, no precipitating factor was identified that resulted in destabilization. These researches concluded that 21% exhibited behaviors consistent with poor compliance and 12% of individuals had concomitant infectious processes.

Brain natriuretic peptide (BNP) has been study to determine the predictive ability of this biomarker in determining post-discharge outcomes (Logeart et al., 2004). Logeart et al. (2004) prospectively evaluated 114 patients enrolled in a single center study. Nine patients died during the initial hospitalization and 105 survivors were discharged home with the following characteristics: NYHA class II to III, no rales, no gallop, and no severe hypotension. All patients were judged to be clinically stable at discharge. In follow-up, 15% of the patients were readmitted or died during first month and more than

40% in six months. A subsequent validation study was performed with a separate 109 patients from another center. The pre-discharge BNP level was predictive of death or readmission; with higher pre-discharge BNP serving as a strong, independent predictor of these adverse outcomes. The pre-discharge BNP levels were more relevant than BNP changes during the acute care phase and more conclusive than echocardiogram findings. These authors suggest that pre-discharge BNP levels >350ng/l are strongly related to death or readmission; 23.5% in one month and 79.4% at six months. A BNP under 350ng/l translated into an event rate of 0% at one month and 12.7% at six months. A BNP >700ng/l was associated with death or readmission for heart failure at 31% at one month and 93% at six months. There is suggestion from this study that heart failure patients are discharged without adequate circulatory stabilization, despite clinician's evaluation to the contrary.

Schwarz and Elman (2003) performed a prospective, descriptive study of 156 patient-caregiver dyads. The purpose of this study was to evaluate predictors of hospital readmissions as measured within seven to ten days of discharge (Schwarz & Elman, 2003). In this study, 44% of patients were readmitted within three months. The patient factor related to readmission was the interaction effect of severity of cardiac illness and functional status. The caregiver factor associated with readmission was the interaction of caregiver stress and depression.

An analysis was completed as part of the Initiation Management Pre-discharge Assessment of Carvedilol Heart Failure (IMPACT-HF) Registry, concurrent with the IMPACT-HF study regarding the in-hospital initiation of carvedilol phosphate (Coreg ®)

(O'Connor, Stough, Gallup, Hasselblad, & Gheorghiade, 2005). This was a prospective, observational, multicenter registry; and this analysis of the registry was comprised of 567 patients enrolled and followed for 60 days. The investigation compared the 60-day death or hospitalization rates among baseline variables. The data was obtained at admission, during hospitalization, discharge and 60 days after registry entry. The mortality rate was 8.5% and rehospitalizations occurred with a frequency of 25.7% within 60 days; the combination of death and rehospitalization was 31.4%. The model derived for both death and rehospitalization within 60 days included age, nitrates on admission and one or more heart failure admission within 12 months.

There are additional studies that have explored social and behavioral factors related to adverse events in the heart failure population (Happ, Naylor, & Roe-Prior, 1997). Happ, Naylor and Roe-Prior (1997) conducted a qualitative study of 16 patients through a retrospective review of records from a larger trial. The absence of strong social support or motivation contributed to nonadherence. In this study nonadherence to diet and medications contributed to symptom appearance and rehospitalizations.

Tsuyuki et al. (2001) participated in a 43-week multicenter clinical trial entitled the Randomized Evaluation of Strategies for Left Ventricular Dysfunction Pilot Study, or RESOLVD Pilot Study. A total of 768 patients with heart failure associated with left ventricular dysfunction, left ventricular ejection fraction under 40%, were evaluated prospectively and systematically for immediate precipitants associated with heart failure exacerbation (Tsuyuki et al., 2001). Clinical event reporting was completed through a heart failure event form for patients experiencing worsening of heart failure. There were

323 episodes of worsening HF in 180 patients during follow-up period resulting in 143 hospitalizations. There was no significant difference in clinical examination findings at baseline in patients with and without heart failure events except for peripheral edema and jugular venous distention. The factors implicated in worsening of heart failure status included non-compliance with salt restriction 22%; non-cardiac causes such as pulmonary infections 20%; study medications 15%; use of antiarrhythmic agents in past 48 hours 15%; arrhythmias 13%; calcium channel blockers 13%; and inappropriate reductions in heart failure therapy 10%. Factors which were not related to worsening of heart failure in this patient population included medication noncompliance, myocardial ischemia, uncontrolled hypertension, and the effects of other medications.

The OPTIME-CHF study, Outcomes of a Prospective Trial of Intravenous Milrinone for Exacerbation of Chronic Heart Failure, was a trial involving 949 patients with left ventricular systolic dysfunction randomized to milrinone lactate (Primacor®) or placebo at 78 centers (Felker et al., 2004). A variety of factors were evaluated on admission to predict outcomes at 60 days, including mortality or the composite of death or rehospitalization. There were initially 41 candidate variables in five categories related to demographics, cardiac history, co-morbid conditions, bedside assessment and laboratory studies. The variables associated with death at 60 days included increased age, lower systolic blood pressure, NYHA class IV symptoms, elevated blood urea nitrogen (BUN) and decreased sodium. The 60-day mortality was 9.6% with a model with c-statistic .77 which is considered to have substantial discriminatory power.

Predictors of the composite of death or rehospitalization in 60 days included the number of heart failure admissions in preceding 12 months, elevated blood urea nitrogen, lower systolic blood pressure, decreased hemoglobin, and a history of percutaneous coronary intervention (Felker et al., 2004). The rate of the composite of death or rehospitalization was 35.2% in 60 days with the model for death and rehospitalization having a c-statistic .69. These researchers then converted the 60 day mortality predictors to a nomogram; for example age, sodium level, NYHA class, systolic blood pressure and blood urea nitrogen were assigned certain point values depending on the patient's characteristics; this point value was totaled and assigned a percentage to predict 60 day mortality. This nomogram is useful for risk stratification and assists in making decisions about acuity of care and the triaging of patients and to determine the intensity of post-hospitalization care.

Another sub-study from the previously mentioned OPTIME-CHF data was conducted to evaluate serum sodium in association with mortality and rehospitalizations (Klein et al., 2005). This was a retrospective analysis of previously obtained data. In this evaluation, patients with lower sodium had more severe heart failure, defined as a higher number of previous admissions, longer disease duration, lower blood pressure and higher blood urea nitrogen. The admission serum sodium was determined to be an independent predictor of increased number of days hospitalized for cardiovascular reasons and increase in mortality within 60 days after discharge; independent of left ventricular ejection fraction, degree of congestion, symptoms and functional class. There is a notable trend toward higher mortality and rehospitalizations for patients with the lowest sodium;

patients in the lowest quartile of serum sodium experienced death or rehospitalizations at 41% in 60 days.

The Center for Medicare and Medicaid Services (CMS) commissioned a study with Yale University to evaluate data from 1998 Medicare databases and a sampling of chart reviews (Krumholz et al., 2000). Over 222,000 patient records were reviewed and models were developed to predict readmissions and mortality. The researchers applied statistics to form a model derivation based on the data and applied and tested the model based on additional data. The mortality model was judged to have good performance; however, the readmission model was found to have poor discrimination. Predicting readmissions continues to be elusive to investigators, even with the use of large databases.

Prediction models for mortality have been developed to include the Seattle Heart Failure Model (Levy, Mozaffarian, & Linker, 2004). This model was derived using retrospective data from 1,125 individuals who were enrolled in a separate study PRAISE1 (Prospective Randomized Amlodipine Survival Evaluation). The model is available on-line and information can be entered into the model to predict one, two and three year survival. The model is based on the combination of the following characteristics: age, gender, NYHA class, weight, left ventricular ejection fraction, systolic blood pressure, ischemic or non-ischemic etiology, QRS duration, medications, diuretics with dosages, laboratory findings and device therapy (pacemaker or internal defibrillator). The interactive model allows the data to be entered and to obtain information regarding survival if interventions such as medications or device therapy are

added. The model is useful in guiding therapies based on mortality predictors. However, factors related to morbidity, and specifically related to predicting hospitalizations are not a component of this model.

As these studies demonstrate, there has been voluminous research describing the mortality and morbidity in heart failure patients, from a variety of perspectives. The significant research findings are predominately related to predictors regarding mortality, with less conclusive results encompassing hospitalizations and re-hospitalizations. In 2008, Ross et al. published a systematic review of 117 studies regarding statistical models and predictors of readmission in heart failure. Many studies are based on retrospective reviews and analysis of data related to larger studies, pharmaceutical trials or registries, there are also a number of prospective studies. The systematic review suggests that there were scarcity of patient characteristics that were consistently associated with heart failure readmission. Despite these multiple studies and an improved understanding of this patient population, adverse outcomes, specifically re-hospitalizations, continue to be problematic in this patient population. Many of the correlates explored in prior research are based upon evaluations of the patient during the admission phase of hospitalization as predictors to later events. Currently there are few studies that describe characteristics at the time of discharge related to outcomes after hospitalizations.

Discharge Characteristics

The vast majority of prior studies are based upon evaluations of patient factors at the time of admission into an acute care facility or in the outpatient setting to predict

outcomes at a later point in time. The initial admission evaluation and patient characteristics reflect a condition when the patient is acutely decompensated due to a variety of factors, and may not be indicative of future events. An individual with a significant history may present earlier due to an understanding and acknowledgement of symptoms, a different patient may delay treatment and present in critical distress even though the underlying disease process may be less severe. After diagnostic and therapeutic interventions are performed in the acute care setting the patient is evaluated for discharge. Regardless of the patient's status on admission, patients at the time of discharge should exhibit clinical stability in order to deem discharge an appropriate next step in the patient's care. Fewer studies have been performed to evaluate the relationship of characteristics at the time of discharge and future patient outcomes.

Hamner and Ellison (2005) performed a retrospective, descriptive, correlational study of 557 patients to determine factors related to readmission. A readmission rate of 40% in six months was noted in this study (Hamner & Ellison, 2005). The study factors were grouped into seven broad categories including demographics, co morbidities, clinical parameters, medication regimen, discharge factors, medical management information and psychosocial status (Hamner & Ellison, 2005). Four derivation models were tested; Model 1 included physiologic variables, Model 2 included initial admission variables, Model 3 included discharge variables and Model 4 included medications. The only model to achieve statistical significance was Model 3, related to the discharge variables. The discharge variables that were found to be predictive of future readmissions

in this study were related to discharge disposition and referrals. This study highlights the importance of considering discharge characteristics as related to future hospitalizations.

A study was conducted through the Veterans Affairs (VA) to evaluate discharge characteristics in an effort to establish a process-outcome link between early readmission and the quality of care during the previous admission (Ashton, Kuykendall, Johnson, Wray, & Wu, 1995). These researchers evaluated records of patients with chronic conditions, including chronic obstructive pulmonary disease, diabetes and heart failure (n=748) to evaluate an association between quality of inpatient care and readmission within fourteen days at 12 VA hospitals. Patients factors at the time of discharge were evaluated and scored based on specific criteria. The criteria included: 1) substantial improvement in symptoms and signs; 2) stable or decreasing weight, not increasing; 3) temperature under 37.8C for at least 24 hours; 4) BUN and creatinine stable or decreasing, not increasing; 5) stable medications for 24 hours; 6) digoxin level less than 2.6nmol/L and not increasing; 7) prothrombin time stable, not increasing; 8) patient and/or family understand medication regimen; 9) patient and/or family understand dietary regimen; and 10) plans for follow-up care written in chart. In summary, the criteria can be classified as clinical stability, education of the patient/family and plans for follow-up care.

In heart failure patients, decreased readiness for discharge adherence scores were significantly correlated with an increased risk of readmission (Ashton, et al., 1995). The findings relate that releasing the patient before readiness for discharge criteria were met was associated with readmissions. A readiness for discharge score below the 25th

percentile was associated with a twofold increase in readmissions when other covariates were accounted for. No demographic variables assessed in this study were found to have a statistically significant association with readmissions. Patients who experienced changes in their medication regimen just before discharge were more likely to be readmitted. Early readmissions were attributable to substandard inpatient care of recent hospitalization and accounted for one in five early readmissions for heart failure, when other explanatory factors were considered.

Moser, Doering and Chung (2005) did not evaluate patients at discharge; however their study was based upon assessments of patients shortly after discharge. These researchers evaluated 202 patients with a home visit three to seven days after being discharged for a hospitalization with heart failure (Moser, Doering, & Chung, 2005). The patient group was found to be functionally impaired (NYHA class III 44% or IV 26%), with psychological challenges (50% with anxiety, 69% with depression), substantially impaired health related quality of life, substantial symptom burden and with poor adherence to medications. The patients were deemed to be clinically unstable and vulnerable to rehospitalizations with modifiable risk factors that increase the likelihood of further decompensation including psychological, social and behavioral risk factors. The researchers suggest that the high rate of rehospitalizations may indicate that the judgments for clinical stability and the ability of the patient to assume their own care may not be accurate.

Discharge characteristics were evaluated in the dissertation research of Howie-Esquivel (2005) at the University of California at San Francisco. Seventy-two patients

with the primary diagnosis of heart failure were evaluated within 48 hours of discharge (Howie-Esquivel, 2005). The participants in this study experienced a 47.2% rehospitalization rate and 15.3% mortality rate during the study period. Variables at the time of discharge were correlated to predict rehospitalization within 90 days. The four variables that indicated independent association with rehospitalization were pulmonary disease (defined as asthma, chronic obstructive pulmonary disease or pulmonary infection within the prior three years), female gender, ethnicity (non-white/Caucasian), and symptom stability (a component of the Kansas City Cardiomyopathy Questionnaire). Other significant findings were that females experienced an increased rate of anemia. The length of stay average was different for those rehospitalized, 10.52 days, compared to those who were not rehospitalized, 6.47 days (Howie-Esquivel & Dracup, 2007).

From these previous studies, discharge characteristics appear to have merit in the understanding of patient factors and readmissions. When patient factors are evaluated at discharge or shortly after discharge, a congruent premise is that there remains a degree of instability in many individuals. The persistent clinical instability is often related to the difficulty in identifying persistent congestion in heart failure patients after a course of aggressive inpatient therapy.

Identifying Persistent Congestion

The patient's subjective response and objectively obtained physical findings assist the clinician in obtaining an evaluation of the patient's status that guides further treatment and management. After several days of aggressive therapies and reduced activity levels, the ability to make a clinical decision of a patient's stability is complex. Patients

hospitalized for heart failure do not exert themselves in an equivalent manner to usually daily activities (Moser, Doering, & Chung, 2005). Patients admitted with heart failure often exhibit severe and dramatic symptoms of dyspnea, and any “appreciable improvements that occur with therapy can obscure the intensity of symptoms and functional impairment remaining” (Moser, et al., p. 984 e11).

The IMPACT-HF (Initiation Management Pre-Discharge Assessment of Carvedilol Heart Failure) registry was a component of a greater study (O'Connor, Stough, Gallup, Hasselblad, & Gheorghiade, 2005). The registry data was analyzed to predict events related to many factors, all of which were quantifiable and easily accessible. One set of factors collected included the signs and symptoms patients experienced at admission and discharge. On admission, patients experienced fatigue (37.2%), dyspnea on exertion (77.1%), rales (63.8%) and edema (58.9%). On discharge the rates of these symptoms were 34.6% for fatigue, 42.2% for dyspnea on exertion, 17.3% for rales and 25% for edema. Many patients experienced persistent symptoms at discharge. There was discussion related to these characteristics, but the discharge findings were not used in any statistical predictions and it is not clear the level of significance of the changes from admission to discharge for this cohort. However, the data provide further consideration that patients may not be stable at discharge, because there was “evidence of volume overload and related symptoms were still present at the time of discharge” (O’Connor, et al., 2005, p. 204). The authors describe “one potential explanation for the persistently high event rate despite the use of evidenced-based therapies is that the patients’ heart failure symptoms were incompletely treated before hospital discharge. It is possible that

patients are discharged too early while they still have evidence of volume overload." (O'Connor, et al., 2005, p. 204).

In a study completed by Logeart, et al. (2004) which evaluated BNP levels with outcomes of death and readmissions, pre-discharge BNP were found to be predictive of one and six month outcomes. All patients were judged to be stable at discharge although there was a high readmission and mortality rate (Logeart et al., 2004). These authors concluded that in "practice it is difficult to evaluate, using clinical criteria, the stability of such weakened and sometimes bedridden patients after several days of aggressive treatement" (Logeart et al., 2004, p. 640). Patients with heart failure are deemed clinically stable, but are discharged without sufficient circulatory stability. Conclusions from the ADHERE registry indicate that "…admission for heart failure is a high-risk event for patients, with death or significant adverse consequences for many" (Adams et al., 2005).

Length of Stay

Another aspect relevant to the management of heart failure patients is related to length of stay. Welsh et al. (2002) described the characteristics of heart failure patients admitted through the emergency department and throughout their hospital admission. The average length of stay was 4.6 days (range 0-21, median 3, SD 4.3) in this patient population, with 33% of patients remaining in the hospital for two days or less (Welsh et al., 2002). The median length of stay for heart failure patients in this study was three days. Similarly, the Acute Decompensated Heart Failure National Registry (ADHERE) of 52,047 enrollees reported a median length of stay of 4.3 days (Fonarow, 2003; Adams,

2005). The length of stay for Medicare beneficiaries in 2001 was 5.8 days, which is similar to length of stay for all Medicare hospitalizations (MQMS, 2008).

Discharge Criteria

In the 2006 Comprehensive Heart Failure Practice Guidelines, The Heart Failure Society of America provided recommendations regarding treatment goals and discharge criteria for patients admitted for acute decompensated heart failure. The recommendations regarding treatment goals and discharge criteria are Level C guidelines, which are defined as expert opinion. “The need to formulate recommendations based on level C evidence is driven primarily by a paucity of scientific evidence in many areas critical to a comprehensive guideline” (HFSA, 2006). Thus, further research in this area is necessary to provide empirically valid practice recommendations, because there is currently a lack of evidence-based criteria to assist with these decisions.

The key variables for this study are derived from several aspects of the HFSA guidelines. In the guidelines, there are various treatment goals for patients who are admitted with heart failure decompensation. The first treatment goal is to improve symptoms (respiratory status), especially congestion and low-output symptoms (HFSA, 2006). A second treatment goal is to optimize volume status (volume status). Discharge criteria are also described, including recommendations relevant to all patients with the hospitalized with heart failure. Two of the discharge criteria that are recommended for all heart failure patients include that exacerbating factors are addressed (respiratory status) and a near optimal volume status achieved (volume status). For patients with advanced heart failure or recurrent admissions for heart failure, discharge criteria include

ambulation before discharge to assess functional capacity after therapy (functional status).

Existing Data

Heart failure is an end state to many other chronic diseases, including coronary artery disease and hypertension. Therefore, patients who develop heart failure already have preexisting pathologies and represent a complex patient population. The complexity of this patient population challenges the researcher to design and perform a high quality study due to the many potential variables in this patient group. The prior literature is vast and no study can account for all factors that have been previously validated as important in the care of patients with heart failure, including: physiologic characteristics, heart failure etiology, heart failure type, demographic factors, social support, cognitive function, quality of life, psychological alterations, self-efficacy, knowledge base, pharmaceutical interventions, device therapy and non-pharmacological interventions. Therefore, studies are generally aimed at finding a specific problem and evaluating factors with a direct correlation to the problem.

A report was issued from the National Heart, Lung and Blood Institute Working Group on Outcomes Research in Cardiovascular Disease (Krumholz et al., 2005). This group provided recommendations regarding future outcomes research in cardiovascular disease and provides guidance regarding research priorities. An aspect that was described as important to the field of cardiovascular research is the promotion of the use of existing data. There were four research priorities identified: "(1) national surveillance of high prevalence CV conditions; (2) patient-centered care; (3) translation of the best science

into clinical practice; and (4) studies that place the cost of interventions in the context of their real-world effectiveness." (Krumholz et al., 2005, p 112).

Many patients who are hospitalized for heart failure are physically and emotionally burdened. The performance of research on a vulnerable population who is experiencing an acutely ill event, can potentially encumber the patient further. The utilization of data that already exists is ethically sound in patients admitted with heart failure decompensation and is supported in the literature.

Nursing Sensitive Indicators

A review article describing recent research in nurse sensitive outcomes in cardiovascular patients, including those with heart failure, was performed (Deaton & Grady, 2004). Nurse sensitive, was defined as "partially or wholly influenced by nursing care" (Deaton & Grady, 2004, p. 329). The authors relate that there are multifaceted explanations accounting for readmissions in heart failure patients, including physical, psychological, and system characteristics. The suggestion from this review is that further research is necessary to determine the interaction and relative importance of these factors.

Nurses have a unique role and relationship in the care of patients with heart failure. Yamokoski, et al. (2007) evaluated 373 patients for rehospitalization and death following hospitalization for heart failure. At the end of hospitalization, physician investigators and nurse coordinators estimated the risk of rehospitalization and death and clinical characteristics were documented. Re-hospitalization was not predicted well by any method. However, a prognostic model based on these clinical characteristics was developed to determine survival. The nurses' determination of six month survival post

hospitalization was superior to either physicians' or the model-based prediction. The authors suggest that the role and training of the nurses, as well as the direct care nurses provide to patients, enhances the nurses' abilities to make accurate predictions regarding survival in heart failure patients.

Current Management

A significant amount of prior literature is available that explores the different aspects and attributing factors related to hospitalizations and mortality, as well as interventions to improve heart failure care. Recommendations range from nutritional counseling, to cardiac resynchronization therapy, to transplantation. Pharmaceuticals have an essential role in the management of heart failure; however, medications and device therapy are not a focus of this study. The non-pharmacological aspects of the care of heart failure patients are emphasized. Non-pharmacologic therapies have significant benefit in the care and outcomes of individuals with heart failure (Duffy & Hoskins, 2004). The literature supports that the following interventions are beneficial to prevent hospitalizations in patients with heart failure: patient and family education (Caldwell, Peters, & Dracup, 2005; F. H. Gwadry-Sridhar et al., 2005; Kasper et al., 2002; Koelling, Johnson, Cody, & Aaronson, 2005; Krumholz et al., 2002; Kutzleb & Reiner, 2006), telephone monitoring programs (Benatar, Bondmass, Ghitelman, & Avitall, 2003; Dunagan et al., 2005; Galbreath et al., 2004; GESICA, 2005; Grancelli et al., 2003; Kutzleb & Reiner, 2006), remote monitoring systems (Cleland, Louis, Rigby, Uwe, & Balk, 2005; Goldberg et al., 2003), comprehensive discharge planning (Phillips et al., 2004) and transitional care models (Naylor et al., 2004).

An individual's discharge disposition and post-hospitalization referrals are also related to rehospitalizations (Hamner & Ellison, 2005). Other interventions that decrease readmission for heart failure are frequent monitoring in the outpatient setting (Delgado-Passier & McCaffrey, 2006) and disease management programs (Laramee, Levinsky, Sargent, Ross, & Callas, 2003; McAlister, Stewart, Ferrua, & McMurray, 2004; Philbin, 1999). Multidisciplinary management teams are well proven as essential in the care of heart failure patients (Crowder, 2006; Galbreath et al., 2004; F. Gwadry-Sridhar, Flintoft, Lee, Lee, & Guyatt, 2004; Hamner, 2005; Holland et al., 2005; McAlister, Stewart, Ferrua, & McMurray, 2004; Mejhert, Kahan, Persson, & Edner, 2004; Phillips et al., 2004; Sisk et al., 2006).

The multi-faceted nature of the care and management of heart failure patients has been noted and researchers have explored them in numerous ways. Yet, despite these multiple studies, hospitalizations continue to be problematic and the reduction of these incidents remains a challenge to health care providers today and in the foreseeable future. As a result, research in this area continues, given the essential need to address the difficulty of the morbidity associated with hospital admissions and re-hospitalizations in individuals with heart failure.

Summary of the Literature Review

Patients with heart failure are at risk for mortality and morbidity, specifically related to hospitalizations. Hospital admission is a marker of instability in patients with heart failure. The predominant goals for hospitalization are to obtain diagnostic information and to achieve clinical stability. Future events after hospitalization are

common in this patient population and this study attempts to understand clinical characteristics at the time of discharge to determine an association with future outcomes. Researchers have explored discharge characteristics in the past, and there is suggestion that these factors are related to future adverse outcomes. Previous studies support the current research of determining correlations of re-hospitalizations to nursing sensitive indicators at discharge.

Nurse-specific indicators at the time of discharge are the variables of interest in this study because they have not been explored specifically before in this context and current predictors of hospitalizations are not conclusive. If nurse sensitive indicators are related to future outcomes, resources can be allocated and support services obtained based upon those most likely to be readmitted. Nurse sensitive indicators may also assist in determining the utilization of appropriate resources and therapies including home health services, skilled nursing facilities, hospice care, medications, the intensity of follow-up care and non-pharmacological interventions. Strategies can be developed to improve outcomes for individuals with heart failure and their associated families or support group.

CHAPTER III

Methods and Procedures

The research presents a descriptive, correlational analysis of the data and uses logistic regression to study the contribution that nursing sensitive indicators make to the risk of re-hospitalization in patients admitted to acute care with a primary diagnosis of decompensated heart failure. The nurse-sensitive indicators proposed in this study are respiratory status, volume status and functional status.

Settings

There are two settings for this study; both are located in a suburban area in the mid-Atlantic region of the United States and are within the same hospital system. The first setting is a large, 833-bed, private, not-for-profit tertiary care hospital. There are approximately 85-100 patients admitted with the diagnosis of heart failure per month at this location. The second setting is a 318-bed, private, not-for-profit community hospital with approximately 35-50 patients admitted with the diagnosis of heart failure per month. The two settings were selected to increase the number of potential subjects in the study and to add diversity to the study population, as one setting cares for a wider range of ethnic groups. Utilizing both sites in this region also increases the probability of capturing re-admissions for the 60-day post hospitalization period, as many patients would be readmitted to the same hospital system.

Subjects

Data was obtained via data extraction from existing medical and health records. A retrospective chart review is advantageous in this study population for several reasons. A

larger number of study subjects can be obtained for evaluation, which improves statistical efficiency and power of the data. This study design is also an authentic representation of care that is occurring in the clinical setting, rather than a design in which data is collected in a standardized manner that is unlike the usual clinical setting or standards of care. The study sample was derived from all individuals discharged with the primary diagnosis of heart failure at the two study institutions for 2006 and 2007; until the proposed sample size was obtained. The sample of subjects who experienced heart failure readmission is a population sample and was limited by the study time period and inclusion/exclusion criteria; no subject was systematically excluded from the study.

An index stay was defined as the first hospitalization with a discharge diagnosis of heart failure, Diagnostic Related Group (DRG) 127 occurring in the study period. The patient was the unit of analysis; patients who experienced re-hospitalization were analyzed once, as one event. All individuals readmitted within 60 days with a primary discharge diagnosis of heart failure after an index hospitalization with a discharge diagnosis of heart failure was included in the readmission group. The comparison group reflects those individuals with an index hospitalization with a discharge diagnosis of heart failure without readmission for heart failure for the 60 days after the index stay. The comparison group was obtained in a one to one ratio to the readmission group.

The sample size for this proposed study was derived from a number of factors (Appendix A). An effect size is estimated based upon the prior work of Howie-Esquivel and Dracup (2007). Effect size was estimated from the 95% confidence interval (0.97-0.99) and hazard ratio (0.98) of the Quality of Life Symptom Stability Score, which was

one of three significant predictors (p=0.02) in this study. The effect size is estimated to be moderate. For the purposes of determining a sample size for this proposed study, a small to moderate effect size (0.1) was selected.

The number of predictors is derived from the retrospective chart review of 2176 patients (1129 derivation cohort/1047 validation cohort) to evaluate outcomes within six months of discharge in a group of heart failure patients (Krumholz et al., 2000). Outcomes included all-cause readmission, heart failure related readmission and death. Thirty-four factors were evaluated and through this analysis four factors emerged as significant predictors of readmission and death, these included prior hospital admission, prior heart failure diagnosis, diabetes mellitus and an elevated creatinine (Krumholz et al., 2000). The number of predictors in this study is set at five. By convention, the significance (alpha) is set at the standard of .05 with a power of .80; then this information was entered into the software program by Daniel Soper (Soper, 2008). The sample size is determined to be 134 and an additional 15% is added to account for mortality, which was the mortality rate experienced in the work by Howie-Esquivel and Dracup (2007). The final sample size is 154 individuals.

Inclusion and exclusion criteria are defined based on prior studies (Appendix B). Setting these criteria also assist in controlling for known confounders in the study of heart failure patients.

Inclusion criteria

Discharged with the primary discharge diagnosis of heart failure, Diagnostic Related Group (DRG) 127

Admission for greater than 24 hours

Age greater than or equal to 50 years

Exclusion criteria

Cardiac transplant candidate

Acute coronary event within the previous 30 days of index hospitalization

Coronary revascularization – percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) within the previous 30 days of index hospitalization

Left ventricular assist device (LVAD)

Five or more non-cardiac Current Procedural Terminology (CPT) codes

Subject mortality within 60 days after index hospitalization

Patient discharged to hospice setting

Protection of Human Subjects

Approval was obtained from The Catholic University of America School of Nursing, the Catholic University Committee for the Protection of Human Subjects and though each Institutional Review Board prior to the initiation of the study. All human subject and confidentiality requirements were fulfilled and respected to the fullest extent possible. Procedures were implemented to ensure the confidentiality of all patient data; no identifying patient information is collected on the data collection forms. The Health

Insurance Portability and Accountability Act (HIPAA) describe 19 patient identifiers and none of these identifiers were collected in this study. Strict adherence to the policies of the participating and sponsoring institutions for the protection of human subjects were maintained. This study utilizes existing data and involves minimal risk to human subjects. A code number was assigned to each patient and the data was not linked to identifying patient information.

Instrumentation

Demographic data and medical history were abstracted from the medical record and data was entered onto the Demographic Form (Appendix C) and the Data Collection Form (Appendix D). Data was extracted to reflect nurse-sensitive indicators of respiratory, volume and functional status for the 24-hour period of time prior to discharge. An evaluation of respiratory status included an evaluation of the patient's respiratory rate, breath sounds, cough, oxygen saturation**,** dyspnea, orthopnea, and chest radiographic findings of pleural effusions or congestion within 24 hours of discharge. An evaluation of volume status included an evaluation of weight changes, volume changes recorded in intake and output records, heart sounds (S3), jugular venous distention, hepatojugular reflex, lower extremity edema and ascites within 24 hours of discharge. Functional status was evaluated in regards to documentation of the patient's functional ability, activities of daily living, bathing, toileting, ambulation and mobility within 24 hours prior to discharge.

Reliability of data collection and an evaluation of the quality of data abstraction underwent periodic review. An evaluation of the data collected began after 10 patients

were enrolled in the study and a preliminary data review occurred under the guidance of dissertation committee faculty. Data abstraction was compared against the first chart throughout the evaluation process. An assessment of the data commenced at regular intervals: 25, 50, 100 and after all patient data was collected.

Data Collection Protocol

The data collection protocol (Appendix E) began with a preliminary evaluation of subject charts for individuals admitted with heart failure at the two study settings from 2006 through 2007. Medical records were reviewed and subjects with a primary discharge diagnosis of heart failure were evaluated for inclusion into the study. Medical records were reviewed to determine if the subject data met inclusion and exclusion criteria. Patients who met inclusion criteria and did not have any exclusion criteria were evaluated to determine if the patient experienced re-admission with a discharge diagnosis of heart failure within 60 days of index hospitalization. These subjects were select for the readmission group. A representative comparison group was selected that matched the readmission group in terms of institution and admission year and month; the comparison group fulfilled the inclusion and exclusion criteria and did not experience a heart failure readmission within 60 days of the index hospitalization.

If the subjects met criteria for the readmission group or comparison group, medical and health information were extracted from the records using standardized forms (Appendix F and G). Data was obtained to include: demographic, patient history, physical examination and diagnostic testing. Data was extracted to reflect the key study factors, including respiratory status, volume status and functional status.

All data collection began first and primarily from the notes of the professional nursing staff including physical assessment findings. Once these records were exhausted, then additional records were reviewed to include the demographic forms, physical therapy notes, laboratory reports, radiographic reports, admission note, discharge dictation and provider progress notes.

Data analysis procedures began after 10 patients were enrolled in the study and a preliminary data review occurred under the guidance of dissertation committee faculty. Data analysis commenced at regular intervals, 25, 50, 100 and after all patient data was collected.

Data Analysis

Data Analysis was completed utilizing the SPSS software. Descriptive and frequency statistics were computed for all study variables, including demographic data, medical history information and clinical factors. The prevalence of key study variables: respiratory, volume and functional status were evaluated. There was a comparison of the readmission group to the comparison group in terms of clinical characteristics, co-morbidities and heart failure status. Figure 2 represents the model that was analyzed.

Figure 2

Equation for Analysis

The statistical model to be analyzed was:

$$\ell n \left(\frac{y_1}{1-y_1}\right) = \alpha + \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 \ldots \beta_x + \text{error}$$

Where: y_1 = the probability of readmission

α = constant

β_1 = respiratory status

β_2 = volume status

β_3 = functional status

β_4 - βx = demographic characteristics

β_5 - βx = clinical characteristics

The dependent variable was specified as a dichotomous value where 1 = heart failure readmission within 60 days after index heart failure hospitalization; 0 = otherwise. Respiratory status included an evaluation of the patient's respiratory rate, breath sounds, cough, oxygen saturation**,** dyspnea, orthopnea, and chest radiographic findings of pleural effusions or congestion. Volume status included an evaluation of weight changes, volume changes recorded in intake and output records, heart sounds (S3), jugular venous distention, hepatojugular reflex, lower extremity edema and ascites. Functional status was evaluated in regards to documentation of the patient's functional ability, activities of daily living, bathing, toileting, ambulation and mobility.

A plot of residual values and a correlation matrix was analyzed to detect multicollinearity and heteroscedasticity. Since the logistic regression procedure is generally robust, corrections were made only if they improve the predictive power of the model. In general, independent variables of interest were retained in the model. If multicollinearity in these variables reduces the predictive power of the model, index variables containing independent variables of importance were specified to remove multicollinearity, and the equation was re-estimated. Relative risk and odds ratios were computed to identify predictors of re-hospitalization.

In the case of missing data, the SPSS imputation protocol was implemented. Imputed value estimations varied depending on the variable concerned and guided the general imputation approach and equations used for each of the variables.

In order to evaluate the generalizability of study findings, a comparison was made to a large, nationally representative database. The National Discharge Survey data from 2005 was evaluated and compared to the characteristics of individuals in this study to determine the similarity of the study sample to a national sample of individuals with heart failure. Comparisons were made in terms of age, gender, ethnicity, length of stay, insurance type and selected co-morbidities. A comparison of the study sample to the national sample improves the ability to provide recommendations regarding generalization of findings.

Limitations

The primary limitation is the difficulty in controlling for a number of factors in heart failure patients that may contribute to the final outcomes. For example, a patient

may have knowledge regarding self-care practices for heart failure, which may improve outcomes, or the medication regimen may be sub-therapeutic which may reduce outcomes. There is difficultly in accounting for such a variety of factors and possibly confounders. To account for these various factors a number of methods were used including the application of inclusion and exclusion criteria, study design and statistical methods.

The second limitation to the study is that the adequacy of the data is determined by the accuracy of documentation in the medical records. The medicals records reflect the care that the patient receives during hospitalization; however this reflection of care does not always fully capture the care and assessment provided. Nevertheless, the care that is documented is a representation of the care delivered and may more accurately reflect the care that is actually delivered versus a prospective study in which data is obtained that is outside the ordinary scope of clinical practice.

Summary

Heart failure has an enormous impact on individuals who experience the disorder as well as the health care community. This clinical syndrome has a high prevalence and results in significant mortality and morbidity. Heart failure patients have frequent hospitalizations and re-hospitalizations. This study was designed to explore nurse-sensitive indicators (respiratory, volume and functional status) related to heart failure patients at the time of discharge and to determine a relationship to readmissions within 60 days of discharge. A relationship was determined between these factors and re-hospitalizations; therefore an understanding of this relationship can assist providers in

determining appropriate discharge timing, discharge placement and follow-up. This research also facilitates our abilities to describe characteristics of heart failure patients and adverse events, including re-hospitalizations, in this patient population.

CHAPTER IV

Study Findings

Patients with heart failure may experience hospitalization due to an acute exacerbation of their condition. Recurrent hospitalizations soon after discharge are an unfortunate occurrence in this patient population. This study explored the clinical characteristics of respiratory status, volume status and functional status at the time of discharge and the correlations of these characteristics to readmission for heart failure. The study is a descriptive, correlational quantitative study that explores the contribution that nursing sensitive discharge clinical characteristics make to the risk of 60-day readmissions in patients hospitalized with acute decompensated heart failure.

Data Analysis

Data were analyzed using SPSS version 16 or SPSS/PASW version 17 (SPSS Inc., Chicago, IL). Descriptive statistics were utilized to describe characteristics of the cohort (Table 3). Descriptive data are reported as frequencies, means with standard deviations and percentages. Patients were divided into the readmission and no readmission groups. Readmission was defined as an admission into an acute care hospital with a primary discharge diagnosis of heart failure, Diagnostic Related Group (DRG) 127, within 60-days of discharge from the index hospitalization with a primary discharge diagnosis of heart failure. All other patients were defined as no readmission, including patients who experienced hospitalization within the 60-day readmission period with a primary discharge diagnosis other than heart failure.

Outliers

The data were evaluated for outliers through the use of the explore data statistics command in SPSS. No significant outliers were noted for heart rate, systolic blood pressure, diastolic blood pressure, respirations, age, brain natiuretic peptide, sodium, hemoglobin, hematocrit or left ventricular ejection fraction. One significant outlier was noted for oxygen saturation, weight change, intake and output, ambulation distance and blood urea nitrogen. These outliers occurred in the case of separate individuals and were considered random occurrences; therefore, the values of these indicators were removed from the final dataset. Two significant outliers were noted for length of stay and these were also removed from the final dataset. The analysis for creatinine revealed ten outliers; therefore, additional categories were developed for analysis. The additional categories separated individuals with a creatinine over five from those under five; a second category excluded cases with a creatinine over 4.5, which encompassed 11 cases, representing 8.2% of the cohort.

Missing Data

The dataset was also analyzed for missing data; and missing data of less than or equal to 5% was considered acceptable for analysis in this study. Data for key study variables, brain natiuretic peptide, weight change, intake and output, and congestion were imputed. Data were analyzed for tobacco use, alcohol use, implantable cardiac defibrillators, pacemakers, oxygen saturation, dyspnea, effusions, congestion, weight change, intake and output, ambulation distance and ambulation devices although missing data was present. Data not included in the analysis, because greater than 50% of the data

was missing, included: illicit drug use, height, body mass index, cough, orthopnea, admission weight, discharge weight, S3, jugular venous distention, hepatojugular reflux and ascites.

Independent sample *t* tests were used to compare clinical characteristics between the readmission and no readmission groups. Correlation coefficients were tabulated using Pearson product-moment and Spearman rho to determine indicators for readmission. Once these indicators were established, separate but parallel logistical regression models were constructed.

A hierarchical technique was the preferred approach because entry of variables is based upon an evaluation of theoretic, clinical and statistical considerations rather than an automated stepwise technique. The demographic variables were entered first in a separate step, followed by the clinical variables of interest to reflect the extent of the predictor variables. This forced entry method evaluates the predictor variables in blocks to assess their predictive ability, while controlling for the effects of other predictors in the model. The age and gender of the subjects in this cohort correlated with many predictors and in previous studies these factors are notable predictors of mortality and re-hospitalizations; therefore, age and gender are entered into the model first.

Sample Characteristics

A total of 291 subject charts were reviewed for this study. Thirty-eight subjects were disqualified from the study, because inclusion criteria were not met, the individuals were: less than 50 years of age (n=20), admitted for less than 24 hours (n=3) or had a primary discharge diagnosis other than heart failure (n=15). One hundred nineteen

subjects did not qualify for the study because of elements that required exclusion by the study design: experienced mortality within 60 days after index hospitalization (n=25) or mortality information could not be confirmed (n=70), an acute coronary event, percutaneous coronary intervention or coronary artery bypass procedure within the previous 30 days of index hospitalization (n=10), cardiac transplant candidate (n=10) or discharged to the hospice setting (n=4). Subject charts that did not meet study criterion did not undergo further review and were barred from the final study.

A total of 134 subjects were included in the final cohort of this study, 65 (48.5%) subjects in the readmission group and 69 (51.5%) subjects in the no-readmission group. There were more females (55.2%) than males (44.8%) with an average age of 75.25 (SD 11.34) years (Table 4). The average length of stay for the index hospitalization was 5.83 (SD 3.29) days. The primary ethnic group was Caucasian (64.9%) and subjects were generally married (40.3%) or widowed (35.8%). The majority of patients were admitted through the emergency department (93.3%) and discharged on a routine basis to the home setting (79.1%).

Table 4

Baseline Patient Characteristics, n=134

Characteristic	Mean	%	SD
Age, years	75.25 (50-90)		11.34
Gender			
Female	74	55.2	
Male	60	44.8	
Ethnicity			
Caucasian	87	64.9	
Black/African American	21	15.7	
Asian	6	4.5	
Hispanic	8	6	
Other	9	6.7	
Not Stated	3	2.2	
Marital Status			
Married	54	40.3	
Single	20	14.9	
Widowed	48	35.8	
Divorced	10	7.5	
Not Stated	2	1.5	
Discharge Status			
Routine/Home	106	79.1	
Short-term Hospital	9	6.7	
Long-term Hospital	12	9.0	
Length of stay, days	5.83 (1-17)		3.29
Payment Source			
Medicare	100	81.3	
Medicaid	4	3.0	
Other Government	1	0.7	
Blue Cross	4	3.0	
Other Private/Commercial	9	6.7	
HMO/PPO	1	0.7	
Self-pay	4	3.0	
Other	2	1.5	
Admission Source			
Referral	12	9	
Transfer	20	14.9	
Emergency	102	76.1	
Admission Type			
Urgent	9	6.7	
Emergency	125	93.3	
Living Alone	28	20.9	
Previous Heart Failure	84	62.7	
Co-Morbidities			
Hypertension	106	79.1	
Diabetes Mellitus	69	51.5	
Coronary Artery Disease	74	55.2	
Valvular Heart Disease	68	50.7	

(continued)

Table 4 *(Continued)*

Characteristic	Mean	%	SD
Co-Morbidities *(continued)*			
Rhythm	77	57.5	
Atrial Fibrillation	61	45.5	
Renal Insufficiency	61	45.5	
Pulmonary Disease	49	36.6	
Cardiology Consultation	91	67.9	
Previous Heart Failure	84	62.7	
Discharge Medications			
ACEI/ARB	83	61.9	
Beta-blocker inhibitor	100	74.6	
Diuretic	100	74.6	
Digoxin	37	27.6	
Aldosterone antagonist	26	19.4	
Statin	58	43.3	
Aspirin	61	45.5	
Cardiac Rhythm at Discharge			
Normal Sinus Rhythm	67	50	
Atrial Fibrillation	36	26.9	
Sinus Bradycardia	9	6.7	
Sinus Tachycardia	5	3.7	
Other Rhythm	29	21.6	
Laboratory Evaluations			
BNP, pg/ml (n=67)	618.63 (43-2300)		518.99
Sodium, meq/L	138.11 (123-147		4.09
Blood urea nitrogen, mg/dL	31.71 (10-86)		15.79
Creatinine, mg/dL	1.76 (0.5-8.5)		1.59
Hemoglobin, g/dL	11.5 (7.2-16.5)		1.86
Hematocrit, g/dL	34.86 (20.6-58.9)		5.78
Left Ventricular Ejection Fraction, %	45.66 (10-80)		17.32
Reduced LVEF <40%	47	36	
Borderline LVEF 40-50%	29	23	
Preserved LVEF >50%	53	41	
Vital Signs			
Heart Rate, bpm	76.37 (45-133)		14.65
Systolic Blood Pressure, mmHg	126.72 (80-188)		20.92
Diastolic Blood Pressure, mmHg	66.22 (36-99)		12.25
Respirations , per min	18.99 (16-24)		1.50
Oxygen Saturation, % (n=118)	96 (86-100)		2.39
Weight Change, Kg (n=64)	-2.05 (-11.72 to +3.2)		2.92
Intake and Output, ml (n=55)	-4166.53 (-15448 to -1020)		3542
Functional Status			
Ambulation with assistance	81	60.4	
Ambulation devices	70	52.2	
Distance in Feet (n=45)	76.04 (0-300)		81.74
ADLs with assistance	69	51.5	
Bathing with assistance	68	50.7	
Toileting with assistance	69	51.5	

Analysis was completed to evaluate the dataset for any significant differences between the two data collection sites. Length of stay was significantly different between the two settings, 6.48 days (SD 3.38 days) at one setting versus the second setting at 5.32 days (SD 3.15 days), ($p < .044$). There were no significant differences in age, brain natiuretic peptide, left ventricular ejection fraction, oxygen saturation, intake/output, sodium, blood urea nitrogen, creatinine, hemoglobin, hematocrit, heart rate, systolic blood pressure, diastolic blood pressure, respirations, ambulation distance or weight change between these two institutions.

The subjects in the cohort experienced co-morbidities often associated with heart failure. The most common co-morbidity was hypertension (79.1%), followed by cardiac rhythm abnormalities (57.5%), coronary artery disease (55.2%), diabetes mellitus (51.5%), valvular heart disorders (50.7%), renal insufficiency (45.5%) and chronic pulmonary disease (36.6%). Subjects experienced the index heart failure admission for a variety of reasons: hypertension (28.4%), other causes (21.6%), dilated cardiomyopathy (16.4%), ischemia (15.7%), unknown (14.9%), cardiac rhythm abnormalities (10.4%) and cardiac valvular disorders (9.7%). Other causes of heart failure admissions were often associated with renal indications, including exacerbation of renal insufficiency, renal failure or volume overload.

Results

Bivariate correlation coefficients were tabulated using Pearson product-moment and Spearman rho to determine indicators for readmission. The correlation of key study factors with 60-day heart failure readmission is presented in Table 5. The health status

measures with statistically significant correlations with 60-day heart failure readmission were assistance with activities of daily living (p <.000), crackles (p <.000), congestion on chest radiograph (p <.001), assistive devices for ambulation (p <.001), intake and outputs (p <.01), dyspnea (p <.01), effusions on chest radiograph (p <.05), history of previous heart failure (p <.05), left ventricular ejection fraction (p <.05) and ethnicity 2 (white=1, black=2, others=3, Hispanic=9) (p <.05).

Table 5

Correlation Matrix for Key Factors (n=115)

Factor	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1. Readmission										
2. Age	.030									
3. Gender	-.123	-.263*								
4. ADLs	.433^{+}	.264^{+}	-.147							
5. Crackles	.327^{+}	.127	-.062	.254*						
6. Dyspnea	.266*	.101	-.073	.325^{+}	.165					
7. Congestion	.514^{+}	.213	-.008	.239	.146	.321				
8. Devices	.309^{+}	.443^{+}	.263	.549^{+}	.269*	.215*	-.013			
9.Intake/Output	-.349*	.073	.238	-.099	-.177	-.148	-.310	-.160		
10. HF history	.241*	.113	.176*	.086	.085	-.038	.074	.120	-.255	
11. Ethnicity2	.176*	-.264*	-.038	-.046	.221*	.108	.090	-.057	-.046	.012

*P<.05 $^{+}$P<.001

In this cohort, 60-day heart failure readmission was not correlated with length of stay (p=.083), age, systolic blood pressure or diastolic blood pressure, heart rate, respirations, cough, lower extremity edema, weight change, oxygen saturation or creatinine. Readmission was also not associated with cardiology consult or being under the care of cardiology during the index hospitalization for heart failure. Discharge medications, such as angiotensin converting enzyme inhibitors (ACEI), angiotensin

receptor blockers (ARB), beta blocker inhibitors (BBI), diuretics, digoxin and aldosterone antagonists, were not associated with re-hospitalization for heart failure.

Factors which demonstrated an association with re-hospitalization were evaluated for evidence of multicollinearity and to determine which characteristics were highly auto correlated. For example in the overall dataset, blood urea nitrogen and creatinine; creatinine and renal failure; hemoglobin and hematocrit; activities of daily living and assistance with bathing; activities of daily living and assistance with toileting were highly correlated. Therefore, the index of these correlations were investigated to evaluate characteristics that were related to rehospitalization. When factors related to rehospitalization were evaluated and there was evidence of multicollinearity of key study factors; for example, activities of daily living and assistance with bathing were highly correlated, then these items were ranked. Ranking the factor was based upon the correlation of the predictor variables to the dependent factor, readmission, and the variable with the higher rank was entered into the model building equation first to ensure that the predictor variables are strongly related to the dependent variable but not to each other.

Predictors were also evaluated in terms of the study hypothesis and the conceptual framework, in which it was theorized that an evaluation of characteristics that are performed near the time of hospital discharge are related to readmission. Therefore, indicators, such as an evaluation of activities of daily living within the 24 hour period prior to hospital discharge were preferred over left ventricular ejection fraction. Although left ventricular ejection fraction was statistically related to readmission

($p < .05$), this indicator was not necessarily performed at the end of discharge or was relevant to the discharge period. An additional premise of this study obliges the evaluation of factors that are specific to nursing care and nursing assessment. Congestion and effusions on chest radiograph and brain natiuretic peptides are not considered primary nursing functions; therefore were not ideal in the final model. Although the indicators that have a medical component are related to re-hospitalization, it is noteworthy that key nursing indicators of readmission, such as assistance with activities of daily living and bathing with assistance revealed a stronger correlation to 60-day heart failure readmission.

Logistic regression analysis was used to predict the probability that an individual discharge with a diagnosis of heart failure with key study factors would be readmitted for heart failure within 60-days. The most compelling model derived included the predictor variables of age, gender, assistance with activities of daily living, crackles and dyspnea. A test of the model with age and gender versus a model with intercept only was not statistically significant X^2 (2, n=115) = 2.18, p =.336. A test of the full model which includes activities of daily living, crackles and dyspnea versus the model with the intercept, age and gender only was statistically significant X^2 (3, n=115) = 47.64, $p < .000$. The final model included 115 subjects, in which a complete dataset of all study factors were available for analysis and entry into the model.

A summary of the accuracy of the classification of cases based on the model, allows for the calculation of the sensitivity and specificity of the model and the determination of the positive and negative predictive values. The overall success rate was

only 52.2% for the intercept only model, and 56.5% with the intercept, age and gender model. There was improvement with the full model which included all the predictors. Overall, the predictions were correct 89 out of 115 times, for an overall success rate of 77.4%. The full model is able to correctly classify 78.2% of those who did have a readmission, known as the sensitivity of the prediction, the percentage of occurrences that were correctly predicted. The full model was also able to correctly classify 76.7% of the subjects where the predicted event, readmission, did not occur. This is known as the specificity of the prediction, the percentage of non-occurrences correctly predicted.

Additional statistical criteria were evaluated to determine how well the full model, with the set of predictor variables, explains the categorical dependent variable, readmission. Indication of the adequacy of the model appraised the model to have sufficient goodness of fit. The Cox & Snell R Square and Nagelkerke R Square are the R square statistics utilized in logistical regression, in this model the R squares were 33.9% and 45.3%, respectively. The recommended test for overall fit of a binary logistic regression is the Hosmer and Lemeshow test, a finding of non-significance corresponds to the conclusion that the model adequately fits the data. The Hosmer and Lemeshow test for this model was appropriate ($p = .599$) indicating the relative importance of each predictor variable to determine the binary dependent variable, readmission.

Table 6 describes the logistic regression coefficient, odds ratio and confidence interval for each of the predictors. Employing a 95% criterion for the confidence interval, crackles and activities of daily living had independent significant partial effects. The odds ratio for assistance with activities of daily living indicates that when holding all other

variables constant, an individual who requires assistance with activities of daily living is 10.26 times more likely to experience readmission than an individual who does not require assistance with activities of daily living. An individual with crackles during the 24 hour period prior to discharge was 5.41 times more likely to experience readmission than an individual who does not have crackles during this time period. An individual who experiences dyspnea during the 24 hour period prior to discharge was 1.79 times more likely to experience 60-day heart failure readmission than an individual who was not evaluated to have dyspnea during this time.

The control factors, age and gender, were slightly and negatively related to readmission. This suggests that patients who are younger are .043 times more likely to experience readmission than older patients. In terms of gender, patients who are female are .769 times more likely to experience readmission within 60 days of hospitalization than males. However, neither age nor gender contributed to the final model in a significant manner.

Table 6

Logistic Regression Evaluation of Readmission

Predictor	**B**	**Odds Ratio**	**95% CI**
Age β_5	-.043	.958	.92-1.00
Gender β_4	-.769	.464	.170-1.26
ADLs β_3	2.33	10.26	3.70-28.44
Crackles β_2	1.69	5.41	1.87-15.61
Dyspnea β_1	.579	1.79	.572-5.57

The data was entered into the model proposed in Figure 2, and a final statistical model based on the analysis was derived (Figure 3).

Figure 3

Final Equation

The final model is:

$$\ell n \left(\frac{y_1}{1-y_1}\right) =$$

$$1.325 + .579\beta_1 + 1.69\beta_2 + 2.328\beta_3 - .769\beta_4 - .043\beta_5 + \text{error}$$

Where y_1 = the probability of readmission

α = constant

β_1 = dyspnea

β_2 = crackles

β_3 = assistance with activities of daily living

β_4 = gender

β_5 = age

Generalizability

Generalizability of the current study is constrained by the small sample size and whether the results can be applied to a larger sample population. In this study, the current cohort is compared (Table 7) to the National Hospital Discharge Survey (NHDS) and the Acute Decompensated Heart Failure National Registry (ADHERE) databases, from 2005 and 2003 respectively (Fonarow, 2003). The current cohort was comparable to other large

databases, in terms of several characteristics, including age, gender, admission type and payment source. The current cohort may be ethnically different or have different marital status from the other databases, although comparisons are difficult to formulate, due to the large number of unstated individuals in the National Hospital Discharge Survey regarding both of these characteristics.

Table 7

Comparison of Characteristics from the National Hospital Discharge Survey (NHDS), Acute Decompensated Heart Failure Registry (ADHERE) and Study Data

Characteristic	**NHDS CDC, 2008 (n=8642) 2005**	**ADHERE Fonarow, et al., 2003 (n=52,047) 2002-2003**	**Dissertation 2009 (n=134) 2006-2007**
Age, years	74.38 (SD 13.37)	75.2 Median	75.25 (SD 11.34)
Gender			
Female	4779 (55.3%)	52%	74 (55.2%)
Male	3863 (44.7%)	48%	60 (44.8%)
Length of Stay, days	5.41 (SD 4.55)		5.83 (SD 3.29)
Ethnicity			
White	51.7%	73%	87 (64.9%)
African American	18.2%	19%	22 (15.7%)
American Indian/ Alaskan Native	0.2%		0%
Asian	0.4%		6 (4.5%)
Native Hawaiian/ Pacific Islander	0.2%		0%
Other	2.2%		9 (6.7%)
Not Stated	27.1%		3 (2.2%)
Hispanic			8 (6%)
Marital Status			
Married	13.6%		54 (40.3%)
Single	5.4%		20 (14.9%)
Widowed	14.1%		48 (35.8%)
Divorced	2.7%		10 (7.5%)
Separated	0.5%		
Not Stated	63.8%		2 (1.5%)

(continued)

Table 7 (*Continued*)

Characteristic	NHDS (n=8642) 2005	ADHERE (n=52,047) 2002-2003	Dissertation (n=134) 2006-2007
(continued)			
Principal expected source of payment			
Medicare	76.3%	72%	100 (81.3%)
Medicaid	7.2%	6%	4 (3.0%)
Other Government	0.7%	1%	1 (0.7%)
Blue Cross/Blue Shield	3.2%		4 (3.0%)
HMO, PPO	6.0%	8%	1 (0.7%)
Other Private	3.2%	8%	9 (6.7%)
Self-pay	1.6%	3%	4 (3.0%)
Other	1.9%	2%	2 (1.5%)
Type of Admission			
Emergency	69.9%		125 (93.3%)
Urgent	17.7%		9 (6.7%)
Elective	6.8%		
Unknown	5.6%		
Source of admission			
Emergency room	71.8%		102 (76.1%)
Outpatient referral	14.1%		12 (9%)
Transfer	3.0%		20 (14.9%)
Status at Discharge			
Routine/Home	64.7%		103 (79.1%)
AMA	0.8%		
Short-term Facility	3.5%		9 (6.7%)
Long-term Care	17.0%		12 (9.0%)
Alive/Not Stated	10.1%		
Dead	2.8%		
Not Stated	1.1%		

The current cohort also demonstrated similarities to the ADHERE database in regards to patient co-morbidities.

Table 8

Comparison of Co-Morbidities of Study Data to ADHERE

Co-Morbidity	**Study Data 2009 2006-2007 n=134**	**ADHERE Fonarow, et al., 2003 2002-2003 n=52,047**
	%	**%**
Hypertension	79.1	72
Diabetes mellitus	51.5	44
Coronary artery disease	55.2	58
Valvular heart disease	50.7	23
Cardiac rhythm abnormalities	57.5	
Atrial Fibrillation	45.5	31
Renal Insufficiency	45.5	29
Pulmonary Disease	36.6	31

Summary

In conclusion, the data clearly represent that a composite of individuals who exhibit persistent symptoms of heart failure decompensation at the end of hospitalization are at risk for 60-day re-hospitalization for heart failure. The cohort of patients who experience readmission have discharge characteristics consistent with crackles and dyspnea within the 24 hour period prior to discharge and require assistance with activities of daily living, independent of age and gender.

CHAPTER V

Discussion

Hospitalizations and re-hospitalizations shortly after discharge are problematic in individuals with heart failure. This study improves our understanding of heart failure patients through the identification of factors related to early heart failure re-hospitalization. The principal findings of the study indicate that there are clinical characteristics at the end of hospitalization in individuals with heart failure that are related to 60-day re-admission for heart failure. This study provides evidence that nursing sensitive clinical characteristics contributed as determinants of readmission in this cohort of heart failure patients.

Research Hypotheses

At the outset of the study, three research hypotheses were proposed. It was hypothesized that in patients hospitalized and discharged with a discharge diagnosis of heart failure:

H_1: Reduced respiratory status at discharge is related to 60-day heart failure readmission

H_2: Increased volume status at discharge is related to 60-day heart failure readmission

H_3: Reduced functional status at discharge is related to 60-day heart failure readmission

Respiratory Status

The first hypothesis was proposed to determine if there are indicators for re-hospitalization based on an individual's respiratory status at the end of hospitalization. Respiratory status was operationally defined as respiratory rate, breath sounds, cough, oxygen saturation**,** dyspnea, crackles, orthopnea, and chest radiographic findings of pleural effusions or congestion on chest radiograph within 24 hours of discharge. Of these characteristics, crackles ($p<.000$), congestion on chest radiograph ($p<.001$), dyspnea ($p<.01$) and effusions on chest radiograph ($p<.05$) were related to 60-day heart failure readmission. These respiratory characteristics are consistent with persistent respiratory compromise and reduced respiratory status with subsequent destabilization which required additional hospitalization.

Volume Status

This hypothesis was proposed to determine if there are indicators for re-hospitalization based on an subject's volume status at the end of hospitalization. Volume status was defined as weight changes, volume changes recorded in intake and output records, heart sounds (S3), jugular venous distention, hepatojugular reflex, lower extremity edema and ascites within 24 hours prior to discharge. Several of these characteristics, heart sound (S3), jugular venous distention, hepatojugular reflex and ascites, were not evaluated statistically due to the large amount of missing data for these characteristics. The assessment of lower extremity edema during the pre-discharge period was a frequent finding, 53.7% in the cohort, for those who experienced heart failure readmission and those that did not and was not correlated with readmission. Of these

volume status characteristics, the volume changes recorded in the intake and outputs reports ($p<.01$) were significantly related to 60-day heart failure readmission.

The finding related to intake and output is a paradox, in which individuals, who lost the most volume as measured through the intake and output records, were more likely to be readmitted. One of the primary therapies during hospitalization is the removal of fluid through the administration of diuretics; this is the cornerstone of acute care practices in individuals admitted with acute decompensated heart failure and adequate renal function. In general, greater fluid losses are generally accepted as equating with patient stabilization and clinical improvement. Although this may hold true and essential in the acute care setting; this was not maintained in terms of post-hospitalization patient improvement and stability, in this cohort of patients. The patients with large fluid losses and rehospitalizations may represent a portion of patients who are clinically more tenuous to volume changes or who are over-diuresed during hospitalization. Over-diuresis may actually contribute to outpatient instability, either electrolyte imbalances, intolerance of medications or through clinical changes associated with dehydration, such as orthostasis. Therefore, this second hypothesis could not be upheld; an increased volume status at discharge was not necessarily related to 60-day heart failure readmission.

Functional Status

This hypothesis was proposed to determine if there are indicators for re-hospitalization based on an individual's functional status at the end of hospitalization. Functional status was evaluated through the documentation of the patient's functional ability, ambulation and independence of mobility within 24 hours prior to discharge.

Patients requiring assistance with activities of daily living ($p<.000$), assistance with bathing ($p<.000$), assistance with toileting ($p<.000$), assistive devices for ambulation ($p<.001$) and assistance with ambulation ($p<.01$) were significantly more apt to experience 60-day readmission. During the analysis, these factors converged and indicated that those subjects requiring assistance with activities of daily living (ADLs) required equivalent assistance in the individual daily functions of toileting, ambulation and bathing. These factors provide confirmation to support the third hypothesis that reduced functional status at discharge is related to 60-day heart failure readmission.

Conceptual Framework

The conceptual framework was proposed to identify nursing sensitive indicators that predict 60-day re-hospitalizations in patients with heart failure (Figure 1). The model presumes individuals hospitalized with heart failure receive appropriate monitoring and treatment of their illness during their inpatient care. At the end of the hospitalization, as the patient exhibits indications of clinical improvement, the patient is evaluated for discharge. In this model, respiratory, volume and functional status are evaluated during this discharge phase to ascertain if a relationship exists between these indicators and 60-day re-hospitalizations for heart failure. The conceptual framework suggests that patients who experience certain characteristics related to respiratory, volume and functional status will or will not have a re-hospitalization for heart failure.

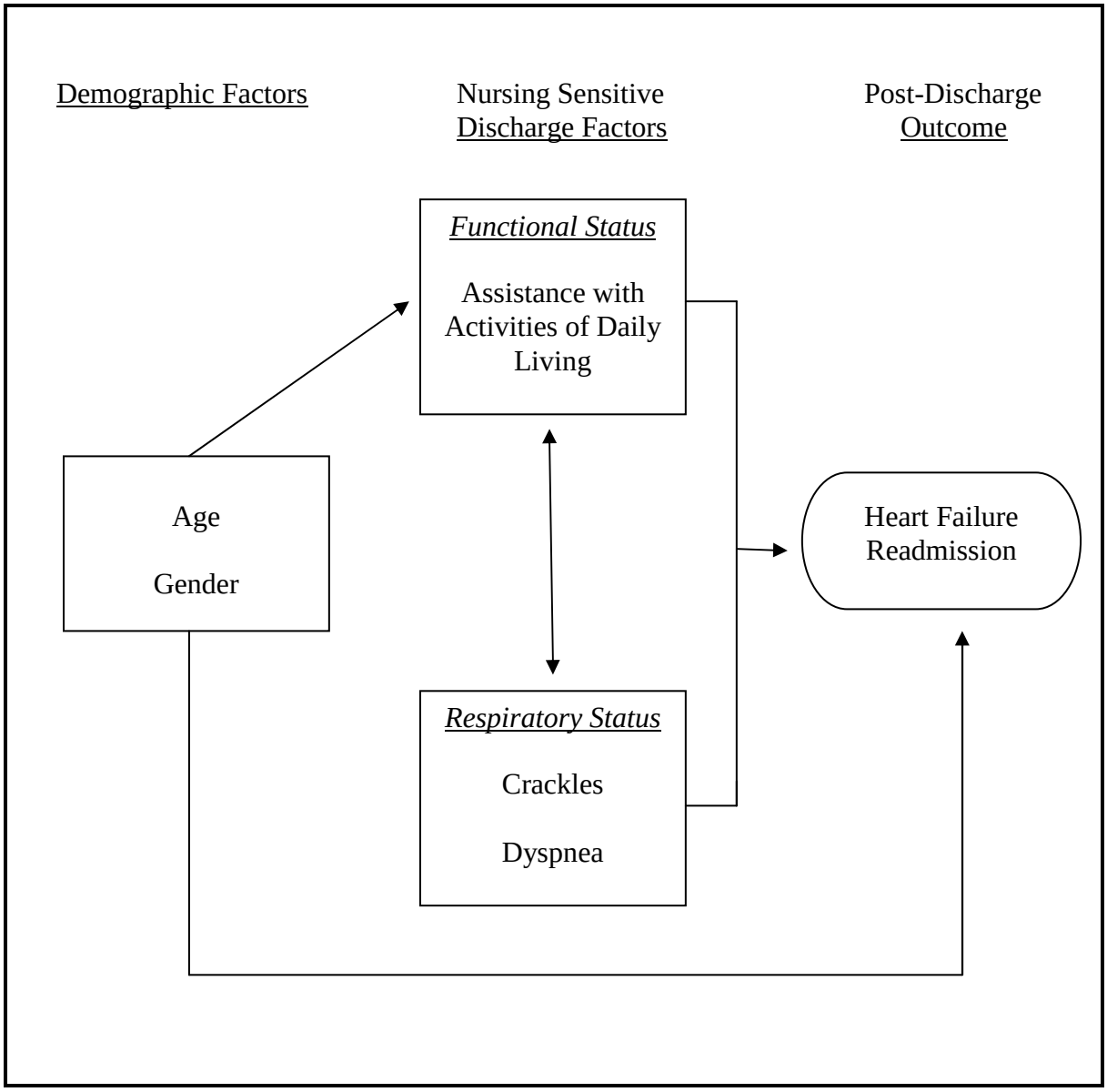
The conceptual framework was validated based upon key study predictors in the categories of respiratory status and functional status. Respiratory status, as indicated by crackles and dyspnea within the 24 hours prior to discharge, were related to post-

discharge outcomes. Functional status, as indicated by assistance with activities of daily living was related to post-discharge outcomes of re-hospitalization or no re-hospitalization. The contribution of volume status towards the determination of re-hospitalization was more complicated; indicating those with more volume loss experienced a greater risk of re-hospitalization. Statistical analysis was limited for this factor due to the quantity of missing data.

An additional conceptualization is presented to represent the central findings of this current study (Figure 4). The findings suggest that individuals with limitations in their day to day functioning as evidenced by impairment in their ability to perform activities of daily living are more likely to return to the inpatient setting after discharge. The inabilities to perform activities of daily living are influenced by the patient's respiratory status, as evidenced by crackles and dyspnea at the time of discharge. The factors likely represent an interaction of events to result in the phenomena of decompensation and return for hospitalization.

Figure 4

Conceptualization of Heart Failure Readmission



Discussion

The comprehensive guidelines from The Heart Failure Society of America, HFSA, (2006) describe several treatment goals for patients who are admitted with heart failure decompensation. The first treatment goal is to improve symptoms (respiratory status) and one of the discharge criteria includes the initiative that exacerbating factors are addressed (respiratory status). In the ADHERE registry, the clinical outcome of symptom status was evaluated at the time of discharge (Fonarow, 2003). At discharge, 50% of patients were considered asymptomatic, 38% were deemed improved but still symptomatic and less than 1% was considered worse or did not change. In the ADHERE registry and the current cohort, it is apparent that many patients continued to have symptoms at the time of discharge and these symptoms are respiratory in nature. In 2008, Seo, Roberts, Pina and Dolansky evaluated predictors of essential motor tasks, such as activities of daily living, in 102 patients with heart failure. The significant predictors which result in modification of daily activities were dyspnea with motor tasks, age and gender. The current study validates that the evaluation of symptoms, particularly respiratory symptoms, is essential in the planning of care for individuals hospitalized with heart failure. In addition, this study suggests a link between persistent respiratory symptoms, specifically dyspnea and crackles, at the time of discharge and the relationship to future heart failure hospitalizations.

In the HFSA (2006) guidelines, recommendations are made regarding volume status in the treatment of patients hospitalized for heart failure and the discharge criteria. Treatment guidelines include the recommendation to optimize volume status. One of the

guidelines for discharge criteria, for all patients hospitalized for heart failure, is to achieve near optimal volume status. Patients who are admitted for heart failure decompensation are often prescribed diuretics and are monitored for fluid status through measurements of inputs and outputs and daily weights. As the patient is prepared for discharge, the evaluation of volume status is an essential component in determining if the patient has achieved a euvolemic state. In the current study, patients who experienced the most volume loss experienced readmissions at a greater rate. Therefore, determining the optimal volume status continues to be an elusive concept.

The ability to quantify diuresis as a measure of clinical volume improvement is problematic in this cohort. The present study suggests that those individuals who experienced the most noteworthy diuresis actually experienced 60-day heart failure readmission more frequently. Factors regarding volume status are problematic because in this cohort they suffered from incomplete data, and the accuracy of this measure is imperfect, however, there is a trend in the current data that suggests that those individuals who lose the most fluid volume are more unstable post-hospitalization for reasons currently not implicit. Perhaps these are the patients that are most likely to gain fluid due to dietary indiscretion or lack of education; perhaps these are the patients who are overdiuresed during hospitalization; perhaps these are the patients that are most tenuous in term of response to volume changes. The blood urea nitrogen at discharge was greater than 20mg/dL (normal 8-20mg/dL) in 71.2% of the entire cohort of subjects, suggesting that the majority of subjects were discharged in a state of volume contraction. Clearly, the answers are not elucidated in this study; however, there is suggestion that large volume

losses in a short period of hospitalization may not result in long-term positive patient outcomes and may not be equivalent to a euvolemic state.

For patients with advanced heart failure or recurrent admissions for heart failure, discharge criteria include ambulation before discharge to assess functional capacity after therapy (HSFA, 2006). Functional capacity or functional status has become a valuable patient outcome because it describes characteristics regarding the patient's day to day functioning and has a relationship with quality of life (Doran, 2003). Functional status is generally viewed as a multidimensional concept that includes physical, psychological, cognitive and social components. However, in the specific guidelines of the HFSA, functional capacity is defined in terms of ambulation. In the current study, individuals who required assistance with ambulation and activities of daily living were both significantly more prone to experience 60-day heart failure readmissions.

Prior Studies

The evaluation and understanding of predictors of hospitalizations and re-hospitalization in patients with heart failure has been an interest of other researchers and explored through previous studies. Unlike previous studies, early readmission for heart failure in this cohort was not correlated with length of stay, age, gender (Howie-Esquivel & Dracup, 2007), lower systolic blood pressure (Opasich et al., 2001), anemia, diabetes (Krumholz, et al., 2000), heart rate (Opasich et al., 2001) atrial fibrillation (Opasich et al., 2001), respiratory rate, oxygen saturation, creatinine (Krumholz, et al., 2000), cardiology consultation (Hamner & Ellison, 2005), lower extremity edema or discharge medications.

Howie-Esquivel and Dracup (2007) evaluated 72 participants within 48 hours of discharge to determine whether demographic, clinical or psychological variables predicted an increased risk of hospitalization (Howie-Esquivel & Dracup, 2007). These researchers concluded that female gender, ethnicity, pulmonary disease and symptom stability were correlated with an increased risk of rehospitalization within 90 days of discharge. In the current cohort there was significant correlation with ethnicity and readmission, however, ethnicity did not contribute to the final model.

During the index hospitalization 67.9% of subjects were under the care of a cardiologist or received cardiology consultation. Patients who were admitted under the cardiology service or received cardiology consultation during their hospitalization were more likely to have lower left ventricular ejection fractions and device therapy; these patients were also more apt to be discharged on additional cardiac medications. There was a statistically significant difference in the number of patients with permanent pacemakers, biventricular pacemakers and implantable cardiac defibrillators in those under the care of cardiology. Also, these patients were more likely to be discharged on beta-blockers, digoxin, aldosterone antagonists, statins HMG Co-A reductase inhibitors and aspirin therapy. Regardless of the care pattern, there was comparable incidence of discharge prescriptions for angiotensin converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs). In terms of heart failure readmission within 60 days of the index hospitalization for heart failure, initial care and management by cardiology did not impact the readmission rate. One explanation may be that the individuals who receive specialized care may represent a more ill population. Another

basis may be that re-hospitalization is related to a multitude of explanatory factors in addition to standard medical care.

Diagnostic Findings

An intriguing laboratory finding in this study includes the high prevalence of anemia in this cohort of patients. Hemoglobin (normal 12-16 g/dL) under 12 g/dL was noted with a frequency of 63.4% and hematocrit (normal 37-47 g/dL) under 37 g/dL at a frequency of 70.2%. Anemia was statistically correlated ($p = .020$) with the distance in feet that an individual was able to ambulate.

An elevated brain natiuretic peptide (BNP), over 350ng/l, was noted in 62.7% of patients within the 24 hour period prior to discharge. In prior studies, this biomarker has exhibited predictive ability in determining post-discharge outcomes (Logeart et al., 2004). Logeart et al. (2004) determined that the pre-discharge BNP level was predictive of death or readmission; with higher pre-discharge BNP serving as a strong, independent predictor of these adverse outcomes. These authors suggest that pre-discharge BNP levels >350ng/l strongly related to death or readmission; 23.5% in one month and 79.4% at six months; BNP under 350ng/l event rate 0% at one month and 12.7% at six months. A BNP >700ng/l was associated with death or readmission for heart failure at 31% at one month and 93% at six months. In the current cohort, although half of the patients did not have BNPs acquired within the 24 hour period before discharge, of those that were collected, 32.8% were greater than 700ng/l.

Patients with chronic kidney disease represented a unique sub-population in this cohort. Although data for this sub-population was not captured fully, 21.6% of patients

required hospital admission for other reasons during their index stay. Other causes of heart failure admissions were often associated with renal indications, including exacerbation of renal insufficiency or renal failure. An elevated blood urea nitrogen greater than 20 mg/dL (normal 8-20 mg/dL) and creatinine greater than 1.1 mg/dL (normal 0.4-1.1 mg/dL) was evident in 71.2% and 55.6% of the cohort, respectively. Creatinine was statistically associated with other causes of heart failure, hypertension, blood urea nitrogen, diabetes mellitus, renal insufficiency, coronary artery disease, the use of HMG Co-A reductase inhibitors and male gender. Creatinine was negatively correlated with hemoglobin, hematocrit, history of previous heart failure, cardiac consultation and the use of diuretics and digoxin.

Throughout the study findings, it is apparent that patients with significant renal disease are a unique heart failure population. Those with chronic kidney disease have challenges to contemporary heart failure medical management in order to protect remaining kidney function, and the use of diuretics, digoxin and angiotensin converting enzyme inhibitors may be contraindicated. These patients also seem to represent a group that has a more tenuous response to changes in volume status. Severe kidney impairment, especially those who undergo chronic hemodialysis, represents an additional distinctive heart failure population that requires further study regarding specific management and care. Traditional acute care methods of treating this patient population, diuretics, are not warranted in this situation. Urgent and daily dialysis may be necessary during the in-patient stay. A separate evaluation of this group is necessary to determine if the traditional three day a week dialysis treatment is sufficient in patients with concomitant

heart failure. Also, these patients are routinely in contact with medical and nursing personnel through the dialysis services in the outpatient setting; this environment may contain a unique opportunity for monitoring individuals with renal failure to prevent heart failure exacerbations and hospitalizations.

Heart Failure Diagnosis

This study implored the stringent criteria that subjects were required to have an index hospitalization with a discharge diagnosis of heart failure, this provides some assurance that the patient's primary reason of hospitalization was for heart failure. Many studies make predictions based on admission assessment criteria, patients may obtain an initial diagnosis of heart failure based on their presentation, however, during the course of their evaluation a determination of a separate, related or more pronounced reason for their underlying condition and hospitalization rather than heart failure may emerge. Another key criterion of this current study is the evaluation of individuals who experienced readmission for heart failure exclusive of readmissions for other causes.

The evaluation of the readmission for heart failure ensures that the patient had a heart failure readmission only, as determined by the discharge diagnostic related group. The evaluation of all cause readmission in this population can be confounding to study results. Heart failure is the sequella of many chronic diseases and patient with heart failure are known to have a significant number of co-morbidities. Many of the hospitalizations in this patient population are related to these chronic conditions rather than heart failure specifically. By ensuring the index hospitalization and the re-

hospitalization were clearly and primarily related to heart failure controls for many confounding issues in this complex patient population.

The mean readmission time for subjects in the readmission group was 29.4 days (range 1-60 days). Subjects in the no-readmission group also experienced a substantial number of re-hospitalizations in this 60-day period, 20 patients in this group experienced readmission, which represents 29% of this group. The average number of days to re-hospitalization in the cohort with readmissions for primary reasons other than heart failure was 20.6 days and the readmissions were for a variety of other causes, generally associated with the individual's co-morbidities.

Exclusion criteria were based on conditions that are known to be associated with individuals for heart failure, however, could be a measure of the associated condition rather than heart failure. The premise was used to isolate individuals who are anticipated to return to a setting outside of acute care, usually the home setting, with the expectation that they will remain there. Patient who are listed for transplantation or enroll in a hospice setting were disqualified for these reasons, because they represent a unique heart failure population. Also, patients who experience an acute coronary event, coronary revascularization or coronary artery bypass grafting represent individuals with primary, active coronary disease rather than heart failure exclusively. Heart failure is an end state to many other chronic diseases, including coronary artery disease and hypertension. Therefore, patients who develop heart failure already have preexisting pathologies and represent a complex patient population. The complexity of this patient population

challenges the researcher to design and perform a high quality study due to the many potential variables in this patient group.

Discharge Criteria

The vast majority of prior studies are based upon evaluations of patient factors at the time of admission into an acute care facility or in the outpatient setting to predict outcomes at a later point in time. Admission characteristics are not necessarily a reflection of the patient's usual status. Hospital admission represents an episode of time when the patient is acutely decompensated due to a variety of factors. Regardless of the patient's status on admission, patients at the time of discharge should exhibit a standard of clinical stability in order to deem discharge an appropriate next step in the patient's care. The current study concisely evaluated discharge specific characteristics to determine the relationship of factors at the time of discharge and future patient outcomes.

Logeart et al. (2004) underscored the importance of the discharge evaluation in regards to how patients will do after they return home. In this study, discharge was decided by two cardiologists based on clinical examination, biological tests, electrocardiogram, chest radiograph and when the patients had no signs of decompensation, stable blood pressure, stable renal function and optimal angiotensin converting enzyme inhibitor and diuretic dosages (Logeart et al., 2004). The patients were judged to be stable at discharge although 15% were readmitted or died in the first month and more than 40% after six months.

Moser, Doering and Chung (2005) suggest that judgments regarding clinical stability and ability to assume care post-discharge may not be accurate for many patients

and is related to re-hospitalizations (Moser, Doering, & Chung, 2005). This current study is confirmation that those individuals who exhibited the clinical characteristics of dyspnea, crackles and require assistance with activities of daily living at the end of hospitalization required re-hospitalization at a more considerable rate.

As the burden of heart failure continues to tax our health resources, innovations in care models are being developed. Institutions are adopting care patterns to evaluate and provide short-stay care for patients with heart failure in the emergency department or observation settings within the hospital. In response to these new care patterns, the Society of Chest Pain Centers provided recommendations in 2008 to address these concerns (Peacock, et al., 2008). In this document, discharge criteria were proposed including the evaluation of clinical congestion, as measured by an improvement of dyspnea and the evaluation of the patient's ability to ambulate without recurrent dyspnea or orthostasis. Suggested indicators of reduced congestion are reduced body weight and decreased edema, rales and jugular venous pressure. The current study supports the evaluation of dyspnea, crackles (rales) and ambulation as essential targets of clinical evaluation for the evaluation of discharge readiness; however, the evaluation of edema, body weight and jugular venous pressure were not substantiated in this cohort.

Nursing Sensitive Indicators

Deaton and Grady (2004) conducted a review article describing recent research in nurse sensitive outcomes in cardiovascular patients, including those with heart failure. The authors conclude that there are multifaceted explanations accounting for readmissions in heart failure patients, including physical, psychological, and system

characteristics. This current study adds to our growing empirical evidence that nurse sensitive factors are one component of these explanatory factors for readmissions in patients with heart failure.

The evaluation of respiratory, volume and functional status are clinical conditions that nurses and nurse practitioners routinely evaluate. Nursing-sensitive indicators reflect the structure, process and outcomes of nursing care….Patient outcomes that are determined to be nursing sensitive are those that improve if there is a greater quantity or quality of nursing care…" (ANA, 2008). In the current study, a link is offered between these nurse-sensitive indicators and re-hospitalizations, clinicians can consider these factors to guide clinical decision making at discharge.

Nurse-specific indicators at the time of discharge are the variables of interest in this study because they have not been explored specifically before in this context and current predictors of hospitalizations are not conclusive. As nurse sensitive indicators are predictive of future outcomes, resources can be allocated and support services obtained based upon those most likely to be readmitted. Strategies can be developed to improve outcomes for individuals with heart failure and their associated families or support group.

Study Limitations

Whether a patient requires early readmission for heart failure, is determined by a multitude of interacting factors. Although this study evaluated one aspect of this phenomenon, discharge characteristics during the index hospitalization, other conditions are essential as well. The care the individual receives during the post-discharge period in the home setting is an additional consideration. Individuals in this study were not

evaluated in regards to their home care situations after hospitalization. For example, data was not obtained to reflect the number of patients who were discharged and scheduled to receive home health services. The majority of the subjects were discharged to the home setting; however, there was no evaluation of the percentage of individuals who were receiving professional services post-discharge and the contribution this would have made to re-hospitalization in this cohort of subjects.

The second limitation to the study is that the adequacy of the data is determined by the accuracy of documentation in the medical records. This study utilized a retrospective study design which poses challenges in capturing a complete data set for all key variables, for example the intake and output records were missing at a rate of 59%. Yet, the use of existing data reflects and captures clinical practice, and many clinicians are aware that these records are notoriously incomplete. The medicals records reflect the care that the patient receives during hospitalization; however this reflection of care does not always fully capture the care and assessment provided. Nevertheless, the care that is documented is a representation of the care delivered and may more accurately reflect the care that is actually delivered versus a prospective study in which data is obtained that is outside the ordinary habits of clinical practice.

A final limitation to the study is the ability to generalize to other heart failure populations. Although a comparison was made to a large national database, the sample size and sample characteristics are reflective of this patient cohort and may not be consistent with other individuals with heart failure.

Implications for Clinical Practice

Adverse health outcomes occur due to a complex interaction of factors. A number of these factors are not amenable to change, such as age, gender or ethnicity. Disease processes associated with heart failure, such as coronary artery disease and hypertension can be modified, but not eliminated. Therefore, the identification of potentially modifiable factors from research allows the application of these findings to guide interventions and to direct care practices. This study identifies potentially modifiable patient clinical factors at the end of hospitalization, dyspnea, crackles and activities of daily living. Based on these factors, recommendations and interventions may be developed to mitigate the risk of re-hospitalizations. For example, dyspnea is a patient symptom and is meaningful to patients with heart failure as well as a known precursor to hospitalization. Therefore, it is appropriate to evaluate a patient for dyspnea at the time of discharge to assist in evaluating discharge readiness.

An evaluation of discharge readiness will result in the determination to continue hospitalization for those most likely to be readmitted and accelerating discharge in those least likely to be readmitted. In 2002, Baker, Einstadter, Thomas and Cebul evaluated 23,505 Medicare patients hospitalized in Ohio. In their report, the mean length of stay declined from 9.2 days to 6.6 days during this time period. The ADHERE Registry reports in the cohort of 107,362 patients as of January 2004, the median length of stay was 4.3 days (Adams, et al., 2005). As the care of heart failure continues to be researched, clinicians will continue to be required to balance patient length of stay in the context of discharge readiness and prevention of readmission. An understanding of

characteristics at discharge that are consistent with heart failure readmission assists us with this decision.

The results from this study may help to develop criteria, guidelines or clinical pathways to assist in discharge decision-making and clinical guidance of care. Clinical decision-making based on these nursing sensitive factors may guide judgment when considering home health services, referrals, long-term care facilities, hospice care, medications, non-pharmacological interventions, intensity of post-hospitalization outpatient follow-up and length of hospitalization. The overall goal is to improve patient outcomes by reducing readmissions, avoiding exacerbations of illness and maintaining health based on scientific and empirical data.

Recommendations for Future Research

Future studies in this patient population include studying the final model in a prospective manner. The model can also be tested with a new cohort of patients in a retrospective manner or with a wider demographic reach. After additional model testing, clinical guidelines can be developed for the discharge period based on the current model with recommendations for care and monitoring.

Additional studies could incorporate the guidelines from the Heart Failure Society of America, including the recommendation that individuals receive a reevaluation in the outpatient setting in three days after discharge for exacerbation of heart failure. This indicator was not captured in this report and may prove helpful in knowing if early or frequent post-discharge management is effective in preventing rehospitalization in this patient population.

A separate evaluation of individuals with end stage kidney disease and chronic hemodialysis is necessary to determine if the traditional three day a week dialysis treatment is sufficient in patients with concomitant heart failure. Also, these patients are routinely in contact with medical and nursing personnel through the dialysis services in the outpatient setting; this environment may contain a unique opportunity for monitoring individuals with renal failure associated with heart failure to prevent heart failure exacerbations and hospitalizations.

Guidelines for discharge decision-making may improve discharge timing or improve considerations for outpatient care and monitoring. The overall goal is to improve patient outcomes by reducing readmissions, avoiding exacerbations of illness and maintaining health based on scientific and empirical data. The ADHERE registry suggests that there are significant opportunities to improve the care of patients admitted with decompensated heart failure (Fonarow, 2003). Subsequent research can build upon the findings from this study to determine if the recommendations from the HFSA comprehensive guidelines can be supported through empirical findings and if more specific recommendations can be provided to the practicing clinician.

Conclusion

Hospital admission in a patient with heart failure is a marker of instability. Commonly, heart failure patients have frequent adverse outcomes after hospitalizations for exacerbations of illness, including re-hospitalizations, often shortly after discharge. Future events after hospitalization are prevalent in this patient population and this study

endeavors to provide a novel understanding of clinical characteristics at the time of discharge to determine an association with future outcomes, specifically 60-day heart failure readmissions. This study adds to our understanding of clinical characteristics, such as respiratory status, volume status and functional status at the time of discharge and the correlations of these characteristics to readmissions. A consideration of these characteristics provides an additional perspective to guide clinical decision making and the evaluation of discharge readiness. Along with determining readiness for discharge, an appreciation of clinical discharge factors provides a representation of clinical stability which has implications for post-hospitalization care and monitoring.

APPENDIX A

Sample Size Determination Formula

Effect size 0.1 = Small to Moderate Effect Size
Derived for QOL variance in Howie-Esquivel & Dracup (2007)

Alpha 0.05

Predictors 5

Power 0.8

Sample Size = 134
=15% to account for mortality = 20

Final Sample Size = 154

APPENDIX B

Inclusion and Exclusion Study Criteria

Inclusion criteria

_____ Discharged with the primary diagnosis of heart failure Diagnostic Related Group (DRG) 127

_____ Admission for greater than 24 hours

_____ Age greater than or equal to 50 years

Exclusion criteria

_____ Cardiac transplant candidate

_____ Acute coronary event within the previous 30 days of index hospitalization

_____ Coronary revascularization – (PCI) or (CABG) within 30 days of index stay

_____ Left ventricular assist device (LVAD)

_____ Five or more non-cardiac Current Procedural Terminology (CPT) codes

_____ Subject mortality within 60 days after index hospitalization

_____ Discharged to hospice care

APPENDIX C

Demographic Form

Code Number	_____
Admission Year	_____
Readmission within 60 days of index hospitalization	1=yes; 2=no
Length of Stay	_____days
Age at index hospitalization >90 years If no, then	1=yes; 2=no _____years
Gender	1=male; 2=female
Social Living Alone	1=yes, 2=no, 99=missing
Ethnicity	1=White 2=Black/African American 3=American Indian/Alaskan Native 4=Asian 5=Native Hawaiian/Pacific Is 6=other 8=Multiple races indicated 9=Hispanic 99=Not stated
Marital Status	1=Married 2=Single 3=Widowed 4=Divorced 5=Separated 99=Not stated
Discharge Status	1=Routine/discharge home 2=AMA 3=Short term hospital 4=Long term institution 5=Other Alive status 99=Not Stated

Principle Payment Source	1=Workmen's Comp 2=Medicare 3=Medicaid 4=Title V 5=Other Government 6=Blue Cross 7=Other Priv/Comm 8=Self-pay 9=No Charge 10=Other 11=HMO/PPO 99=Not stated
Type of Admission	1=Emergency 2=Urgent 3=Elective 99=Not available
Source of Admission	1=Physician referral 2=Clinical referral 3=HMO referral 4=Transfer from a hospital 5=Transfer from skilled nursing facility 6=Transfer from other health facility 7=Emergency room 9=Other 99=Not available

APPENDIX D

Data Collection Form

Code Number	_____
History of previous HF	1=yes, 2=no, 99=missing
Co-Morbidities	
Obtained from diagnosis associated with discharge	
HTN	1=yes, 2=no, 99=missing
DM	1=yes, 2=no, 99=missing
CAD	1=yes, 2=no, 99=missing
MI	
CABG	
PCI	
Angina	
Valvular Disorder	1=yes, 2=no, 99=missing
Rhythm Disorder	1=yes, 2=no, 99=missing
Atrial Fibrillation	1=yes, 2=no, 99=missing
Renal Insufficiency	1=yes, 2=no, 99=missing
Pulmonary Disease	1=yes, 2=no, 99=missing
COPD	
Asthma	
Heart Failure Etiology at Index Hospitalization	
Ischemic	1=yes, 2=no, 99=missing
Hypertensive	1=yes, 2=no, 99=missing
Dilated	1=yes, 2=no, 99=missing
Valvular Disorder	1=yes, 2=no, 99=missing
Rhythm Disorder	1=yes, 2=no, 99=missing
Unknown	1=yes, 2=no, 99=missing
Other	_____
Habits	
Tobacco	1=yes, 2=no, 99=missing
ETOH	1=yes, 2=no, 99=missing
Illicit Drugs	1=yes, 2=no, 99=missing
Cardiology Consultation	1=yes, 2=no, 99=missing

Medical Devices

Implantable Cardioverter Defibrillator (ICD)	1=yes, 2=no, 99=missing
Pacemaker	1=yes, 2=no, 99=missing
Biventricular	1=yes, 2=no, 99=missing

Discharge Medications

Obtained from Medication Reconciliation Form or Discharge Summary

ACEI/ARB	1=yes, 2=no, 99=missing
BBI	1=yes, 2=no, 99=missing
Diuretic	1=yes, 2=no, 99=missing
Digoxin	1=yes, 2=no, 99=missing
Aldactone/Epleronone	1=yes, 2=no, 99=missing
Statin	1=yes, 2=no, 99=missing
ASA	1=yes, 2=no, 99=missing

Laboratory

Obtained closest to discharge

BNP	Date_____	Result _____
Sodium	Date_____	Result _____
BUN	Date_____	Result _____
Creatinine	Date_____	Result _____
Hgb/HCT	Date_____	Result _____

LVEF Date_____ Result_____%

Obtained from echocardiogram or nuclear imaging

Heart Rhythm _____

Normal Sinus Rhythm	1=yes, 2=no, 99=missing
Atrial Fibrillation	1=yes, 2=no, 99=missing
Sinus Bradycardia	1=yes, 2=no, 99=missing
Sinus Tachycardia	1=yes, 2=no, 99=missing

Heart Rate _____bpm

Blood Pressure _____mmHG

Temperature _____F

Height _____inches

BMI _____

Respiratory Status

Respiratory Rate _____per min

Breath sounds
- Crackles 1=yes, 2=no, 99=missing

Cough 1=yes, 2=no, 99=missing

Oxygen Saturation _____%

Dyspnea present 1=yes, 2=no, 99=missing

Orthopnea 1=yes, 2=no, 99=missing

CXR
- *Obtained closest to discharge* Date_____
- Pleural effusion 1=yes, 2=no, 99=missing
- Congestion 1=yes, 2=no, 99=missing

Volume Overload/Congestion

Weights
- Admission _____lbs
- Discharge _____lbs
- Weight change during hospitalization _____lbs

Intake and Output
- Volume change during hospitalization +/-_____cc

Heart sounds
- S3 present 1=yes, 2=no, 99=missing

JVD 1=yes, 2=no, 99=missing

Hepatojugular reflex 1=yes, 2=no, 99=missing

Lower Extremity Edema 1=yes, 2=no, 99=missing

Ascites 1=yes, 2=no, 99=missing

Functional Capacity

Ambulation	1= Independent 2=Assisted 99=missing
Ambulation Distance	_____feet
Assisted Devices	1=yes, 2=no 99=missing
ADLs	1=Independent 2=Assisted 99=missing
Bathing	1=Independent 2=Assisted 99=missing
Toileting	1=Independent 2=Assisted 99=missing

APPENDIX E

Data Collection Protocol

1. Evaluation of subjects admitted and discharged with heart failure

2. Review medical records for data collection purposes

3. Determine if patient data meets inclusion and exclusion criteria

4. Determine if patient had readmission within 60 days of index hospitalization
   Select for readmission group

5. Select representative comparison group
   Match institution, admission month and admission year
   Meets criteria
   No heart failure readmission within 60 days of index hospitalization

6. Obtain demographic data

7. Obtain patient history data

8. Obtain physical examination data

9. Obtain diagnostic testing data

10. Extract data relevant to respiratory status

11. Extract data relevant to volume status

12. Extract data relevant to functional status

13. Evaluation of data abstraction will begin after 10 patients are enrolled in the study

14. Data analysis procedures will begin after 10 patients are enrolled in the study
    Preliminary data review

15. An evaluation of the data abstraction will commence at regular intervals, 25, 50, 100 and after all patient data is collected

16. Data analysis will commence at regular intervals, 25, 50, 100 and after all patient data is collected

17. Data compared with National Discharge Survey, 2005

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